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The Stock Market Channel of Monetary Policy

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Abstract

This paper argues that the stock market is an important channel of monetary policy. Monetary policy affects real economic activity because inflation levies a property tax on stocks in addition to an income tax on dividend payments. Inflation thus taxes stocks more heavily than it does bonds. Households alter their required rate of return as inflation changes, and firms adjust production in order to satisfy their shareholders' demands. As the stock market channel grows in importance, the appropriate intermediate target for the central bank is the price level, with price stability being the ultimate goal.

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I. INTRODUCTION

Understanding how monetary policy affects economic activity remains one of the greatest challenges of academic and Federal Reserve economists. To get an idea of the difficulty of this problem, think of the economy as a vast network connecting businesses, individuals, and government institutions of all types. Then think of a map that shows all of the different connections among these economic agents. Somewhere on this map is the Federal Reserve, which has direct connections to nearly all of the banks on the map but none to any of the nonbank firms or households—the major movers of economic activity. Somehow, economists must trace the path that monetary policy follows—starting with the Fed, then following the transactions among the various interconnected agents until the monetary policy has its intended (and possibly some unintended) effects on sales and purchases, production and consumption, investment and savings.

The idea of the economy as a network (or web) thus implies many possible paths, or channels, through which monetary policy flows to affect the economy. All of these paths, however, have one similarity—they must pass through some financial market. Each financial market—a market in which money is exchanged for claims on real assets—has at least one "special feature" that allows a change in the money supply to have lasting effects on real economic activity. Thus, every proposed mechanism for monetary transmission can be associated with an aspect of a particular financial market. And although economists often speak of "the" monetary transmission mechanism as if it had only one path, our network view implies that there are at least as many monetary transmission paths as there are financial markets in the economy.

Economists currently recognize a handful of monetary transmission paths: the traditional "money" channel, and two variations of the "credit" channel. Although three mechanisms are quite different from each other, each operates through the same market—the market for commercial lending, which we shall refer to as the "bond market". All three of these stories describe how monetary policy can affect the desire or ability of firms to borrow resources in order to finance their investment projects or other operations.

An important financial market that has been overlooked as a channel for a monetary transmission mechanism is the stock market. While most economists agree that stock returns are related to real economic activity—the S&P 500 index is part of the Index of Leading Economic Indicators—few have argued that stock returns play any role beyond serving as a measure of expected future corporate profits. In this paper, however, we argue that the stock market forms an important transmission path for monetary policy. The specific mechanism, which we will discuss in detail, is the inflation tax on household equity holdings.[2] Moreover, due to changes in the economy in the past 25 years, we believe that the stock market

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[2]This inflation tax is distinct from the impact of inflation on the tax system. See Feldstein and Slemrod (1978) and Feldstein and Summers (1977) for examples.

transmission mechanism has become increasingly potent. It is essential, therefore, that economists and monetary policymakers understand this transmission mechanism and its implications for policy.

II. CURRENT VIEWS OF MONETARY POLICY TRANSMISSION

From the start, it is important to understand that we are not arguing that the stock market is the only, or even the main, monetary transmission path. In the past, researchers appear to have been somewhat preoccupied with trying to prove that one or another channel is the main, or only, path through which monetary policy affects economic activity. As the view of the economy as a network indicates, we believe that many channels exist and function simultaneously. Some of these paths are independent of each other, while others may be closely intertwined. The potency of each path and its relationship to other paths, furthermore, probably change over time as agents react to the conditions of the economy. As such detecting any particular path is extremely difficult, since econometric techniques depend on stable relationships in the data. Needless to say, the policymaker's job also becomes more complicated.

In the "money channel" story of the monetary transmission mechanism, only one financial market exists in the economy, where money is exchanged for "all other" assets.[3] When monetary policy lowers the return to holding money by lowering short-term interest rates, demand for other assets increases. Among these other assets are bonds issued by firms to finance their investment projects. As the demand for their bonds increases (raising the price and lowering the return), firms realize that more of their investment projects have positive net present value, and they thus issue more bonds in order to finance them. As such, investment increases and output rises. In this story, the "special feature" of the financial market is that money is an asset that substitutes for other assets that represent real claims against firms.

Recent empirical work on the money channel has focused on the link between monetary policy and short-term interest rates. The money channel's story is that short-term interest rates decline when the Fed increases the money supply. This interaction has been termed the "liquidity effect." Verifying the existence of the liquidity effect has proved difficult and controversial. Economists such as Christiano and Eichenbaum (1992) and Pagan and Robertson (1995) claim to have found this negative relationship by using non-borrowed reserves as proxies for changes in the money supply. But the relationship is apparently substantially weaker for the 1980s. Thornton (1997) also argues otherwise, suggesting that offsets to changes in discount-window borrowing by the Fed can induce a correlation between nonborrowed reserves and interest rates that merely mimics, but is not, the liquidity effect. In

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[3]They include stocks, bonds, and any asset that is not outside money. In the simplest form of the money view, the effect of monetary policy on the returns of all non-money assets is the same. See Cecchetti (1995).

fact, Thornton argues that total reserves are the correct proxy for money supply shocks in this case, and they also do not show the presence of a liquidity effect.

The mechanisms associated with the "credit channel" of monetary policy encompass special features in the commercial-lending market that affect the abilities of the firms to borrow. One mechanism is the creditworthiness of business borrowers. Changes in interest rates will affect the net worth of the firms, and thus their creditworthiness, by altering the values of assets, liabilities, and interest-sensitive cash flows. Therefore, an increase in the quantity of money improves the balance sheets of firms by reducing interest rates, enabling them to borrow and invest more. The other feature of the commercial-lending market is the existence of "bank dependent" borrowers, usually smaller firms. As the name suggests, these smaller businesses depend heavily on commercial banks to meet their financing needs. In turn, the quantity of lending undertaken by commercial banks is related to the stance of monetary policy. When the Fed tightens the money supply by reducing the quantity of bank reserves, banks reduce their lending to all loan customers, including those for whom banks are the only source of credit. In this case, a contraction among bank-dependent businesses is large enough to affect macroeconomic performance, thus threatening to spread to other firms.

