Glamour vs. Value: The Real Story

Very preliminary (please do not quote without permission)

Abstract

This paper uses cross-sectional variation between glamour (high stock market price) and value (low stock market price) portfolios to address the possible relationship between misvaluation and fixed investment. In a large sample of U.S. firms over the period 1980-2001, glamour firms invest substantially more than value firms. The difference between the investment of glamour and value firms persists when we control for fundamentals. The higher investment of glamour firms could be due to the fact that overvaluation makes equity finance cheap. In fact, the median glamour firm raises more in new share issues than its total capital expenditures for the year. If glamour firms are responding to misvaluation rather than fundamentals, then they may be investing too much. We describe and implement four tests designed to distinguish whether the high investment of glamour firms is the result of fundamental shocks or misvaluation shocks: investment reversals, stock market returns of high-investment firms, the path over time of the marginal product of capital, and overreaction tests. Parametric estimates of the effect of misvaluation on investment suggest that a one standard deviation increase in misvaluation raises investment by more than 20%. We consider the possibility that overinvestment might be due to managers who sometimes succumb to sentiment and present tests designed to distinguish between this possibility and the active financing mechanism. The evidence consistently supports the active financing mechanism and is equivocal on managerial excess optimism.

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1. Introduction

Some observers believe that the recent U.S. recession was the culmination of a stock market bubble that led to unusually high levels of business fixed investment in the late 1990s, overinvestment in production capacity (especially in the sectors of the economy that were most affected by the bubble), and the collapse of investment as some firms attempted to reverse bubble-induced excesses.[1] If correct, this account has potentially important implications for macroeconomic modeling and policy. In fact, there is an ongoing, lively debate about the appropriate monetary policy response to a possible bubble and, more generally, the role of asset prices in policy formulation.[2] In this paper, we provide empirical evidence on the links between stock market overvaluation and business fixed investment.

Glamour firms have been defined as firms with high stock market prices relative to an accounting-based measure of firm worth (e.g., low Book/Market ratios). In contrast, value firms have been defined as firms with low stock market prices. Value firms substantially outperform glamour firms, with 8-10% higher annual returns averaged over the five years subsequent to portfolio formation. A leading interpretation is that investor sentiment affects stock market prices and glamour portfolios include many temporarily overvalued firms.[3]

[1] The *Economist* (October 4, 2003, p. 60), for example, reports that, "One reason for the current doldrums [in IT spending] is that many firms still regret binge-buying during the bubble."
[2] For example, see Bernanke (2003), Hunter, Kaufman, and Pomerleano (2003), and references cited therein for a discussion of these monetary policy issues.
[3] The leading alternative explanation is that the risk characteristics of glamour and value portfolios differ. See, for example, Campbell and Vuolteenaho (2003) and Cohen, Polk, and Vuolteenaho (2002).

We compare the investment behavior of glamour and value firms. Using a large, unbalanced panel data set of more than 100,000 observations of U.S. firms over the period 1980-2001, we find that glamour firms invest considerably more than value firms.

Suppose a firm gets a favorable fundamental shock. Since stock prices are forward-looking, its stock price may rise and the firm could have a sufficiently high price to be classified as a glamour firm. The firm might also invest more because fundamentals have improved. There are thus at least two possible interpretations of the finding that glamour firms invest more than value firms. First, q investment theory may work. Second, overvaluation may induce firms to invest more.

One way in which we address the fundamentalist interpretation is by controlling for economic fundamentals. We find that the investment of glamour firms is substantially higher than value firms, even after controlling for time- and sector-specific shocks, idiosyncratic shocks, and information that may be in the hands of firms (but not available to the empirical researcher) at the time of portfolio formation.

What mechanisms are responsible for the high investment of glamour firms? One possibility is an "active financing mechanism." Overvaluation implies a low cost of equity finance. We compare new share issues by glamour and value firms to see if there is evidence of an active financing mechanism.

Do glamour firms invest too much? We address this question in four main ways. First, a firm that experiences a favorable fundamental shock today will tend to have higher investment in the future than it had before the shock. In contrast, a firm that overinvests today as a result of overvaluation will tend to have lower investment in the future.

