

The Optimum Quantity of Money*

BY DANIEL SANCHES

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central premise of monetary policy in the U.S. throughout the first decade of the 21st century has been a firm commitment to avoid deflation. Indeed, it is the consensus view of policymakers and most economists. Nonetheless, Nobel laureate Milton Friedman proposed that optimal monetary policy should lead to a steady rate of deflation. For some economists, the Friedman rule is mainly a benchmark for thinking clearly about the assumptions underlying our models and a systematic guide for deciding how to modify our models, that is, a way of making scientific progress. However, it is not an exaggeration to say that most of the work in the field of monetary theory has focused on identifying situations in which Friedman's insight does not apply. In this article, Daniel Sanches discusses the Friedman rule and the main arguments that have been made against it.

A central premise of monetary policy in the U.S. throughout the first decade of the 21st century has been a firm commitment to avoid deflation, that is, a persistent fall in the price level. Indeed, it is the consensus view of policymakers and most economists.¹



Daniel Sanches is an economist in the Research Department of the Philadelphia Fed. This article is available free of charge at www.philadelphiafed.org/research-and-data/publications/.

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Nonetheless, in an influential 1969 article, Nobel laureate Milton Friedman proposed that optimal monetary policy should lead to a steady rate of deflation. Since the article was published, his notion of the optimum quantity of money has become one of the most widely celebrated and debated propositions in monetary economics. In large

¹ See, for example, the 2002 and 2010 speeches by Ben Bernanke.

* 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.

measure, this is because a broad class of monetary models has confirmed that deflation should be part of the best monetary policy.

For some economists, the Friedman rule is mainly a benchmark for thinking clearly about the assumptions underlying our models and a systematic guide for deciding how to modify our models, that is, a way of making scientific progress.² In fact, it is not an exaggeration to say that since Friedman proposed his rule for monetary policy decisions, most of the work in the field of monetary theory has focused on identifying situations in which Friedman's insight does not apply. This article discusses the Friedman rule and the main arguments that have been made against it.

WHAT IS MONEY AND WHY DO WE NEED IT?

To understand Friedman's ideas about the best monetary policy, we first need to understand why people need money. This lies at the heart of any theory of monetary policy. The most obvious answer is that people need money to conduct their daily transactions. In principle, money can be any object that serves as a means of payment as long as people believe that it will be widely accepted as a means of payment in future trades. For a long time, commodities such as gold and silver were used as a means of settling transactions; now dollar bills, checks, and debit cards serve this function. In

² Viewed this way, the optimum quantity of money in monetary theory stands with the Modigliani-Miller theorem in corporate finance and the Coase theorem in contract and bargaining theory.

other words, you and I need tangible objects that help us pay for things at the grocery store, at a restaurant, online, etc. While currency and checking accounts are assets specially created for the purpose of serving as a means of payment, other assets, such as stocks and corporate bonds, are not typically used in this way.

Because we need a medium of exchange to pay for things, we can say that households and firms demand some convenient form of money to help them with their daily transactions. But who supplies money? Private entities such as commercial banks offer us checking accounts that allow us to write checks or use a debit card to conveniently pay for things. The Federal Reserve System (the U.S. central bank) also creates money. It supplies U.S. currency and reserve balances that help households, firms, and financial institutions make payments and settle debts. Thus, an important aspect of monetary policy is to control the amount of money in the economy, taking into account people's need for a means of payment. For instance, a central banker would certainly be concerned if there was too little money in the economy relative to the number of transactions. This would certainly cause problems for shoppers, workers, traders, and others.

Money is only one item among a large menu of assets held by households and businesses, so it is helpful to think of the demand for money as part of a broader portfolio problem. For instance, every month you have to decide how much to spend and save out of your income. After making this decision, you have to think about the kinds of assets you want to hold to achieve your monthly goals. You have to decide what fraction of your income you want to keep in your bank account and use your debit card for your daily purchases. You may also put some of your savings into higher-yielding assets.

What is important for our discussion is the decision about the kinds of assets you think are useful for helping you pay for transactions.

The Transactions Role for Money. Economists usually define money as something that serves essentially three purposes: a unit of account, a medium of exchange, and a store of value. As a unit of account, money gives us a convenient way to measure the relative values of apples, oranges, and laptops. As a medium of exchange, money is an asset that facilitates transactions. Money allows

in exchange for the convenience of having an asset that helps them pay for things. In other words, the transaction service that money provides comes at a cost: the low interest income the money holder receives.