Both the creditworthiness channel and the bank-dependent borrower channel have a strong implication for small firms: because they are generally less creditworthy and depend more on banks for their financing, they will be affected most by changes in monetary policy. Gertler and Gilchrist (1994) and Oliner and Rudebusch (1992) have documented the disproportionate effects of monetary tightening on smaller firms. In addition, simulations by Cooley and Quadrini (1998) show that the output and stock prices of small firms are more sensitive to changes in monetary policy when creditworthiness is inversely related to the size of the firm.

Since it has been well documented that the net worth of a firm affects its investment, the search for evidence about the creditworthiness channel has concentrated on building a link between monetary policy and investment. Using cross-sectional data, Gertler and Gilchrist (1994) found that interest-rate changes affect creditworthiness, particularly for small firms. Bernanke, Gertler, and Gilchrist (1996) provide additional evidence of this "financial accelerator" effect. But, again, establishing the link between interest rates and monetary policy, which is necessary to make this channel work, has proved difficult.

The links between monetary policy and economic activity implied by the bank-dependent borrower channel appear to be solid empirically. It is clear that a class of bank-dependent business borrowers does exist and that this group comprises a small but significant part of the economy. It is also true that bank lending responds to the stance of monetary policy. Bernanke and Blinder (1992) described how bank lending falls significantly six to nine months after an increase in the Fed Funds rate, a pattern that other researchers have verified.

But financial innovation and the consequent explosion in alternatives to bank loans have begun to diminish the size of the group of bank-dependent borrowers rapidly. Edwards and Mishkin (1995) have documented the rapid decline in the share of business lending supplied by

commercial banks since the 1970s.[4] Nonbank financing instruments, particularly commercial paper, and nonbank financial firms (such as finance companies) have provided a wide range of firms with lower-cost financing alternatives to commercial bank loans. And although the size of many small firms and their absence of appropriate collateral still prevent them from accessing these alternatives, financial innovation will likely continue to reduce the extent to which all business borrowers depend on banks in the future. In particular, asset securitization techniques have nearly advanced to the point at which firm size and asset mix no longer prevent access to the bond markets.

Thornton (1994) acknowledges this point, and suggests still another reason that the credit channel may be weakening. Not only does the credit view require a special relationship between firms and the bank, but this channel also requires that the bank be subject to required reserves. He notes that many types of deposits in the last two decades have been freed from reserve requirements, thereby weakening the link between monetary policy and the banks' ability to lend.

This discussion illustrates the point we made about the changing nature of monetary transmission mechanisms. In the past, when few alternatives to bank financing existed, the credit channel was perhaps the dominant path through which monetary policy affected economic activity. But as alternatives to bank lending have developed and proliferated, the importance of this channel has declined. Interestingly, to the extent that monetary policy created the circumstances that led to the financial innovation (such as high market interest rates), it engineered the decline of this transmission mechanism. But perhaps just as interestingly, changes in this transmission mechanism have not stopped monetary policy from affecting economic activity. Again, we argue that the continued impact of monetary policy is due to the growing importance of other transmission mechanisms as the bank-dependent borrower channel declines.

III. THE STOCK MARKET CHANNEL

As a monetary transmission mechanism, the stock market channel passes through the stock market rather than through the bond market. The role of equity markets in the transmission of monetary policy is established through the imposition of key conditions within any general equilibrium model of the economy with money. As we discuss the stock market channel, we will sketch (but not derive) such a model and describe these key conditions.

Whenever a household purchases a financial asset, it receives a claim that is denominated nominally. That is, the claim generates income in the form of cash and must first be converted into (sold for) money if the owner of the claim wishes to trade it for goods and services. Firms

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[4]The decline in the size of the liquidity effect documented by Pagan and Robertson (1995) may reflect the decline in this component of the banking sector.

ultimately back the claims they issue against the value of or return from the physical capital goods they own, such as factories and machines, but households generally prefer not to own such physical capital goods. Essentially, this distinction is the only difference between our model and standard growth model. Our model accounts explicitly for the fact that households own nominally denominated stocks and that firms own the physical capital in the economy; the standard growth model posits that households own physical capital directly and rent it to the firms. Although this distinction may not seem large, it turns out to be quite important.

Our model economy must have at least three assets: money and nominal equity (shares of stock), which are nominally denominated; and physical capital.[5] As indicated, households hold the money and the nominal equity, and the firm owns the capital stock. The representative investor in the economy holds equity so as to satisfy the condition—

$$1 = E_t \left[mrs_{t+1} \frac{R_{t+1}}{\Pi_{t+1}} \right] \qquad (1)$$

where mrs_{t+1} measures the investor's tradeoff between consumer goods today and those in the future.[6] This tradeoff determines the rate at which the investor wishes to discount payments in the next period. $E_t[x]$ is the investor's expectation of x conditional on his or her information set at time t. Π_{t+1} is the gross inflation rate from time t to t+1, which is expressed by the ratio of the consumer price levels, P_{t+1}/P_t. The gross rate of return on stock held from time t to t+1 is R_{t+1}. This return on stocks consists of the capital gain P_{t+1}^S / P_t^S plus the dividend yield (or dividend-price ratio) D_t / P_t^S. Dividends are paid in cash. Thus, the investor determines the optimal purchase of stocks by balancing the loss in expected utility from purchasing stocks today against the gain in expected utility in the next period from consuming the proceeds from the stocks.