Second, we examine the stock market returns of high-investment firms, comparing the returns of high-investment glamour and high-investment value firms. If investment is determined by fundamentals, firms with high investment all have similarly favorable investment opportunities. Investment decisions are observable to outside investors and provide a signal to investors that firms have good prospects. Thus, if misvaluation plays no role, there will be no systematic differences between the returns to portfolios of high-investment glamour and value firms. In contrast, if overvaluation leads to overinvestment, high-investment glamour firms will tend to have low subsequent returns.

Third, we analyze the pattern of marginal products of capital over time. A favorable fundamental shock increases a firm's stock price and shifts up its demand for capital (i.e., its marginal product of capital schedule). At the original capital stock, the marginal product of capital is higher. As the firm increases its capital stock in response to the shock, the marginal product of capital gradually declines. In contrast, a favorable misvaluation shock shifts down the capital supply curve (due to cheaper equity financing). The marginal product of capital declines around the time of portfolio formation (as firms increase their capital stock to equate the marginal product of capital to the lower cost of capital) and later rises as the misvaluation gradually dissipates.

Fourth, some models suggest agents have extrapolative expectations. In these models, agents may overreact to a sequence of positive or negative shocks. Barberis, Shleifer, and Vishny (1998) propose this as a possible explanation for the superior returns of value firms. We introduce overreaction tests that are designed to determine whether the investment of glamour firms overreacts to sales shocks.

Many of the preceding tests address the qualitative question of whether misvaluation affects investment. The quantitative question is also of interest: how much does misvaluation affect investment? To address this question, we add a measure of misvaluation to several standard investment specifications -- a generic investment specification, a neoclassical investment model, a flexible accelerator model, and a Q model.

The paper is organized as follows. Section 2 describes the data. Section 3 compares the investment of glamour and value firms. Section 4 discusses (and provides evidence on) the active financing mechanism. Section 5 presents four tests aimed at determining whether glamour firms overinvest. Section 6 presents parametric estimates of the effect of misvaluation on investment. Section 7 introduces the idea of managerial excess optimism and reports tests designed to distinguish between the active financing mechanism and managerial excess optimism. Section 8 provides a brief summary and some tentative conclusions.

2. Data Description

The data is primarily drawn from CompuStat and CRSP. The sample period is 1980-2001. To minimize survivorship biases, we use unbalanced panel data.

We measure whether a firm is a glamour or value firm in a given year using the sales/price ratio. The sales/price ratio has several key advantages: sales is a relatively straightforward accounting concept, rarely extremely small, and never negative.[4] Portfolios are formed by sorting all the firms for which the necessary data is available in

[4] Book/market is also used in the literature, but it has many disadvantages. See, e.g., the discussion of book/market in Lakonishok, Shleifer, and Vishny (1994).

a given year by the sales/price ratio. The two deciles with the highest stock price (relative to sales) in a given year are classified as glamour firms. The next six deciles are classified as "typical" firms. The two deciles with the lowest stock price (again, relative to sales) are classified as value firms. The portfolio formation procedure allows a firm to be a glamour firm this year, a typical firm next year, and a value firm the year after. In fact, it is common for firms to move from one portfolio to another.

In finance, it is common to use the equity value of the firm as a measure of size, but that would be clearly inappropriate when we are investigating misvaluation. Instead, when we analyze investment, we use the capital stock to control for size. The capital stock is calculated using a standard perpetual inventory algorithm. The primary variable we analyze is the ratio of investment (I) to the capital stock (K).

There are a few extreme outliers for I/K. This is a common issue in panel data studies involving I/K, resulting from mergers and other accounting changes. We use standard techniques to address the issue. For results involving I/K, we windsorize; i.e., trim the sample by deleting the 1% tails of the I/K distribution. In addition, we usually report medians as well as means.

Further details of data construction are provided in the data appendix. Summary statistics for several of the main variables are presented in Table 1.

3. Do glamour firms invest more than value firms?

We begin by looking at the ratio of investment to the capital stock (I/K) for glamour and value firms. The median I/K for glamour firms is about 0.16, as shown in

Table 2. This is more than twice as large as the median for value firms (0.07), and the difference is highly statistically significant.

