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MONETARY POLICY ACTIONS AND THE INCENTIVE TO INVEST

THE "VALUE OF WAITING" MAY OVERWHELM LOW INTEREST RATES

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Abstract

The ability of monetary policy actions to affect the private sector's incentive to invest in fixed capital is hotly debated. Whereas a downward shift in the yield curve increases the present value of expected cash flows and should spur investment, lower short-term interest rates make delay more desirable. These influences work against each other so the net effect of stimulative monetary policy actions could go either way. This article outlines a simple investment decision rule that captures both effects of changing interest rates. It also clarifies why monetary policy actions that shift the yield curve may or may not affect fixed investment.

Keywords: Business Fixed Investment, Monetary Policy, Real Options

MONETARY POLICY ACTIONS AND THE INCENTIVE TO INVEST

Many economists and policymakers consider business fixed investment ("fixed private nonresidential investment" in the national accounts) to be an important transmission channel for monetary policy actions. Moreover, business fixed investment may be a leading economic indicator. Although business fixed investment accounted for only 9 to 14 percent of GDP in any quarter between 1960 and 2003, it accounted for about 24 percent of GDP growth during the two years following the recessions of 1969-70 and 1981-82. Also, declines in business investment spending typically lead the economy into recession, most recently during late 2000 in advance of the 2001 recession.

The decision to invest depends critically on the opportunity cost of capital—that is, the rate at which future cash flows are discounted. For given cash flow expectations, the lower the cost of capital, the more potential investment projects are profitable and hence should be implemented. Although the Federal Reserve does not exert direct control over the cost of capital, monetary policy may affect the incentive to invest in important ways. This article adapts a recently developed model to highlight the complex link between monetary policy actions and the private sector's incentive to invest.

The Net Present Value Rule

The simple textbook net present value (NPV) rule states that a given project should be undertaken if (and only if) its NPV—that is, the sum of its discounted cash flows—is positive. The project's NPV is calculated as

(1) $$\mathrm{NPV} = \sum_{t=1}^{T} \frac{\mathrm{CF}_t}{(1+k)^t} \quad ,$$

where k is the (marginal) opportunity cost of capital and the CF are (point estimates of uncertain) end-of-period *incremental* cash flows (i.e., in excess of the firm's existing cash flows, some of which may be crowded out by the new project).

The marginal cost of capital, k, should reflect only the market-related—that is, systematic—risk of the *project* (rather than the firm). It is merely an extension of the Modigliani-Miller theorem to say that the "risk that is relevant in computing a project's cost of capital is the risk of the project's cash flows and not the risk of the financing instrument (e.g., stocks, bonds) the firm issues to finance the project." This is why there is no uniform value for the cost of capital of a given company. In fact, companies "should adopt a policy of using different costs of capital, at least at the divisional level" (Bodie and Merton, 2000).

Although the NPV rule generally is correct in a static world, it is by now well-known that it does not always give the correct answer from a dynamic perspective (that is, when there are multiple decision points). The NPV rule might lead to an inefficient investment decision if projects available today can be delayed until tomorrow. If a project can be delayed, it might be worthwhile to wait even if the NPV of undertaking the project today is positive. Such a situation arises if the value of waiting is higher than the NPV of starting the project today, possibly because the marginal cost of capital, k, is likely to be lower tomorrow. In other words, there might be value in waiting to undertake business fixed investment even if the project is currently profitable.

A positive value of waiting exists only where investment is irreversible and where, at the same time, uncertainty about a parameter pertinent to the investment decision will be resolved at a future date. Irreversibility exists if a project undertaken today cannot be reversed at zero cost tomorrow. In other words, there is irreversibility if the investor's decision today bears on the choice set available to the investor tomorrow—a sort of path dependency. A candidate variable for resolution of uncertainty is the opportunity cost of capital. For given cash flow expectations, it might be worthwhile for an investor to wait to undertake the investment, re-evaluating the investment again at a future date at the then-prevailing cost of capital. Given that many investment projects are, at least in part, irreversible, the existence of a value of waiting is a fundamental insight. What is more, modeling the investment as a decision to exercise a call option (versus keeping it alive by not investing) allows us to derive the value of waiting and its relation to economic uncertainty.