Because the stock yields cash dividend payments (and because it must be sold for money before it can be exchanged for goods and services), the price level is extremely important to the holder of this claim. If the price level rises, the value of the financial asset declines (holding the interest or dividend payouts constant), because the cash payouts that the asset generates will purchase fewer goods and services. This reduction in the value of the asset is thought of as an "inflation tax", because the inflation that diminished the household's purchasing power is thought to be the result of an increase in the money supply.

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[5]Chami, Cosimano, and Fullenkamp (1998) provide a complete description of the underlying model.

[6]The functional form of this marginal rate of substitution is determined by the specific utility function that represents the preferences of the representative investor.

So far, the story applies equally to stocks and bonds.[7] When inflation is high, the value of both stocks and bonds must fall because they are nominally denominated assets. But something about stocks makes this inflation tax much more severe—something that is inherent in the pricing of stocks. Specifically, the price of a share of stock is tied simultaneously to two quantities: the dividends issued by the firm, and the value of the firm's assets. This condition is the source of the difference between stocks and bonds, and therefore is the source of the extra inflation tax on equity relative to bonds. We discuss how this pricing relationship exacerbates the inflation tax next.

First, consider how dividends are used to value the firm. The firm's managers wish to maximize the ex-dividend value of the firm's stock, since the owners of the firm are its shareholders. The optimal condition under which the investor holds equities can be solved forward to find the following expression for the value of the firm's stock:

$$\frac{P_t^s}{P_t} = E_t \sum_{j=0}^{\infty} \left[\left(\prod_{i=0}^{j} mrs_{t+i+1} \right) \frac{D_{t+j}}{P_{t+j+1}} \right] \tag{2}$$

This equation says that the real ex-dividend value of the firm's stock is equal to the present value of all future real dividends. In (2) the investor's marginal rate of the substitution of goods across time, mrs_{t+i+1}, is, in Cochrane's (1991) terminology, the "stochastic discount factor" used to price the firm's equity. Thus, the firm maximizes the real ex-dividend value of the firm's stock by choosing the level of capital and labor that maximizes the discounted value of all future real dividends.

Two aspects of this expression of the value of the firm's stock must be accounted for in general equilibrium. First, the rate of discount used by the firm is the same as the discount rate desired by the investor. Second, a no-arbitrage condition exists where by the investor's valuation of the firm—the value of the firm's capital assets—must equal the firm's valuation of itself, which is the expected discounted value of all future dividends produced with the capital stock.

It is this no-arbitrage condition that increases the inflation tax on equities. To understand this view, think of the following experiment. If every stockholding household were to sell its shares in the firm at once, then all of the company's assets would effectively be sold, as if it had been purchased by another company. If the households then use the money proceeds to purchase goods and services, then the firm's assets are being traded in effect for a bundle of goods and services. But because this transaction takes place through stock certificates, an increase in the price level reduces the value of the money being exchanged for the stock certificates, reducing the quantity of goods and services that can be purchased by the

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[7]For one-period bond, the optimal condition for bonds is the same as equation 1, except that the return is certain.

households. Inflation then effectively reduces the real value of all the firm's assets. Therefore, inflation in one time period taxes the value of the firm's entire capital stock. (Since the households are holding the nominally denominated claim, they are the parties taxed. The value of the firm's capital stock is the base of the tax.)

Thus, the existence of a stock market, where shares of stock are traded for money, has a large effect on the value of the firm. If households owned factories and machines outright and rented them out to the firms for cash rental payments, then only the cash payments would be subject to an inflation tax. This situation would be equivalent to the position of a bondholder, whose cash interest payments are subject to an inflation tax. Inflation in one time period reduces the real value of the current cash rental payment, but it does not affect the real value of the household-owned capital goods themselves. Since the total value of the capital goods used in production far exceeds the rental payment (or dividend) that is paid from their use during any single period, it is clear that the size of the inflation tax on stockholders is quite large relative to the inflation tax on households who own the capital goods directly, or on bondholders. The huge exposure to the inflation tax prompts households to build inflation into their valuation of the firm.

The next equation clarifies this pricing requirement. In the context of various monetary economies, we have shown that the ex-dividend value of the firm is expressed as:

$$\frac{P_t^s}{P_t} = \frac{K_t}{\Pi_t} \frac{1}{A_2(K_{t-1}, I_{t-1})} \tag{3}$$

Here, K_t is the firm's capital stock at time t, and I_t is the firm's investment in new capital at time t . The term $A_2(K_{t-1}, I_{t-1})$ is the additional capital available for production at time t, given that the firm carried out investment at time t-1. The capital stock is divided by $A_2(K_{t-1}, I_{t-1})$, because some adjustment cost would be incurred if the capital good were sold to another firm and had to be installed at the new firm.

Equation 3 clearly shows that the value of the capital stock is deflated by the (gross) inflation rate, which is the inflation tax discussed earlier. If we apply the no-arbitrage condition, we can use equation 3 to consider the inflation tax in terms of the discounted value of all future dividends in equation 2. In equation 2, the nominal dividends paid at time $t+j$ are divided by the price level at time $t+j+1$, because nominal dividends produced by the firm during the current time period are not paid to the shareholders until the beginning of the next quarter. Thus, the shareholder realizes that the real value of these dividends can be reduced with a future increase in inflation. But because the discounted sum of the dividends must always equal the value of the firm's capital, we can replace K in equation 2 with the discounted sum of dividends. Thus, inflation in the current time period "taxes" the entire stream of future dividends at once. Again, this is a key difference between stocks and bonds. While the cash flows from bonds are subject to an inflation tax, the tax is collected period by period and cannot be levied on all bond cash flows at once, as is effectively the case with equities.