The difference in investment between glamour and value firms is dramatic, but it does not demonstrate that stock market misvaluation affects real behavior. In Table 3, we examine whether glamour firms invest more than value firms -- after controlling for fundamentals.

Comparable firms benchmark

The first control for fundamentals is the comparable firms benchmark (where comparable firms are defined as firms in the same industry in the same year). The comparable firms benchmark is a simple way of controlling for industry- and time-specific shocks to fundamentals. Moreover, it is forward-looking to the extent that the investment of comparable firms is based on expectations of future discount rates and the expected future stream of marginal products of capital. The comparable firms benchmark is defined as mean I/K for the row marked "Means" and median I/K for the row marked "Medians." Cell entries show investment spending after subtracting the comparable firms benchmark.

The investment spending of the portfolio of typical firms -- after subtracting the investment spending justified by fundamentals (as measured by the comparable firms benchmark) -- is close to zero, which suggests that their investment is largely driven by fundamentals. Value firms underinvest relative to fundamentals. Glamour firms overinvest relative to fundamentals. The difference between the investment spending of glamour and value firms is about the same after controlling for fundamentals, using the comparable firms benchmark (in the first two rows of Table 3), as it is before controlling for fundamentals (in Table 2). Thus fundamentals, at least as measured by the comparable firm benchmark, do not appear to account for the substantial difference in investment between glamour and value firms.

Fundamental Q

The comparable firms benchmark has the great virtue of simplicity and controls for industry- and time-specific shocks, but it is subject to the potential criticism that it does not control for idiosyncratic shocks.

Abel and Blanchard (1986) present a method of constructing a forward-looking measure of investment opportunities that does not depend on the stock market. The fundamental idea of the Abel and Blanchard technique is well suited to our situation because we would like a measure of investment opportunities that takes into account rational expectations of the future and is not contaminated by stock market misvaluations. Conceptually, the Abel and Blanchard measure of investment opportunities corresponds to Tobin's Q. Hayashi (1982) provides conditions under which the Abel and Blanchard Q, which we refer to as fundamental Q, will correspond to average Q.

Originally applied to aggregate data, the Abel and Blanchard technique was extended to panel data by Gilchrist and Himmelberg (1995), a crucial point, since we want to account for idiosyncratic shocks. In their implementation, Gilchrist and Himmelberg (1995) assume a constant discount rate. This is a potential source of concern, because variation in discount rates, either over time or across industries, might account for differences in investment between glamour and value portfolios. We therefore extend the work of Abel and Blanchard (1986) and Gilchrist and Himmelberg (1995) so that it applies to panel data and allows for variation in discount rates, both over time and across industries. The cost of capital is carefully constructed, including risk adjustment, taxes, and industry-specific prices of both investment goods and output.

Fundamental Q is the expected present value of future marginal products of capital:

$$\lambda_t = E_{t-1} \, \Sigma_{j=0}^{\infty} \, \Pi_{s=0}^{j-1} \, R_{t+s} \left(F_{K,t+j} - C_{K,t+j} \right) \quad (1)$$

where E_{t-1} is the expectations operator, conditional on the information set in period t-1, R is the discount factor, F_K is the marginal product of capital, narrowly defined, and C_K is the derivative of the adjustment cost function with respect to the capital stock. (To be precise, fundamental Q is $\lambda_t - p_t^I / p_t^Y$, where p^I is the price of investment goods and p^Y is the price of output.) Define the marginal product of capital (broadly defined to include the marginal reduction in adjustment costs from an additional unit of capital) as:

$$M_t \equiv \left(F_{K,t} - C_{K,t} \right) \quad (2)$$

We can then define ex post fundamental Q as:

$$\tilde{\lambda}_t \equiv \Sigma_{j=0}^{\infty} \left(\Pi_{s=0}^{j-1} R_{t+s} \right) M_{t+j} \quad (3)$$

and ex ante fundamental Q as:

$$\lambda_t = E_{t-1} \left[\tilde{\lambda}_t \right] \quad (4)$$

Note that λ is the sum of products of random variables, but we can simplify by linearizing $\tilde{\lambda}$ around $R_{t+s} = \overline{R}$ and $M_{t+s} = \overline{M}$, where $\overline{R}$ and $\overline{M}$ are the respective sample means.