The Precautionary Motive for Holding Money. In addition to holding money to conduct transactions, people also hold money as a store of value. In other words, they hold money as a way of transferring purchasing power from today to some future date. Why would people want to hold part of their savings in the form of money

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two complete strangers to engage in trade even though neither party knows anything about the other. When the buyer hands his money to the seller, the transaction is immediately settled, and no further interaction is required. An obvious example is U.S. currency, i.e., the dollar bills you carry in your pocket, which are widely accepted as a means of payment in the U.S. and in some other countries. Other examples of money are checking accounts and some savings accounts that permit you to write a check or use your debit card to pay for your purchases.

Money typically pays a low rate of return, as anyone with a checking account or currency in his or her pocket knows. Why? Since assets that can be used as money provide a transaction service, money issuers (such as commercial banks and the Federal Reserve System) need to pay only a low rate of return in order to induce people to hold their money. And money holders (such as households and firms) are willing to give up some interest income

if other assets, such as government bonds and certificates of deposit (CDs), typically offer a higher rate of return? People may want to hold some of their savings in the form of money because some unanticipated events, such as an unexpected bill, may make them spend more in a given month than they had initially planned. For instance, if your after-tax monthly income is \$3,000 and you decide at the beginning of the month to save \$500 and spend \$2,500, you may choose to keep, say, \$2,800 in your checking account because it could be that you end up spending more on restaurant meals or taxi rides than you had initially planned. In principle, you could handle these unexpected expenses by cashing in bonds or CDs, but brokerage costs, explicit penalties, and uncertainty about the ability to sell securities for full value at short notice make these other assets less than perfect substitutes for unexpected needs. Thus, you keep more money in your checking account than what you actually plan to spend over the month.

Economists refer to this reason for holding money as the *precautionary motive*.

THE FRIEDMAN RULE

When the Nominal Interest Rate Is Positive, Households and Firms Hold Too Little Money. Now that we understand what money is and why people and firms need it, we can turn to our initial question: What is the best policy concerning money creation? In a 1969 article, Milton Friedman proposed a very simple rule for guiding monetary policy decisions. His goal was to overcome a basic inefficiency in monetary exchange: Households and firms tend to hold excessively small money balances when the nominal interest rate on short-term government bonds or CDs is positive. The nominal interest rate refers to the yield that an investor obtains in terms of dollars. For instance, if a bank lends \$1,000 to an individual in exchange for a repayment of \$1,050 one year later, then the *nominal* yield on the loan is 5 percent. In contrast, the *real* yield is 5 percent minus the expected rate of inflation. So if the expected rate of inflation is 3 percent, the real yield on the loan is 2 percent.

For the discussion that follows, it is important to distinguish between the nominal and real interest rate. The key point to keep in mind is that individuals and firms are primarily concerned about their purchasing power over goods and services. When an investor holds a bond, the real rate of interest tells you the increase in purchasing power over goods and services that accrue to the bondholder. The real interest rate is determined mainly by households' preferences and firms' production technologies, the main underlying factors of what economists refer to as the *real economy*. (See *The Nominal Interest Rate, the Real Interest Rate, and the Fisher Effect*.)

Why do households hold excessively small money balances? Even

though money facilitates transactions, households and firms want to keep their money balances as small as possible. After all, money pays little or no interest. An economist would say that there is an *opportunity cost* of holding money: the interest that the household or firm could have earned by holding a nonmonetary but interest-bearing asset such as a 90-day CD or a Treasury bill. As a result, at any point in time, households and firms will choose to hold only a small fraction of their

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wealth in the form of monetary assets. In particular, they choose to hold some money to cover their planned expenditures or perhaps somewhat more because of the precautionary motive.³

Note that the cost to society of printing more paper money or allowing banks to create new checking accounts – the *social marginal cost* of producing money – is essentially zero. The social marginal cost refers to the additional resources required for the central bank to produce paper money or for a bank to create a deposit account when it makes a loan. Once the central bank has set up the printing press to create notes and once a commercial bank has hired its loan officers, set up its accounting system, bought computers, etc., the actual resource costs of creating additional units of paper money or deposits are negligible.