Now that we see how inflation affects the value of the firm, we can see how monetary policy affects the return on equities. Using the definition of stock returns and the equilibrium expression for the real ex-dividend value of the firm, we can rewrite equation 1 for the investor's choice of stocks as:

$$1 = E_t \left[mrs_{t+1} \left(\frac{D_t}{P_t \Pi_{t+1}} + \frac{K_{t+1}}{\Pi_{t+1} A_2(K_t, I_t)} \right) \left(\frac{\frac{1}{K_t}}{\Pi_t A_2(K_{t-1}, I_{t-1})} \right) \right] \qquad (4)$$

Depending how demand for money is specified, the growth rate in the money supply determines the inflation rate. For example, in a simple Cash-in-Advance economy, where money must be used to purchase consumer goods, the gross inflation rate is just the rate of growth in the money supply divided by the rate of growth in consumption.[8] Consequently, monetary policy can influence the return on stocks relative to the return on money in several distinct ways. First, the capital gain from time period t to $t+1$ can be reduced with an increase in inflation during time $t+1$. But the same capital gain can also be increased with an increase in inflation during time t. Finally, higher inflation at time $t+1$ reduces the real value of dividends produced at time t. Thus, a complex process determines the impact of monetary policy on the rate of return on stocks, which in turn yields a change in the investor's holding of stock.

Now that we understand the increased impact of inflation on stockholders, we can sketch out the monetary transmission mechanism. Monetary policy is a key determinant of the rate of inflation. Stockholders respond to actual inflation, expected inflation, and monetary policy actions by changing the rate of return they expect from their stockholdings. The managers of corporations, in turn, are charged with creating value for the shareholders of the firm. They react to changes in the stock price of the firm, and to the required return demanded by their stockholders by changing the conditions of production—how many people and machines are used, what products are produced, and where. Thus, by affecting the rate of inflation, a change in monetary policy will alter stockholders' required rates of return. As required rates of return change, the stock price fluctuates. Managers respond to changing stock prices by changing their investment and production plans, in turn effecting a change in economic activity.

We model how monetary policy affects the real economy by combining equation 2 with 3, yielding:

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[8]When money is used for transaction purchases, as in Marshall's (1992) paper, the inflation rate is a more complicated expression of the future money supply and capital stock. Of course, the actual process by which money growth affects inflation can be quite long and variable. See Cosimano and Jansen (1988) for an example.

$$\frac{K_t}{\Pi_t} \frac{1}{A_2(K_{t-1}, I_{t-1})} = E_t \sum_{j=0}^{\infty} \left[\left(\prod_{i=0}^{j} mrs_{t+i+1} \right) \frac{D_{t+j}}{P_{t+j+1}} \right] \tag{5}$$

If an increase in the growth of money supply increases inflation at time t, then the real ex-dividend value of the firm (the lefthand side of equation 5) falls. If an arbitrage opportunity is to be circumvented, the discounted value of future dividends must fall by an equal amount. It can do so only if allocation of current output between capital accumulation and consumption changes, creating a persistent change in real economic activity.

To illustrate the stock market channel further, we performed a simulation exercise with the model. We are interested in showing the effect of a shock to money growth—presumably originating from the Fed—on real stock returns, the capital stock, and consumption. The response of real stock returns to the money shock confirm a significant stock market response, indicating that the stock market channel is active, and it shows what information is passed along to the households and firms through the market. The responses of consumption and the capital stock show the extent to which the money shock is affecting real economic activity.

Simulating the impact of monetary policy on the investor's decision in equation 4 is quite complex, and it depends on the particular general equilibrium model of the economy. Specifying a particular general equilibrium economy is necessary for evaluating equation 4 since the marginal rate of substitution is a function of consumption, dividends depend on the production process, and inflation depends on the demand for money relative to its supply. We simulated a general equilibrium model of the economy under the following assumptions.[9] First, the investor's utility is additively separable across time and exhibits constant relative–risk–averse behavior. Second, output is generated by a Cobb-Douglas function of capital and labor, where the capital stock has a constant rate of depreciation and the labor supply is fixed. Third, money is demanded because a Cash-in-Advance requirement governs the purchase of consumer goods. Fourth, the rate of growth in the money supply is assumed to follow the first–order stochastic behavior of M1 in the United States from 1954:1 to 1991:2. The average growth rate of the money supply per quarter is 1.3%, while the standard deviation is 0.9%.[10]

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[9]We experimented with different model assumptions; they had no significant impact on the results reported here.

[10]Chami and Cosimano (1988) provide the complete specification of the model and simulation. The parameters of the model are based on Cooley and Hansen (1995). The LQ method is the approximation procedure used.

To determine how the economy responds to monetary policy, we increased the growth rate of M1 by two standard deviations. Money growth subsequently declines by one half each quarter toward its steady–state level of 1.3% per quarter. Given the Cash-in-Advance assumption, inflation follows a similar pattern. The real ex-dividend value of the firm's stock declines, reducing real stock returns today, but increasing real stock returns in the following period. The real return on stocks falls from its steady state rate of 1.48% to 0.92% per quarter, followed by an increase to 1.9% per quarter (Figure 1). Consequently, real stock returns change by about one third of the change in money growth.

With the fall in the real ex-dividend value of the firm's stock, the investor reduces consumption by about 0.5% (Figure 2). This result is usually referred to as the "wealth effect". The reduction in consumption is also related to the increased volatility of stock returns that accompanies the change in monetary policy, because the increase in stock return volatility reduces the investor's estimate of permanent income. The reduction in consumption prompts the firm to make additional investment in capital in anticipation of the higher rate of return in the future. The capital stock increases by about 0.01% (Figure 3), representing about a 0.75% increase in the purchase of new capital. The additional capital stock leads to an expansion in output in the next period. This higher output leads to a recovery in consumption as the economy moves back toward the steady state.