$$\tilde{\lambda}_t \approx \overline{M}(1 - \overline{R})^{-1} + \overline{M}(1 - \overline{R})^{-1} \, \Sigma_{j=0}^{\infty} \overline{R}^{j} (R_{t+j} - \overline{R}) + \Sigma_{j=0}^{\infty} \overline{R}^{j} (M_{t+j} - \overline{M}) \quad (5)$$

We can then find observable counterparts to R and M by using linear combinations of economic variables.

$$M_t = a' Z_t \quad (6)$$

$$R_t = b' Z_t \quad (7)$$

Suppose Z has an auto-regressive structure. For specificity, consider the example where there are two variables in Z and where all the variables in Z are measured as deviations from their sample means.

$$\begin{bmatrix} Z_{1,t} \\ Z_{2,t} \end{bmatrix} = \begin{bmatrix} a(L) & b(L) \\ c(L) & d(L) \end{bmatrix} \begin{bmatrix} Z_{1,t-1} \\ Z_{2,t-1} \end{bmatrix} + \begin{bmatrix} v_{1,t} \\ v_{2,t} \end{bmatrix} \quad (8)$$

Stacking:

$$\begin{bmatrix} Z_{1,t} \\ . \\ . \\ Z_{1,t-\ell+1} \\ Z_{2,t} \\ . \\ . \\ Z_{2,t-\ell+1} \end{bmatrix} = \begin{bmatrix} a_1 & . & . & . & a_\ell & b_1 & . & . & . & b_\ell \\ 1 & 0 & . & . & 0 & 0 & . & . & . & 0 \\ : & & & & & : & & & & \\ 0 & . & 0 & 1 & 0 & 0 & . & . & . & 0 \\ c_1 & . & . & . & c_\ell & d_1 & . & . & . & d_\ell \\ 0 & . & . & . & 0 & 1 & . & . & . & 0 \\ : & & & & & : & & & & \\ 0 & . & . & . & 0 & 0 & . & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} Z_{1,t-1} \\ . \\ . \\ Z_{1,t-\ell} \\ Z_{2,t-1} \\ . \\ . \\ Z_{2,t-\ell} \end{bmatrix} + \begin{bmatrix} v_{1t} \\ 0 \\ . \\ 0 \\ v_{2t} \\ 0 \\ . \\ 0 \end{bmatrix}$$

(9)

In the empirical work, we set $\ell=2$. Equation (9) can be re-written in companion matrix form:

$$\tilde{Z}_t = A\tilde{Z}_{t-1} + \tilde{v}_t \quad (10)$$

Under the assumption of rational expectations, the expectations can be represented as linear projections on variables in the information set:

$$E_{t-1}\left[M_{t+j}\right] = aA^{j+1}\tilde{Z}_{t-1} \quad (11)$$

$$E_{t-1}\left[R_{t+j}\right] = bA^{j+1}\tilde{Z}_{t-1} \quad (12)$$

The infinite sums that comprise fundamental Q can be calculated as follows, using the last term in the expression for fundamental Q as an example:

$$E_{t-1}\Sigma_{j=0}^{\infty}\overline{R}^{j} M_{t+j} = \Sigma_{j=0}^{\infty}\overline{R}^{j} aA^{j+1}\tilde{Z}_{t-1} = a(I - \overline{R}A)^{-1}A\tilde{Z}_{t-1} \quad (13)$$

In our empirical work, the variables that comprise Z are R, Sales/K, Cost/K, p^I / p^Y, and I/K. R is a natural candidate. Under a variety of assumptions (including constant and non-constant returns to scale, fully competitive markets, and imperfect competition, Sales/K and Cost/K are components of the marginal product of capital. We follow Abel and Blanchard in including them as separate variables. The relative price ratio p^I / p^Y is a component of Q. Finally, under some assumptions, I/K is a nice forecasting variable. If investment is determined by fundamentals, then I/K reflects the expected present value of future marginal products of capital.[5]

[5] This follows directly in models based on convex adjustment costs. In models with fixed costs, irreversibility, or other nonconvexities, investment will still depend on the expected present value of future marginal products of capital over some range. See Abel and Eberly (1994).