³ To be more precise, households hold the right amount of money balances given the prevailing prices and interest rates. As will become clear, Friedman argues that households hold too little money because nominal interest rates are wrong — they are too high — from society's point of view.

Let's say that these costs are zero. So, households' and businesses' marginal cost of holding money (the forgone interest) is greater than the marginal social cost of supplying more money (which equals zero). This means that society would be better off if each household was holding a larger fraction of its wealth in the form of monetary assets, which would permit it to carry out a larger volume of useful transactions, that is, purchases of goods and services.

Friedman came up with a straightforward way to overcome this inefficiency: Eliminate the opportunity cost of holding money by lowering the *nominal* interest rate until it was equal to the social marginal cost of producing money, that is, zero. In this case, since there is no opportunity cost of holding money, households and firms will not inefficiently economize on their money holdings.

It is important to note that Friedman was not proposing that monetary policy should drive a household's *real* return on its CDs and other nonmoney assets to zero, which would certainly not be a good thing. He was proposing to drive the nominal return, which equals the household's real return – the return that savers care about – plus the expected inflation rate, to zero. (If this distinction between nominal and real returns isn't obvious to you, take another look at *The Nominal Interest Rate, the Real Interest Rate, and the Fisher Effect*.)

Predictable Deflation Will Remedy the Problem. How can the central bank achieve Friedman's prescription?

The Nominal Interest Rate, the Real Interest Rate, and the Fisher Effect

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o understand how to implement the Friedman rule, it is important to distinguish between the nominal interest rate and the real interest rate. The nominal interest rate tells you how fast the number of dollars in your account will increase over time if you acquire a certificate of deposit (CD) from a commercial bank or a three-month Treasury bill. For example, suppose you want to purchase a CD from your local bank. The bank will promise to repay the principal amount plus the interest agreed on at the time you acquire the CD. For instance, if the bank offers you a 5 percent annual nominal interest rate for a CD with a face value of \$1,000, then at the end of one year, the bank will pay back the principal amount of \$1,000 plus \$50, which is the interest earned. Thus, the yield on your investment in terms of dollars is exactly 5 percent.

The real interest rate corrects the nominal interest rate for the effects of inflation, so that it tells you how fast the purchasing power of your savings will increase over time. Going back to our previous example, suppose that at the end of one year the inflation rate is 2 percent. This means the real yield on your investment is only 3 percent. In other words, the acquisition of the bank's CD increases the purchasing power of your savings by 3 percent at the end of one year. To compute the real interest rate, we can use the following formula:

$$\text{Real Interest Rate} = \text{Nominal Interest Rate} - \text{Inflation Rate}$$

Notice that we can rewrite this equation as follows:

$$\text{Nominal Interest Rate} = \text{Real Interest Rate} + \text{Inflation Rate}$$

Thus, we can split the nominal interest rate into two components: the real interest rate and the inflation rate. This allows us to examine the different economic forces that determine the nominal interest rate.

The real interest rate is determined by factors such as individuals' preferences and firms' production technologies. Think about individuals and firms deciding the rate at which they are willing to lend and borrow. Individuals' willingness to postpone current consumption and their projected future consumption needs will determine the interest rate at which they are willing to loan out funds to firms. And firms' expected profits, determined mainly by the marketability of their products and the productivity of their plants, will determine the rate they are willing to pay. If all prices double, that is, if individuals' incomes, the prices of goods and services, and the firms' profits all double, individuals' preferences and firms' productivity haven't fundamentally changed. Monetary policy certainly affects prices, but, at least to a first approximation, some economists often argue that monetary policy doesn't permanently affect the real rate of interest.

The second component that determines the nominal interest rate is the inflation rate. On many occasions, we do not know what the future inflation rate will be when we need to make our investment decisions today. Thus, if we want to understand the determinants of the nominal interest rate today, we should look at a measure of people's expectations about the rate of inflation over the investment period. Thus, we should rewrite the equation above as:

$$\text{Nominal Interest Rate} = \text{Real Interest Rate} + \text{Expected Rate of Inflation}$$

This means that the nominal interest rate depends on the real interest rate and the *expected* rate of inflation. This expression is usually referred to as the *Fisher relation* or *Fisher equation*, after economist Irving Fisher (1867-1947), who first studied it.