IV. THE STOCK MARKET CHANNEL AND THE PREDICTABILITY OF STOCK RETURNS

Some evidence of the validity of the stock market channel comes from Figure 1. The impulse response of real stock returns to money growth, which oscillates, suggests that movements in stock returns are somewhat predictable. This result is at variance with the view that stock prices are a random walk, which implies that stock returns are unpredictable. But evidence in the past decade counters this view.[11] While some experts attribute predictability to irrational fads, others are starting to believe that it is a rational response to fluctuations in the economy.

The view that stock prices are a random walk stems from the view that changes in the discount factor in equation 2 are unpredictable—implying that stock prices change as new information about the firm's dividends becomes available. In a general equilibrium model of the economy, however, the discount factor is based on the investor's marginal rate of substitution. The marginal rate of substitution is the ratio of the marginal utility of consumption in the future the marginal utility of consumption today, which can in fact respond predictably to economic conditions. For example, suppose the economy is in an expansion—then, consumption growth today would be high relative to consumption growth in the future. As such, a diminishing marginal utility of consumption would lead to a higher marginal rate of substitution. Equation 2 shows that the higher marginal rate of substitution raises stock prices and lowers the rate of return on stocks from time t to $t+1$.

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[11]This evolution in evidence can be seen by comparing Fama (1970) with Fama (1991).

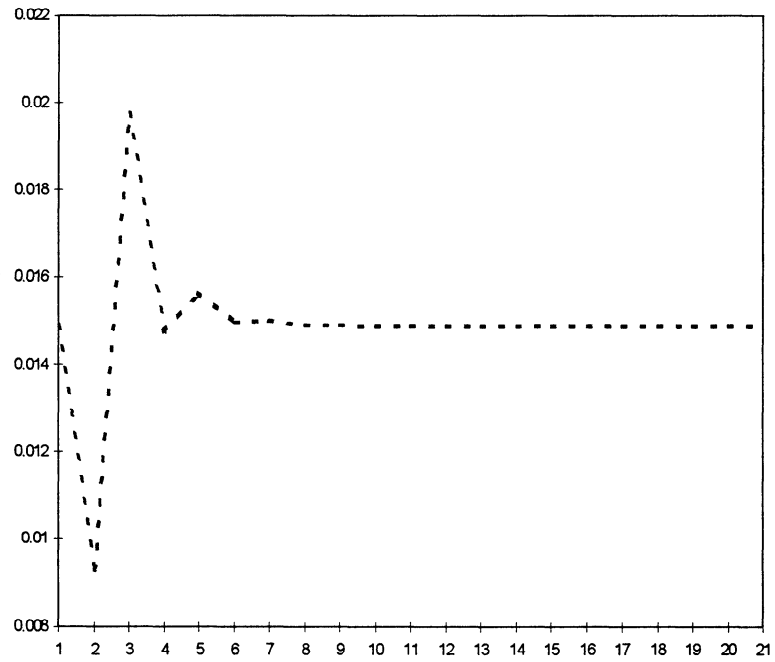# Figure 1. Response of Real Stock Returns to Monetary Shock

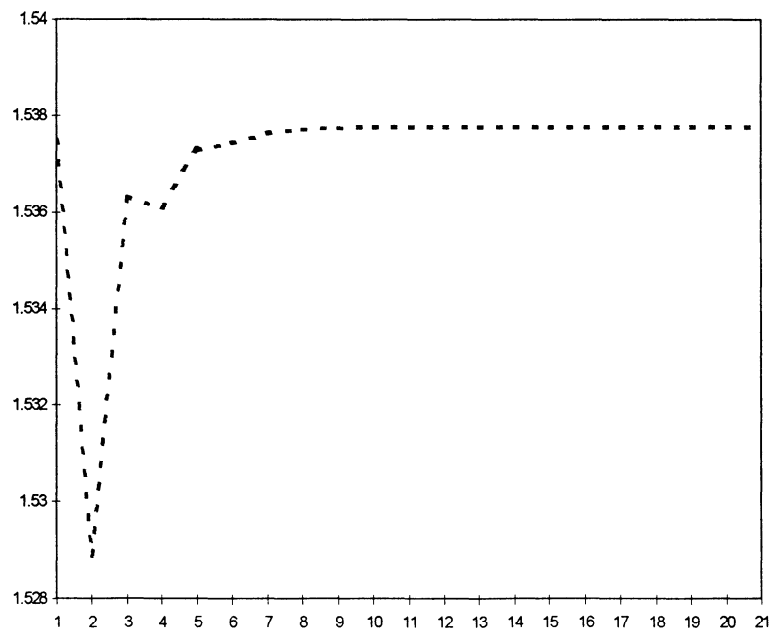# Figure 2. Response of Consumption to Monetary Shock