The fundamental Q benchmark is constructed as follows. For all observations where the required data are available, we regress I/K on fundamental Q, including both firm and year effects in the regression. The predicted value of I/K from this regression is the fundamental Q benchmark. The entries in the cells are summary statistics for the difference between actual I/K and the fundamental Q benchmark (i.e., summary statistics for the residuals from the regression used to construct the fundamental Q benchmark).

Based on the fundamental Q benchmark, glamour firms invest more than is justified by fundamentals, as shown by the mean for glamour firms in the third row of Table 3. The investment of typical firms is close to that justified by fundamentals. Value firms underinvest. The difference in investment between glamour and value firms, after controlling for fundamentals, is highly significant, with a t statistic of more than 15.

The procedure used in constructing the middle two rows of Table 3 is conservative and may substantially understate the effects of misvaluation for two reasons. First, the inclusion of year effects means that the common component of the effect of misvaluation on investment in a given year is removed. For example, if stock market overvaluation tended to boost investment across firms in the late 1990s, this effect would be removed. Second, the inclusion of fixed effects means that the average effect of misvaluation on investment for a given firm is removed. The statistics in the middle rows of Table 3 reflect only the within variation in investment due to misvaluation, not the between variation. Thus, for example, if a high-tech firm in our sample for part of the 1990s overinvested due to overvaluation, only the variation in that firm's overinvestment from one year to another would be reflected in Table 3.

Augmented Fundamental Q

It is possible that the stock market may have information which is not fully reflected in the "econometrician's information set." This problem has been addressed in another context by Fama (1991), who was trying to explain why macroeconomic variables have little explanatory power for stock market returns. Fama argued that stock market participants have additional information about future realizations of macroeconomic variables that is not reflected in the "econometrician's information set." To address this problem, he proposed including actual realizations of future macroeconomic variables. By adding one or two years of actual realizations, Fama found that it was possible to substantially increase the R^2 of a regression of stock market returns on macroeconomic variables. A similar idea has been used by Baker, Stein, and Wurgler (2002).

In this subsection, we introduce a new technique aimed at capturing additional information that agents may have about future realizations of variables. The technique is an extension of Abel and Blanchard (1986) and can be applied to either aggregate or panel data. We use realizations of the variables in Z subsequent to t-1 to capture stock market information not reflected in the "econometrician's information set" at t-1.[6]

Since the technique involves adding information to fundamental Q, we call the resulting variable "augmented fundamental Q." Like fundamental Q, augmented fundamental Q is forward-looking. Also like fundamental Q, it avoids contamination with any biases in the expectations of investors, managers, or analysts. In addition to these advantages of fundamental Q, it incorporates additional information not reflected in $Z_{t-1.}$

[6] Another alternative would be to use analysts' forecasts, as Bond and Cummins (2001) have done. In addition to concerns about the validity of analysts' forecasts that have received considerable publicity in the last several years, a conceptual problem with this approach (given that we are evaluating the effects of sentiment) is that analysts may also be influenced by market sentiment.

We define augmented fundamental Q as:

$$\lambda_t^h \equiv E_{t+h-1}\left[\tilde{\lambda}_t\right] \quad (14)$$

where h refers to the number of additional periods (years) of realizations of the variables in Z that have been incorporated. By incorporating future realizations of the variables in Z, we incorporate information not only about the variables in Z but also about other variables that stock market participants may find useful in forming their expectations.

The expectation of the marginal product of capital, based on the information set at t+h-1 is:

$$E_{t+h-1}\left[M_{t+j}\right] = \begin{cases} M_{t+j} & for \quad j \le h-1 \\ aA^{j-h+1}\tilde{Z}_{t+h-1} & for \quad j > h-1 \end{cases} \quad (15)$$

This implies that the last term in term in augmented fundamental Q (the present value of future marginal products of capital) will be:

$$\lambda_t^h = \sum_{j=0}^{h-1} \overline{R}^j M_{t+j} + E_{t+h-1} \sum_{i=h}^{\infty} \overline{R}^i M_{t+i} \quad (16)$$

where we can resolve the second term on the right hand side as:

$$E_{t+h-1} \sum_{i=h}^{\infty} \overline{R}^i M_{t+i} = \sum_{i=h}^{\infty} \overline{R}^i aA^{i-h+1} \tilde{Z}_{t+h-1} = \overline{R}^h a\left(I - \overline{R}A\right)^{-1} A\tilde{Z}_{t+h-1} \quad (17)$$