Using the Fisher relation, we can also define what is known as the *Fisher effect*. The Fisher effect says that there is a one-for-one adjustment of the nominal interest rate to the expected rate of inflation. It is important to note that the Fisher effect does not say that the nominal interest rate moves one-for-one with actual inflation. At the time you and I agree on a loan, we both have an expectation of what the inflation rate will be over the contract period so that we can compute the real interest rate, which gives the real cost of the loan for the borrower and the real gain for the lender. But if inflation catches the borrower and lender by surprise, the real cost and gain they initially thought they were going to get are not realized. Thus, the Fisher effect states that the nominal interest rate adjusts one-for-one to *expected* inflation (the inflation rate that both parties thought was going to be realized at the time they signed the contract).

According to Friedman, and many other economists, monetary policy affects the nominal rate of return, but not the real rate of return, at least in the long term. So if the central bank can ensure that the expected rate of inflation equals the negative of the real rate of return, the nominal interest rate will equal zero, according to the Fisher equation. If, for example, the real rate of return is 2 percent, then a 2 percent deflation would mean that the nominal rate of return is zero. Households and firms will be happy to hold assets paying a zero nominal rate of return. Intuitively, when prices of goods and services are falling at 2 percent per year, households' and firms' money balances (and their command over goods and services) are increasing in value at 2 percent per year.

This is exactly what Friedman proposed. He said that the central bank should generate a sustained deflation in the economy to drive the nominal interest rate on short-term securities such as Treasury bills and CDs to zero.

How can the central bank achieve this goal? If we think about an economy in which the average rate of growth of output is zero, then the way to achieve a sustained deflation is to reduce the money supply at a constant rate. Specifically, the central bank should contract the money supply at a rate equal to the economy's real rate of return. The prices of goods and services will fall as the money supply declines.⁴

The rule is slightly more complicated in a growing economy. If the central bank were to keep the supply of money constant in a growing economy, nominal prices would automatically

⁴ Friedman argued that there was a fairly tight relationship between the rate of growth of the money supply (which the central bank could control) and the rate of inflation, although they might diverge for a time.

fall, although not necessarily at the rate that would lead households to hold the right amount of money.⁵ The specific rule for the rate of growth of the money supply the central bank should target to implement the Friedman rule also depends on the economy's average rate of growth, and the target growth in the money supply might even be positive. While this should be kept in mind, it is probably easiest to think about the Friedman rule for an economy that is not growing.

For Friedman, it was essential that the central bank make a commitment to act in a predictable way. The predictability of a central bank's policy rule is essential because the rule works through people's expectations about how prices will change. People must firmly believe that prices will fall in a predictable way, and this requires that they expect the money supply to shrink at a steady rate. As long as individuals expect prices to fall steadily at a constant rate and the central bank contracts the money supply at the promised rate – so that individuals' expectations are met – expected inflation will equal actual inflation and nominal interest rates will be driven to zero.

The Friedman Rule Without Deflation. While some critics have rejected the Friedman rule out of hand, other policies that do not involve a sustained deflation would also work. For example, David Andolfatto proposes an alternative way of implementing Friedman's prescription. His idea is to make money itself an interest-bearing asset. In this case, money holders would receive interest payments on their currency holdings and their checking accounts. If the nominal interest rate on money holdings equals the nominal yield on other (riskless) nonmonetary securities, then

⁵ By nominal prices I mean the price of goods and services in terms of dollars.

households bear no opportunity cost of holding money. Thus, we accomplish the same outcome without having to engineer a sustained deflation.⁶

CRITICISMS OF THE FRIEDMAN RULE

Even though the logic behind the Friedman rule is very simple and applies to a broad class of economic models, many monetary economists have argued that it is not the appropriate principle to guide monetary policy decisions. These criticisms come in five main varieties.

The Welfare Loss from Holding Too Little Money Is Small. The first criticism does not question Friedman's logic, but it does question whether Friedman has identified an important problem. Some critics of the Friedman rule have argued that in standard monetary models, deviations from the Friedman rule do not matter much for households' well-being even though the Friedman rule allows society to achieve the highest level of welfare within these simple models. To these critics, Friedman may have been correct logically, but the actual costs of holding too little money are small. Hence, some economists have argued that monetary policy should not place an excessive weight on the goal of eliminating the opportunity cost of holding monetary assets.