Monetary Policy Actions and the Decision to Invest

Monetary policy actions are widely believed to be important for business fixed investment, yet decades of academic research largely have failed to pin down the relationship. In other words, policymakers' confidence that such a relationship exists contrasts sharply with a dearth of agreed theoretical explanations of this key link between the financial sector and the real economy. One possible flaw in many theoretical models linking monetary policy actions and business investment is their failure to account for the timing option that may be embedded in investment decisions. This, in turn, results from the tendency to build static models in which there is only one decision point. In the real world, of course, many investment projects that are passed over today may be undertaken tomorrow. In a sense, therefore, investment projects may compete with themselves at different points in time.

A recent contribution to the dynamic investment literature by Jonathan B. Berk (1999) derives an investment decision rule that incorporates the impact of monetary policy actions on both the cost of capital and the value of waiting. In earlier research, Ingersoll and Ross (1992) had analyzed the value of waiting to invest in the presence of nonstochastic (constant) real cash flows and stochastic (randomly varying) real interest rates. These authors showed that the effect of a monetary policy action—there defined as a parallel shift in the Treasury yield curve—has ambiguous effects on fixed investment activity. This is because changes in the level of interest rates affect both the present value of cash flows (through the discount rate) and the value of waiting to invest (through the real option consisting of timing).

Consider a monetary policy action that causes the yield curve to move down. On the one hand, lower interest rates at all maturities along the yield curve would increase the present value of future cash flows, increasing the incentive to invest. This is the effect that most investment models capture and which shapes the conventional wisdom. On the other hand, the lower yield curve also implies a lower opportunity cost of waiting to invest due to the lower short-term rate. In effect, the urgency to make a decision declines. What's more, monetary policy actions might increase uncertainty about future real interest rates. This could make the option to wait even more valuable. All things considered, Ingersoll and Ross conclude that no general statement can be made about how monetary policy actions affect fixed investment incentives.

Building on Ingersoll and Ross's insight that waiting to invest means keeping alive a call option on the opportunity cost of capital, Berk (1999) presented a simple investment rule that offers an unambiguous theoretical relationship between market interest rates and fixed investment. This option-adjusted—that is, value-of-waiting adjusted—investment rule tells the investor to undertake the project at time $t = 0$ if (and only if) the following inequality holds:

$$\sum_{t=1}^{T} \frac{\mathrm{CF}_t}{(1+\frac{r_0^c}{r_0}k)^t} > 0 \;, \tag{2}$$

where k and CF are defined as above, r_0^c is the current callable risk-free rate with the maturity of the final cash flow of the project, and r_0 is the current duration-matched non-callable risk-free rate.

The difference between inequality (2) and the traditional NPV rule is the quotient r_0^c / r_0—the ratio of callable long and non-callable duration-matched risk-free interest rates. A higher ratio of callable to non-callable rates makes waiting relatively attractive, whereas a lower ratio makes waiting comparatively unattractive, all else equal. This is because a high revealed value of the embedded call option implies that the market places relatively large probability weight on the possibility that long-term interest rates will be lower in the future than they are today.

The implicit assumption of the option-adjusted NPV rule shown in inequality (2) is that all variables are real, that is, adjusted for inflation expectations. This is because the cash flows of the project in question are assumed to be independent of whether the project is undertaken today (at $t = 0$) or in the future. If the variables were in nominal dollar terms, the cash flow stream of a project would not necessarily be independent of the project's starting point. For example, all cash flows would be 10 percent higher in dollar (nominal) terms if the project were delayed and the general price level rose by 10 percent in the interim.