By a similar analysis, it is straightforward to show that the expectation of the second term in (5), conditional on the information set in t+h-1, is:

$$\bar{M}(1-\bar{R})^{-1}\left[\sum_{j=0}^{h-1}\bar{R}^{j}R_{t+j}+\bar{R}^{h}b\left(I-\bar{R}A\right)^{-1}A\tilde{Z}_{t+h-1}\right] \quad (18)$$

Thus:

$$\lambda_t^h=\bar{M}(1-\bar{R})^{-1}+\bar{M}(1-\bar{R})^{-1}\left[\sum_{j=0}^{h-1}\bar{R}^{j}R_{t+j}+\bar{R}^{h}b\left(I-\bar{R}A\right)^{-1}A\tilde{Z}_{t+h-1}\right]$$
$$+\sum_{j=0}^{h-1}\bar{R}^{j}M_{t+j}+\bar{R}^{h}a\left(I-\bar{R}A\right)^{-1}A\tilde{Z}_{t+h-1}$$

(19)

The Abel-Blanchard (1986) expression for λ is a special case of (19). When h = 0, the summations in the second and third terms in (19) drop out and the remaining expression (with h set to 0) corresponds to Abel and Blanchard's λ. (There is a slight difference in the expressions because we use a different timing convention.)

Based on the augmented fundamental Q benchmark, glamour firms invest more than is justified by fundamentals, as shown by the mean for glamour firms in the fifth row of Table 3. The investment of typical firms is close to that justified by fundamentals. Value firms underinvest.

The degree of overinvestment by glamour firms is larger based on the augmented fundamental Q benchmark than on the fundamental Q benchmark. The same is true for the difference in investment between glamour and value firms. There are two, mutually compatible, potential explanations. First, fundamental Q conditions on recent sales growth. If investors have extrapolative expectations, unusually high recent sales growth may contribute to investor sentiment.[7] To the extent that high recent sales growth is correlated with glamour status and overinvestment, the fundamental Q benchmark may attribute part of overinvestment to fundamentals. Second, overinvestment is likely to have consequences, specifically including: 1) depressing the marginal product of capital; and 2) inducing lower subsequent investment, as discussed below. Augmented fundamental Q may capture some of these consequences and therefore better reflect the present value of future marginal products of capital.

The difference between the results for fundamental Q and augmented fundamental Q do not arise because the augmented fundamental Q benchmark is less conservative. As in the case of fundamental Q, we include both firm and year effects in the regression used to construct augmented fundamental Q. Because of the inclusion of firm and year effects, the augmented fundamental Q benchmark may also understate the effects of misvaluation.

4. The active financing mechanism

Overvaluation implies that a firm faces a low cost of equity finance. In fact, there is evidence that firms time the market to take advantage of overvaluation.[8] If this affects the firm's discount rate, some formerly negative NPV projects will become worthwhile. We refer to this as the active financing mechanism.

Baker, Stein, and Wurgler (2002) investigate a related issue. Like us, they are interested in whether stock market misvaluation might affect real investment, but their

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[7] As noted elsewhere, Lakonishok, Shleifer, and Vishny (1994) use sales growth as a criterion for forming glamour and value portfolios.

[8] See, for example, Baker and Wurgler (2000) and the references cited therein.

focus is somewhat different. They look at firms that are dependent on equity because they do not have an alternative source of external finance. They find that the investment of equity-dependent firms is more responsive to stock market Q. In contrast, our focus is on glamour firms; i.e., firms that may have many alternative sources of finance but have an unusually good opportunity to use equity finance because of its low cost.

A natural first step in determining whether an active financing mechanism exists is to look at differences in the sources of financing for glamour and value firms. In particular, do glamour firms rely more heavily on equity financing?