For instance, Thomas Cooley and Gary Hansen and, later, Robert Lucas have quantified the welfare consequences of having an inflation rate above that prescribed by the Friedman rule. These authors use models in which money is required to settle transactions. They conclude that

⁶ While it is important to realize that Friedman's logic does not live or die with his proposal for deflation, the reader should note that policies like Andolfatto's involve a range of implementation issues. Any serious monetary policy prescription needs to take a wide range of practical complications into account.

people would be willing to give up only about 1 percent of their consumption to get rid of a 10 percent inflation, which is viewed as a small cost to society as a whole. According to their model simulations, the opportunity cost of holding money is not really large enough for policymakers to worry about.

Even though these studies have shown that the welfare cost of inflation is quantitatively small in the models they examine, it is hard to avoid concluding that their models must be missing something important. Think of what would happen in the U.S. if the average annual inflation rate were 10 percent. It is hard to believe that most people would not mention inflation as one of their main concerns. Having this in mind, subsequent researchers have shown that realistic additions to standard monetary models can lead to bigger effects. For example, the Cooley and Hansen model and the Lucas model do not include expenditures on machines and equipment. It is natural to ask whether their estimates of the welfare costs of inflation are low because their models have left out something important.

Benjamin Craig and Guillaume Rocheteau argue that firms make smaller capital expenditure decisions when the inflation rate is higher. A higher anticipated inflation rate reduces capital expenditures because it reduces firms' expected real revenue. Firms must decide today how much capital they should purchase to use to produce goods and services in the future. If a firm anticipates a high inflation rate by the time the machines and equipment are ready to produce, then it will probably decide to purchase fewer machines and less equipment today. This reduces the production of goods and services in the capital-intensive sectors and drives up their prices. If this effect is taken into account, the model predicts that households are

willing to give up more than 5 percent of their consumption to get rid of a 10 percent inflation rate, more in line with the perception that inflation is one of people's main concerns.

The Friedman Rule Conflicts with Other Objectives. Some economists argue that monetary policy has more important things to do than reduce the opportunity cost of holding money. They argue that the main role of monetary policy is to respond to shocks that hit the economy, for example, a sudden rise in the price of oil or a decline in the demand for housing. Why? Many economists – notably, economists known as *New Keynesians* – believe that some prices in the economy are *sticky*; that is, they

usually an important input for the production process. But if the firm cannot increase the prices of its products in line with its higher costs, it will suffer a decline in profitability and may have to decrease production for some time. So production will be lost until the firm is able to change its price. Thus, sticky prices can result in inefficient outcomes. In this sense, we can think of an economy in which prices respond flexibly and immediately to changing conditions as a benchmark to guide policy.

The problem is that eliminating the opportunity cost of holding money, as prescribed by the Friedman rule, may be inconsistent with the goal of mitigating the inefficiency arising from

This means that the transactions role for money is as important as the inefficiencies due to price rigidity emphasized in the New Keynesian literature.

do not respond immediately to sudden changes in the economic environment. An online retailer or a restaurant may hesitate to change prices because of the costs of changing advertisements or menus or because they are worried about a negative reaction from consumers. As a result, only some producers change their prices immediately in response to unexpected changes in economic conditions. Other firms will wait until their actual price has moved too far out of line from the price that maximizes profits.

But in many economic models, the economy works best when prices respond flexibly to shocks. To see this, consider a simple example. Suppose that the price of oil suddenly rises 10 percent on a given day and remains at its higher level for some time. A rise in the price of oil certainly increases a manufacturer's costs because oil is

price stickiness. For instance, it could be desirable to have a *positive* nominal interest rate to mitigate the effects of price stickiness. New Keynesian economists believe that this type of inefficiency is more important, so monetary policy should target it.

Note that even if monetary policy has other objectives, it is an open question whether policymakers should ignore Friedman's concern altogether. For example, Aubhik Khan, Robert King, and Alexander Wolman show that in a model with both a transactions role for money and costly price adjustments, the best monetary policy is, in fact, not far from the Friedman rule: In their model, they find that the average level of the nominal interest rate should be close to zero. This means that the transactions role for money is as important as the inefficiencies due to price rigidity empha-

sized in the New Keynesian literature. Boragan Aruoba and Frank Schorfheide have estimated a similar model using postwar U.S. data. They find that the inefficiency due to reduced money holdings and the inefficiency due to sticky prices are of similar magnitude. These two studies suggest that even in the presence of sticky prices, the transactions role for money is quantitatively important, so they argue that Friedman's concerns should be taken seriously.