To build intuition, let us assume for a moment a world without inflation. In such a world with no inflation (and no accompanying inflation uncertainty), the option-adjusted NPV rule—inequality (2)—provides an unambiguous link between business fixed investment and the ratio of a long-term callable default-free rate to a duration-matched non-callable default-free rate. This unambiguous link makes the ratio of callable to non-callable interest rates a fail-safe gauge of the impact of a monetary policy action on the incentive to invest. For instance, if the Federal Reserve, in an attempt to ease financial conditions by cutting the federal funds rate, is able to depress the ratio of the long callable to the duration-matched non-callable default-free rates, then the Fed succeeds in increasing the incentive to invest. Otherwise, the monetary policy action increases the value of waiting more than the NPV of investing today.

In a world without inflation, default-free callable bond yields would be readily available from GNMA ("Ginnie Mae") pass-through mortgage-backed securities (MBS). (GNMA is the Government National Mortgage Association, a federal government agency; like Treasuries, GNMA securities carry the full faith and credit of the U.S. government.) Pass-through MBS inherit the cash-flow characteristics of 30-year fixed-rate mortgages, which can be prepaid at par at the discretion of the borrower (mortgager). Thus, a mortgage effectively is composed of a long-term non-callable bond plus an embedded call option that gives the mortgager the right (but not the obligation) to buy back (call) the bond at par. The value of the embedded call option (written by the mortgagee on long-term nominal interest rates) is reflected in the ratio of GNMA to Treasury yields. The resulting option value captures the value of waiting. Waiting is valuable because interest rates are stochastic and, thus, the opportunity cost of capital may be lower tomorrow than it is today. A high ratio of GNMA to Treasury yields indicates that waiting is relatively attractive because the market attaches a high probability to the possibility that long-term interest rates will drop.

Implementing the Option-Adjusted Cost of Capital

We now calculate the Berk (1999) option-adjusted real cost of capital for the U.S. corporate sector. Because the Berk investment decision rule was derived for a world without inflation, we must make adjustments for inflation expectations. As the ratio of the (nominal) callable and non-callable default-free rates we take the ratio of the GNMA 30-year yield to the 10-year T-note yield; this is to match durations. We measure inflation expectations by the difference in 10-year constant maturity yields between nominal off-the-run Treasury securities and inflation-indexed Treasury securities, calculated from smoothed zero-coupon yield curves. Unlike survey measures of inflation expectations, the yield spread between nominal and inflation-indexed securities is based on actual (investment) decisions. On the other hand, as discussed by Sack (2000) and McCulloch (2003), the TIPS spread is a noisy (because of thin trading) and possibly biased measure of the expected rate of inflation because of embedded liquity and inflation-risk premiums. Also, as argued by Schmid (2003), the TIPS spread tends to overshoot in response to montary policy actions.

Finally, we measure the marginal cost of capital by the sum of the yield of the on-the-run 10-year TIPS and an (unobservable) equity risk premium, defined as the return investors expected above and beyond the 10-year TIPS yield. Now we can write the option-adjusted discount rate as follows:

$$\text{(3)} \qquad \frac{r_0^c - \pi_0}{r_0 - \pi_0}(\rho_0 + \kappa_0) \ ,$$

where r_0^c is the 30-year GNMA current-coupon bond-equivalent yield, π_0 is the TIPS spread measure of inflation expectations, r_0 is the constant-maturity 10-year T-note yield, ρ_0 is the yield of the on-the-run 10-year TIPS, and κ_0 is the equity risk premium as defined above. Expression (3) essentially translates the term $(r_0^c / r_0) \cdot k$ from equation (2) into the real world of inflation.

We calculate the equity risk premium from the Gordon (1962) growth model, which states that the expected real return on equity for the representative investor equals the sum of the market's dividend yield and the long-run rate of growth of real GDP per capita. Because this expected return must equal the sum of the TIPS yield and the equity risk premium, as defined above, it follows that the equity risk premium equals the sum of the dividend yield and the long-run growth rate of real GDP per capita, less the TIPS yield. We set the long-run growth rate of real GDP per capita at 2 percent, the post-WW II average. See the appendix for a description of the variables and the data sources.