We normalize new share issues by investment spending. This allows us to readily address the following question: what percentage of capital expenditures in the current year are financed by new share issues? Normalizing by investment spending does have an important disadvantage, however. Observations with very low values of investment spending have a disproportionate impact on the mean. Instead of reporting the means, we therefore report the median and an additional "aggregated" statistic. Aggregated new share issues (normalized by investment spending) equal (sum of new share issues)/(sum of investment spending), where the sums are taken over a given portfolio in a particular year. Test statistics for the aggregated variables are based on 22 annual observations for each portfolio (1980-2001).

For glamour firms, the median ratio of new share issues to investment spending is about 1.2. For value firms, the median ratio is exactly 0. Thus the median glamour firm raises more from new share issues than it spends on capital goods. Of course, some of the funds that it raises from new share issues may be used to finance investment spending in subsequent years. In contrast, the median value firm does not raise any funds from equity markets.

The aggregated statistics show a similar pattern. In aggregate, glamour firms raise about 60 percent of their investment spending from new share issues. Value firms raise only about 10 percent from new share issues. The difference is highly statistically significant; the t-statistic (based on 22 annual observations) is 3.7.

The evidence in Section 3 shows that glamour firms make substantially larger capital expenditures than other firms. Table 4 shows that glamour firms issue large amounts of new shares, even relative to their high levels of capital expenditures. Together these two pieces of evidence suggest an active financing mechanism, although they do not preclude other possible mechanisms (discussed later) through which sentiment might affect real behavior.

5. Do glamour firms invest too much?

In this section, we introduce four tests designed to distinguish whether the high investment of glamour firms is a result of fundamental shocks or misvaluation shocks: investment reversals, stock market returns of high-investment firms, the time path of marginal products of capital, and overreaction tests.

Investment reversals

Suppose a firm is overvalued and invests too much. It will push its capital stock above the optimal level. Eventually, this will become apparent and the firm will need to reduce investment to achieve the optimal capital stock. Analyzing investment reversals can be thought of as the real counterpart to studies of long-run stock market returns in financial economics. Both are based on the idea that mistakes are eventually reversed. In financial economics, long-run returns studies have been used to provide evidence of temporary overvaluation. We use analysis of possible investment reversals to provide evidence on whether firms temporarily overinvest.

The effect of a fundamental shock can be analyzed in a standard q theory phase diagram. In Figure 1, a favorable fundamental shock shifts the $\dot{q} = 0$ to the right. The stock market price rises and investment is higher than usual along the saddle path to the new steady state.[9] Thus, a favorable fundamental shock leads to higher investment for many periods after a firm becomes a glamour firm.

Now consider a misvaluation shock that temporarily raises a firm's share price. If the shock is sufficiently large, the firm will be pushed into the glamour portfolio. The cost of capital (as perceived by the manager) will fall temporarily and, as a result, the firm's desired capital stock will rise. In a q theory phase diagram, the misvaluation shock will temporarily shift the $\dot{q} = 0$ schedule to the right as illustrated in Figure 2. Investment will temporarily be higher than usual. Then, on the saddle path back to the original steady state, investment will be lower than usual beginning at point R. Thus, a misvaluation shock will lead to a temporary burst of high investment followed by an investment reversal.

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[9] At E, before the shock, $\dot{K} = 0$. Along the saddle path, $\dot{K} > 0$. Thus, along the saddle path, investment is higher than it was before the shock.

In Table 5, we examine investment at the time of portfolio formation and for the subsequent five years.[10] For glamour firms, the median investment/capital ratio falls by about 0.05. This decline is about one-third of the median investment/capital ratio (0.16) at the time of portfolio formation. Arguably, one might want to use the I/K ratio in the year prior to portfolio formation as the point of reference. Additional results (not tabulated in Table 5) show that investment is lower for glamour firms five years after portfolio formation than one year prior to portfolio formation. A nonparametric test of the difference in medians, based on analysis of variance on ranks, yields a Z statistic of 15.7, implying rejection of the null hypothesis of equal medians five years after portfolio formation versus one year prior to portfolio formation (with a p-value of 0.000). Qualitatively similar results hold for the mean I/K ratio. The time path of investment thus seems more consistent with misvaluation shocks than with fundamental shocks.