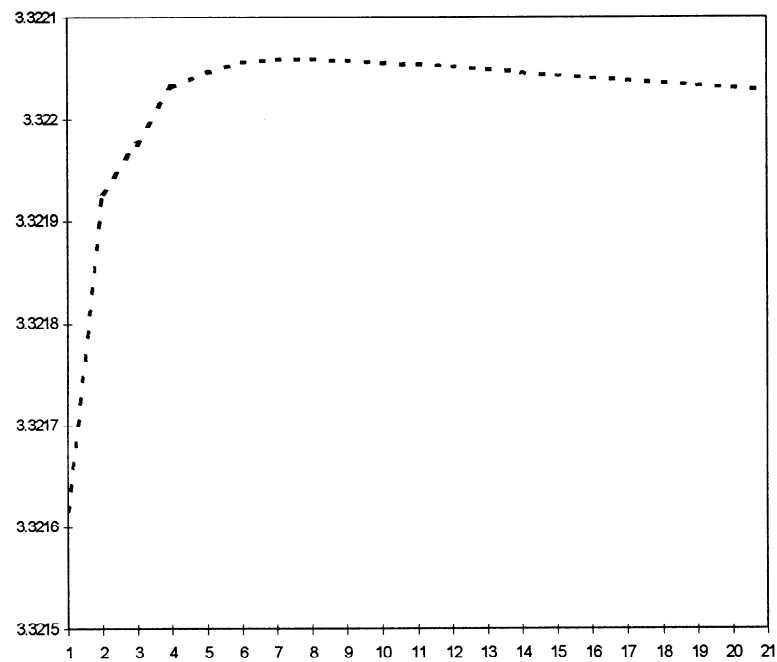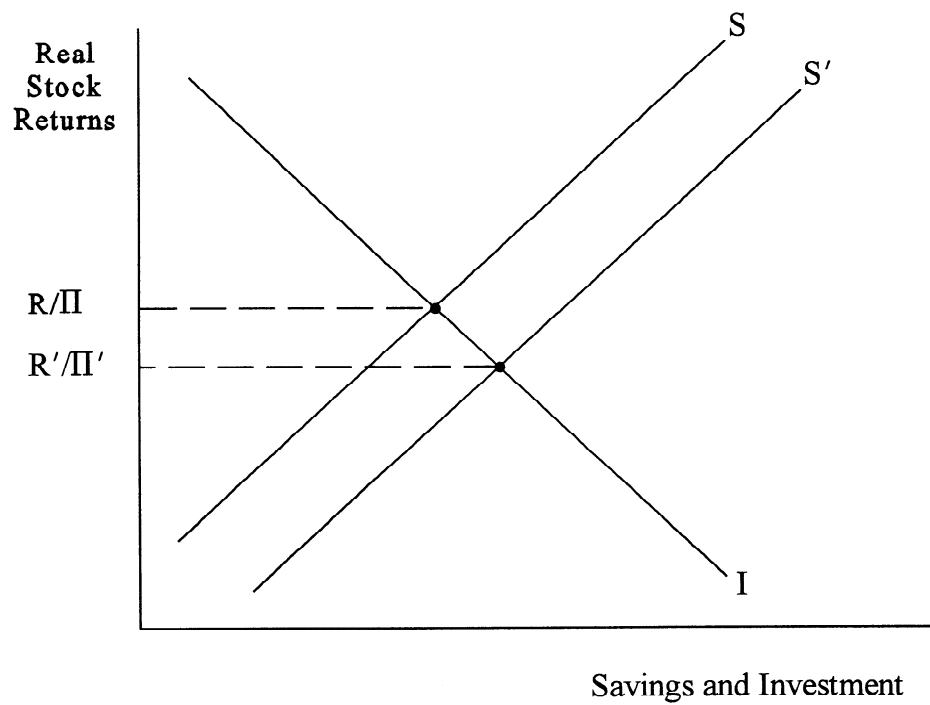Figure 3. Response of Capital to Monetary Shock

Figure 4. Market for Loanable Funds

We represent this result in Figure 4, which depicts the market for loanable funds. The investor's behavior is represented by the saving schedule. The saving schedule shows that investors increase savings when the real return on stocks increases from time t to t+1. Conversely, firms reduce investment in capital goods when real returns decline. This relationship is portrayed by the investment schedule. During an expansion, the savings schedule shifts right as investors increase savings in anticipation of poorer times in the future. The expansion of savings relative to investment reduces the real return on stocks. To the extent that movements in consumption are predictable, movements in stock returns will be predictable.

To represent how the stock channel contributes to the predictability of stock returns, we report the results from 100 simulations of the general equilibrium model with money (Table 1).[12] Following our argument, the first–order autocorrelation in real *ex post* stock returns is -0.50 when the coefficient of risk aversion is equation 5. Fama and French (1988a), among others, have found that real stock returns on an equally weighted portfolio of stocks during the 1926–1985 time period have a negative autocorrelation of -0.26, -0.36, and -0.28 over longer horizons of 2, 3, and 4 years, respectively.

This evidence of negative first–order autocorrelation was subsequently questioned because it was based on data drawn from small samples.[13] Fama and French (1988b) compensated for this problem by using the dividend-price ratio as a proxy for the autocorrelated movements in expected real returns. In Table 1, the contemporary correlation between real stock returns and the dividend price ratio is -0.75, while the correlation between real stock returns and one lag of the dividend price ratio is 0.57. These results are consistent with the U.S. stock market. For example, Chen (1991) found a contemporary correlation of -0.31 for annual data during 1954–1986 time period. In addition, Campbell, Lo, and MacKinlay (1997) developed a VAR model with monthly data for the 1952–1994 time period which found that a 1% change in the lagged dividend price level led to a 0.65% change in real stock returns.

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[12]Chami and Cosimano (1998) took 150 random draws from the probability distributions for money growth and productivity shocks to represent a time series of 150 quarters. The parameters of the model are identical to those used in the impulse responses. The information set of the investors differs, in that investors do not know the dividends produced in the current period until the beginning of the next period.

[13]Campbell, Lo, and MacKinlay (1997, pp.78-80) discuss this issue.

Table 1. Correlation with Real Stock Returns

	Lag 0	Lag 1
Real Stock Returns	1	-.50 (.06)
Dividend/Price Ratio	-.75 (.05)	.57 (.05)
Price Level (CPI)	-.65 (.04)	.66 (.03)
Money (M1)	-.32 (.05)	.31 (.04)
Output	.33 (.07)	-.01 (.09)

Note: The sample moments are calculated from 100 simulations of the competitive equilibrium over 150 quarters, base on parameters by Cooley and Hansen (1995). The coefficient of relative risk aversion is five. These calculations use the log differences in the simulated data. The standard deviations across the 100 simulations are provided in parentheses.