The Recent Experience

As the economy fell into recession during early 2001, the Federal Reserve began an aggressive campaign to stimulate the economy—including business fixed investment. The Fed cut the federal funds rate target 13 times by a cumulative 550 basis points between January 2001 and June 2003. The real long-term Treasury yield (the TIPS yield) fell from about 3½ percent at the beginning of 2001 to around 2 percent by the end of 2003. Conventional models of monetary policy and investment would conclude that monetary policy had been successful in lowering real long-term interest rates significantly, and that we should expect a strong surge in fixed investment. Surprisingly, the level of real business fixed investment spending (not shown) declined for eight consecutive quarters, or cumulatively by nearly 13 percent, between the first quarter of 2001 and the first quarter of 2003. Why did investment spending not increase immediately in response to monetary easing? The answer, we suggest, is the increased value of waiting to invest during this period.

Figure 1 depicts, since 1999, our estimate of the option-adjusted discount rate (or real marginal cost of capital) for the U.S. corporate sector, the TIPS yield, and the value of waiting to invest ("Value of Call"). The option-adjusted discount rate (shown analytically in expression (3) above) was around 5 percent in early 1999, and hovered at this level through mid-2002. Reflecting aggressive monetary easing by the Federal Reserve, starting in January 2001, the TIPS yield declined to around 3 percent by mid-2002. The option-adjusted discount rate remained close to 5 percent, however, as the value of waiting increased modestly. Between mid-2002 and mid-2003, the Fed continued to ease monetary policy and the TIPS yield fell to about 1.5 percent. The value of waiting increased so much during this period, however, that the option-adjusted discount rate actually increased to more than 6 percent. Beginning in early 2003, the value of waiting declined modestly, allowing the option-adjusted discount rate to trend lower through the end of 2003. Meanwhile, business fixed investment increased for the first time in two years during the second quarter of 2003.

Recall that firms with investment projects that can be delayed will consider not just the present values of cash flows beginning today, but also the present values of the same cash flows beginning tomorrow, or the next day. We define the value of waiting as the ratio of callable to non-callable inflation-expectations adjusted default-free rates, $\frac{r_0^c - \pi_0}{r_0 - \pi_0}$. Because there is always some value to waiting, this ratio is always greater than unity. This does not mean that all projects should be delayed indefinitely (Ingersoll and Ross, 1992). Rather, a project should be delayed only if the value of waiting exceeds the NPV of investing today.

It is reasonable to believe that uncertainty about the future path of interest rates increased in the second half of 2002. Pervasive economic and financial turmoil during 2002 plausibly increased interest-rate uncertainty. As it turns out, the sharp increase in the value of waiting overwhelmed the declining real long-term Treasury yield for some time. Only during the first half of 2003 did further declines in the TIPS yield coincide with a gradual, but erratic, decline in the value of the option of waiting to invest (due to decreased uncertainty about the path of interest rates). Thus, the failure of business fixed investment to respond to aggressive monetary policy actions during 2001 and 2002 may be due to the interest-rate uncertainty that shows up in our estimate of the value of waiting.

Our measure concerns only the cost of corporate debt, but clearly, the equity risk premium also may have increased during this period. This also would inhibit business fixed investment. The equity risk premium, $\kappa = d - \rho + g^{gdp}$, increased as the dividend yield, d, rose (due to a decline in the stock market valuation) and the real long-term default-free rate (the 10-year TIPS yield), ρ, dropped. It seems reasonable to assume that the long-term growth prospects of the economy, g^{gdp}, do not fluctuate very much in the short run. Thus, the equity risk premium must have increased during this period, also. Several authors, including Campbell and Cochrane (1999), argue that investors are less risk-tolerant and, hence, demand a larger equity risk premium, during recession than during expansion.

Conclusion

The link between monetary policy actions and business fixed investment is difficult to discern from empirical data. We have shown that there is a clear theoretical link between the real (that is, inflation-adjusted) mortgage and Treasury rates and fixed investment. Unfortunately, yields on inflation-indexed mortgage-backed securities are not widely available because Ginnie Mae does not issue such securities. We approximated this rate, however, and showed that changes in the ratio of GNMA and Treasury yields, combined with other financial-market information, allow decisionmakers and policymakers to gauge (albeit imperfectly) the impact of monetary policy actions on the incentive to invest.