The Recent Japanese Experience. Central bankers usually mention Japan's experience of the last 20 years as a reason to be concerned about deflationary policies. The Japanese economy appears to be stuck in what economists call a *liquidity trap*, a situation in which we observe a very low level of the nominal interest rate. In the last 10 years, the average level of the nominal interest rate has remained below 0.5 percent in Japan, and the inflation rate, as measured by the consumer price index, was positive in only three years. Despite many attempts to stimulate the economy, the average growth rate of output was 1.15 percent from 1997 to 2007, a very slow pace of economic growth.

This combination of deflation and low nominal interest rates creates problems for monetary policy when the economy is in a recession. In this case, any attempt to stimulate the economy by injecting more money through open market operations may have little or no effect on output. Thus, monetary policy should avoid a liquidity trap. In response to these concerns, many economists have devoted a lot of effort to analyzing the best policy responses that would release the economy from the liquidity trap.⁷ For this reason,

⁷ For a discussion of the role of monetary and fiscal policy in avoiding a liquidity trap, see Michael Dotsey's *Business Review* article.

central bankers have been reluctant to consider deflationary policies such as the Friedman rule, especially when they look at the Japanese experience as an example of an economy that appears to be stuck in a liquidity trap.

When Money Is Held for Precautionary Purposes, Some Inflation May Be Good. Another criticism of the Friedman rule is that taking into account the precautionary motive for holding money may lead to prescriptions different from those of the Friedman rule. Some economists argue that precautionary motives are very important for households that have limited

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ability to insure themselves against sudden declines in income or unexpected expenses. In addition to holding money for transactions purposes, these households also hold money because the boiler or the car may break down unexpectedly. More seriously, many households in the U.S. do not have health insurance or other forms of insurance to protect themselves against unexpected health-care expenses. Thus, holding money balances is a form of self-insurance.

But insuring yourself by holding money balances costs you something: the interest income you could have obtained by holding a less liquid but interest-bearing asset. People hold more money than they need for transaction purposes because of the precautionary motive. Edward Green and Ruilin Zhou have shown that a mild inflation

guarantees that people do not hold too much money for insurance purposes. In other words, a mild inflationary policy balances the costs and benefits of holding money for insurance purposes. This result goes against the Friedman rule because it usually implies a positive level for the nominal interest rate, while the Friedman rule, remember, proposes a zero nominal interest rate. But the extent to which a mild inflation is socially beneficial crucially depends on the extent to which private and public insurance markets do not provide enough protection against unexpected events.

Technological Change Has Made "Money" Obsolete. Even though money is a convenient way to pay for things, there are substitutes for money. Credit cards are a good example. When a buyer enters a store and uses his credit card to pay for his purchases, he does not need any money. The buyer's credit card company keeps track of his balance and authorizes any transaction that does not exceed his credit limit.

The merchant also has an agreement with the credit card company to accept the cards the company issues. Even though credit arrangements of this kind work well, notice that some form of money is still necessary to settle debts among the parties involved in the credit network. For instance, the credit card company pays the merchant on the settlement date usually by transferring money from its checking account to the merchant's account. Also, the buyer needs to pay the credit card company on the due date, usually by making an electronic transfer from his checking account to the credit card company's account.

In this respect, Friedman's argument remains valid (even in an economy in which credit prevails as a means of payment for retail trades) if we broadly interpret transactions to include all kinds of transactions.

CONCLUSION

Many economists have criticized Friedman's notion of the optimum quantity of money, despite its being a fairly robust conclusion across a wide range of models. Although Friedman proposed a monetary policy that leads to steady deflation, subsequent researchers have shown alternative ways

to get the same result. In addition, models that take explicit account of how households and firms use money for both transactions and insurance and models in which firms are slow to adjust prices show that Friedman's insights need to be supplemented. While few economists or policymakers would prescribe the Friedman rule as a literal

guide to policy, this does not mean that Friedman's insight is irrelevant. The rule has been useful in spurring serious thoughts about the role of money in the economy and has helped economists make scientific progress in the search for more accurate models of the economy.

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