To show how these results reflect the stock channel, we also report the correlations between real stock returns and inflation, money growth, and output growth (Table 1). Inflation has a negative contemporaneous correlation of -0.65 with real stock returns, reflecting the stock channel. Ample evidence exists that both inflation and unexpected inflation have a negative impact on real stock returns. For example, Choi, Smith, and Boyd (1996) found a contemporaneous correlation of -0.25 for the United States based on monthly data.[14] They found similar results for Chile, Korea, and Taiwan during higher inflationary periods.

The correlation between real stock returns and money growth is similar to the correlation between real stock returns and inflation but smaller in magnitude. Changes in money growth have a positive impact on inflation due to the Cash-in-Advance constraint. However, the positive correlation with consumption growth moderates the correlation between inflation and

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[14]The original response to this correlation was to argue that it reflected of some real phenomena. For example, Fama (1991) attributed this correlation to the effect of output on inflation. While Feldstein and Slemrod (1978) and Feldstein and Summers (1977) argued that it reflected distortions caused by the tax system, Boudoukh and Richardson (1993) show that for over longer time horizons of five years the negative correlation disappeared in the United States during the 1802–1990 period. This result is consistent with our model, since money is neutral in the steady state.

money growth. Consequently, the correlation between money growth and inflation is weaker. Thorbecke (1997) and Patelis (1997) found a positive correlation between expansionary monetary policy and real stock returns, where expansionary monetary policy is measured by a reduction in the funds rate or an increase in nonborrowed reserves.[15] This conflict may be the result of the constant velocity of money under the Cash-in-Advance constraint. With Marshall's (1992) transaction cost justification for money, money velocity responds to a change in short–term interest rates. This response would create a positive correlation between real stock returns and the quantity of money.

V. THE RISE OF THE STOCK MARKET CHANNEL?

While we would like to present convincing empirical evidence that the stock market channel is an important path for monetary policy, we believe that this channel has become prominent only in the past decade. Rather than present econometric tests for the stock market channel, we offer other empirical evidence to support the individual links in the proposed transmission path. While two of the links in the stock market channel have rigorously been established by research, the most critical link appears to have become important only in the past 10 to 15 years. The evidence we present, therefore, is highly suggestive but far from conclusive.

The first link—that monetary policy is a key determinant of the rate of inflation—seems beyond dispute. Standard textbooks such as Mankiw (1997) and Mishkin (1998) provide simple, persuasive evidence of this relationship, and academic journals contain ample evidence of the subtleties of this relationship.

The next link is that investors react to rising inflation and expected inflation by raising their required returns. Although estimating returns is difficult, economists have proxied this effect by studying the effect of inflation on stock returns. When the expected return rises, holding dividends constant, stock prices tend to fall. Thus, an increase in required returns causes a short-run fall in returns due to the capital loss. The evidence in the previous section documented a negative contemporaneous correlation between inflation and stock returns. In addition, researchers such as Nelson (1976) documented this effect for the inflation shock of the early 1970s; McQueen and Roley (1993) found a similar, though weaker, effect in more recent data; and Amihud (1996) found this effect for post-hyperinflation Israel.

Finally, and perhaps most important, the stock market channel requires that managers react to changes in the price of the company's stock by altering production and investment. Academic research into the q-theory of investment is relevant here, since the stock price is the numerator

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[15]This result may be subject to the criticism made by Thornton (1997) that these indicators may not be appropriate measures of monetary policy. Thornton argues that the Fed offsets discount-window lending with open-market operations, and thus that the appropriate measure of monetary policy is total reserves, rather than nonborrowed reserves.

of q. But this relationship is distinct from, and more extensive than, the particular relationship implied by the q-theory. As is well known, the empirical performance of the q-theory is disappointing–but it is unclear whether the failure is due to poor theory or an inability to measure q.

Anecdotal evidence across industries suggests that many corporations have adjusted their operations in recent years in an effort to increase their stock returns—reducing the number of employees, relocating or closing factories, and hiring aggressive new executives to carry out these activities. It is commonly accepted that companies adopt these measures to satisfy their shareholders, and ample evidence suggests that stock owners—and their representatives—have become much more assertive in recent years.

To begin with, the rate of stock ownership has increased among the U.S. population, generally thought to be due to a dramatic increase in so-called indirect stock ownership—ownership of stocks through mutual funds. When Mankiw and Zeldes (1991) compared the consumption of stockholders against nonstockholders, only 27.6% of the U.S. population owned stocks, according to the 1984 PSID. Today, counting both direct and indirect stock ownership, that number is around 40% (Melloan, 1996). While this high rate of growth in stock ownership may not continue, it is likely that the breadth of stock ownership will, as more employers make defined-contribution retirement saving plans such as 401-k accounts available to their employees and include stock mutual funds in the menu of assets available for these retirement accounts.

With the increase in stock ownership, it is reasonable to believe that households are better informed about the risks and benefits of holding equity assets than probably at any other time in history. Stockholding households, especially those that own shares directly, probably intuitively understand that inflation reduces the value of their assets. But given the growth in mutual funds, households need not necessarily be that informed or aware of the inflation tax; paying attention to such matters is the job of the mutual fund manager.[16] Mutual fund managers have a fiduciary responsibility to maximize the return of the fund, given the fund's constraints and rules. Therefore, we would expect that the managers understand and respond to the inflation tax on equity. Given that pension funds alone hold more than 30% of all listed stocks (Mahoney, 1996), and institutional owners generally hold more than 50% of all stocks (Smith, 1996), an outright majority of the equity in this country is controlled by professionals who are paid to keep a close eye on the inflation's effects on equity returns.