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Appendix: Description of Variables

r^c : Callable long-term default-free rate, measured by the current-coupon bond-equivalent GNMA 30-year yield; biweekly; source: Board of Governors of the Federal Reserve.

r : Nominal long-term default-free rate, measured by the constant-maturity 10-year Treasury note yield; daily; source: Board of Governors of the Federal Reserve.

ρ : Real long-term default-free rate, measured by the yield of the on-the-run 10-year Treasury inflation-indexed security; daily; source: *New York Times*.

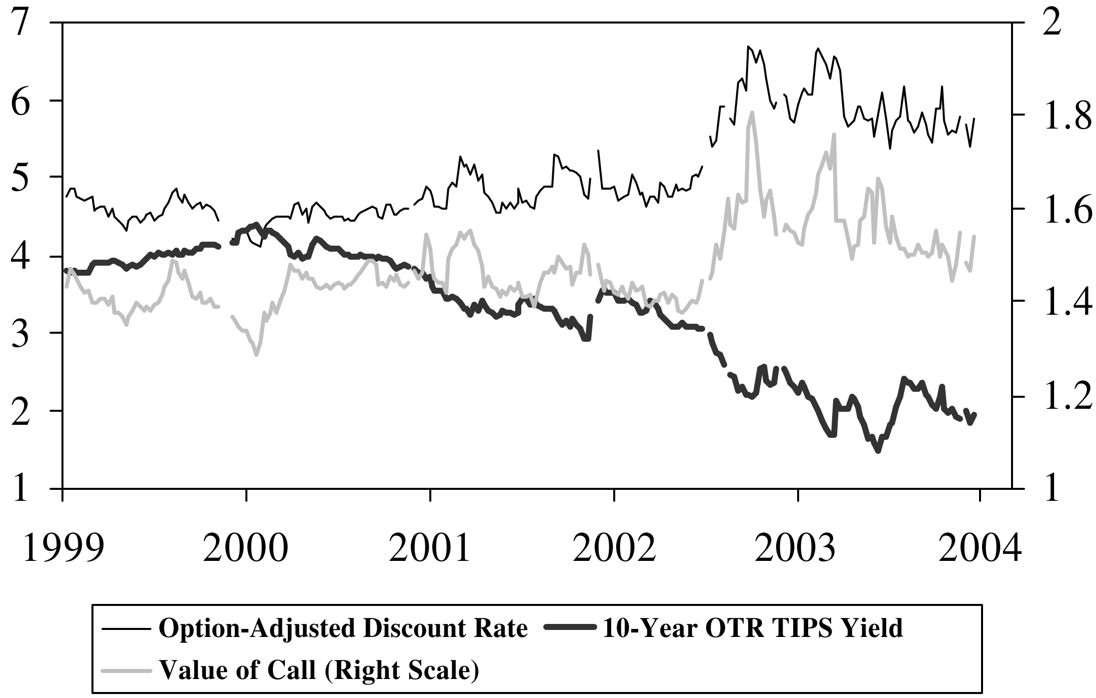
π : Expected rate of inflation, measured by the difference in 10-year constant maturity yields between nominal off-the-run Treasury securities and inflation-indexed Treasury securities, calculated from smoothed zero-coupon yield curves; source: Board of Governors of the Federal Reserve.

κ : Equity risk premium, calculated as follows: $\kappa = d - \rho + g^{gdp}$.

d : Dividend yield, measured by the dividend yield of the S&P 500 Stock Price Index using 4-quarter trailing dividends; monthly; source: Standard & Poor's.

g^{gdp} : Long-term growth rate of real GDP per capita, set at 2 percent (average growth rate of real GDP per capita from 1946 to 2002); source: Bureau of Economic Analysis.

Chart 1 The Real Option-Adjusted Discount Rate and Some of its Components



Note: Weekly observations; first observation: Week of Monday 01/07/1999; last observation: Week of Monday 12/18/2003. Tick marks on the beginning of the year.