The managers of mutual and pension funds, as well as individual stockholders, are placing greater pressure on poorly performing companies to improve their operating efficiencies and profitability. The rise of this practice, known as "shareholder activism," has been one of the most important consequences of the increase in stock ownership documented here. Perhaps

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[16]This presumes that households care enough about inflation to want their mutual funds to have returns greater than the inflation rate.

the most famous of shareholder activists is CalPERS, the California Public Employee Retirement System. Shareholder activists use their leverage as major shareholders to urge companies to change management and improve their operations. Papers by Smith (1996) and Wahal (1996) have studies the effects of shareholder activism on stock returns and accounting measures of firm performance, but researchers have not explicitly studied the link between activism and such real activities as investment and production decisions. Presumably, when shareholder activists succeed in changing some aspect of the firm's management or conduct, it implies that the firm's production activities will change as well.

More significant than the actual use of shareholder activism is the credible threat of management replacement that it has created. James Annable (1997), chief economist of First Chicago NBD, believes that the rise in shareholder activism has led to growing job insecurity among managers of firms. In short, managers now fear for their jobs as never before and are working harder to keep them. They have become more sensitive to shareholders' demands for better returns—indeed, they anticipate them—and are changing firms' operations in order to meet them. This sensitivity to shareholders' wishes, Annable claims, is a fundamental change that has occurred relatively recently as capital markets have become more efficient and shareholders less passive. The upshot of this development is that managers react to movements in their firms' stock prices without having to be prodded by shareholder activists.

This discussion suggests that a monetary transmission path leading through the stock market has strengthened in recent years. The economy contains more stockholders, and these stockholders either care about the inflation tax or pay someone else to deal with it for them. Stockholders and their representatives have become more vocal about pressing firms to increase their returns, and managers have become more responsive to those demands. Thus, a monetary policy shock that leads to higher inflation prompts more stockholders to pressure firms to improve the performance of their stock. The managers of the firms respond to this pressure at least in part by changing the operations of the firm, and real economic activity changes.

VI. Conclusion: Optimal Monetary Policy in an Economy with a Stock Market Channel

Understanding the monetary transmission mechanism is essential to policymakers because different mechanisms may imply that different targets are optimal or appropriate. The stock market channel, for example, suggests that the price level is the appropriate target of monetary policy; the money channel and the creditworthiness channels imply that the interest rate should be targeted; the bank-dependent borrower channel suggests the quantity of credit.

Carlstrom and Fuerst (1995), and Kydland (1989), have analyzed optimal monetary policy within a general equilibrium model with money. Carlstrom and Fuerst introduced two sources of distortion into their model to enable them to analyze monetary policy. The first feature is a Cash-in-Advance constraint, which is a way of modeling the fact that nearly all purchases in

developed economies are made with money. As described earlier, this constraint restricts the use of proceeds from dividends for one period, so that the time value of money comes into play. Due to the Cash-in-Advance constraint on the purchase of consumer goods, the nominal interest rate then distorts the optimal capital accumulation condition.

The second source of distortion is called a "limited-participation model,"in which firms must borrow cash to pay their wage bill. Their borrowing effectively introduces a credit channel of monetary policy into the model, in the sense that the nominal interest rate can influence the equilibrium level of work by affecting labor demand. Labor supply may be either elastic or inelastic in these models. In Carlstrom and Fuerst, labor is elastically supplied.

Carlstrom and Fuerst (1995) found that the distortion to the optimal capital accumulation disappears under an interest rate rule. In addition, the distortion of the labor decision is removed when the nominal interest rate is zero. While our general equilibrium model with elastic labor has the same distortions as the model of Carlstrom and Fuerst, ours has an additional distortion created by the existence of a market for equity.[17] This additional distortion of the economy is shown by equation 5. Inflation alters the no–arbitrage condition between the investor's perceived value of the firm, which is the stock price, and the firm's perceived value of the firm, which is the expected discounted value of dividends. A stable price rule will remove this distortion to the economy.

When the labor supply is inelastic, the interest rate rule does not conflict with the price rule, since the nominal interest rate target can be made consistent with the price rule. However, with an elastic supply of labor the two rules cannot be reconciled, since the zero nominal interest rate required to remove the distortion to labor is inconsistent with the stable price rule used to remove the distortion to the equity market. Thus, the optimal monetary policy is some combination of an interest rate rule and a price rule, which depends on the specification of the economy.[18]

The fact that the inflation tax is a tax on the value of the firm's capital adds another dimension to the policymaker's problem. Kydland (1989) has pointed out that the presence of productive capital creates the possibility of a time–inconsistent policy. This problem is relevant in our case, given that it is not possible to reach the first best solution. The firms commit to a specific level of capital based on an expectation that the optimal monetary policy will be followed in the future. Once the capital stock has been purchased, the central bank's tradeoff between an

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[17]These results pertain to what Carlstrom and Fuerst call the stochastic case without portfolio rigidities. This case is closest to our model presented here. This additional distortion would also be added to Carlstrom and Fuerst's model with portfolio rigidities.

[18]The conflict between various rules was first shown by Poole (1970). Cecchetti (1998) provides a recent discussion of the central bank's tradeoffs between price rules and interest rate smoothing.

interest rate rule and a price rule could be altered. Thus, it may be optimal for the central bank to repudiate the original optimal policy by inflating prices.

The existence of a stock market channel for monetary policy, therefore, changes the fundamental issues facing monetary policymakers relatively little. If anything, this channel helps emphasize the importance of defending the Fed's reputation as an inflation fighter. To the extent that the stock market channel is an important path for monetary policy, it also supports those who argue that stable prices should take precedence over high employment as an objective of monetary policy. It should also affect the specific mix of targets used to achieve the Fed's goals. But even if the stock market channel becomes the primary path for the transmission of monetary policy, it is certain that the Fed's importance in the economy will continue.

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