What about value firms? In the absence of misvaluation, value firms would be the mirror image of glamour firms in the wake of a fundamental shock. An unfavorable fundamental shock shifts the $\dot{q} = 0$ schedule to the left, leading to an immediately lower stock market price and an extended period of lower investment. An unfavorable misvaluation shock immediately reduces q and leads to low investment, eventually followed by a period of higher investment. Because equity financing is not the marginal source of finance for most value firms, an unfavorable misvaluation shock will have a relatively small effect on investment. In Table 5, both the mean and median investment of value firms rise slightly in the five years subsequent to portfolio formation. This evidence is hard to reconcile with fundamental shocks. Fundamental shocks imply that

[10] Note that the entries in the rows for the year of portfolio formation in Table 5 correspond to entries in Table 2.

the investment of value firms should fall over a horizon of several years from the time of portfolio formation, an implication that is decidedly rejected in Table 5.

In Table 6, we repeat the analysis in Table 5, controlling for fundamentals (using the comparable firms benchmark introduced in Section 3). After controlling for fundamentals, the time path of investment for typical firms is flat for the five years after portfolio formation. The time path of median investment for value firms rises slightly. In contrast, even after controlling for time- and sector-specific fundamental shocks, we observe investment reversals for glamour firms. Over the five years subsequent to portfolio formation, the median investment of glamour firms, measured relative to the comparable firm benchmark of fundamentals, declines by more than 60%. The nonparametric test of the difference in medians yields a Z statistic of 9.3, implying rejection of the null hypothesis of equal medians five years after portfolio formation versus one year prior to portfolio formation (with a p-value of 0.000).

To more precisely identify the source of investment reversals, in Figure 3 we divide the portfolio into glamour firms that are overinvesting (relative to fundamentals) at the time of portfolio formation and all other glamour firms. The results are dramatic. It is overinvesting glamour firms that account for investment reversals. The time path of median investment for all other glamour firms is roughly flat (actually rising slightly). In contrast, the median investment of overinvesting glamour firms declines sharply after portfolio formation.

Stock market returns of high-investment firms

If misvaluation plays no role in investment decisions, then firms with high levels of investment all face good investment opportunities. Investment decisions are observable to outside investors and provide a signal to investors that firms have good prospects. Thus, if misvaluation plays no role, there will be no systematic difference between the returns to portfolios of high-investment glamour and value firms.[11]

On the other hand, suppose misvaluation influences investment decisions. Then overvalued firms will tend to overinvest. Eventually, this excess investment will become apparent to investors, leading to lower stock market returns for overvalued firms that have overinvested. Since overvaluation plays little role in the investment decisions of value firms, their returns serve as a useful point of reference: high investment by value firms is indicative of good investment opportunities. Thus, if misvaluation plays a role, high-investment glamour firms will have lower cumulative returns than high-investment value firms at horizons sufficiently long for the excess investment to become apparent to investors. High-investment firms are defined as those with an investment/capital ratio in the top 20% of all firms in a given year.

Table 7 reports the returns of high-investment firms in the year of portfolio formation and cumulative returns over horizons of 1 to 5 years. Returns in the year of portfolio formation are suggestive of misvaluation. Despite the fact that the high levels of investment of this subset of value firms are observable to investors, these value firms experience negative returns in the year of portfolio formation. Of course, this could be because investors have additional information (beyond the high investment levels of these value firms) indicating that these firms are poorly managed or have poor investment

[11] Polk and Sapienza (2002) also examine the relation between high investment and lower subsequent returns, although they do not utilize the cross-sectional variation between glamour and value portfolios.

opportunities. But this is not the case: these high-investment value firms earn high returns in subsequent years.

As suggested by the misvaluation interpretation, high-investment glamour firms have lower cumulative returns than high-investment value firms at the 3, 4, and 5 year horizons after portfolio formation. The differences in returns at all of these horizons are statistically significant.

Does Table 7 simply reflect the value premium?[12] In Table 8, we address this question by comparing the returns of portfolios of high-investment glamour firms and high-investment typical firms. Even compared with typical firms, rather than value firms, high-investment glamour firms earn lower returns. The differences are statistically significant at the 3, 4, and 5 year horizons.

The time path of marginal products of capital

As illustrated on the left-hand side of Figure 4, a favorable fundamental shock shifts out the firm's demand for capital (i.e., the marginal product of capital schedule). At the existing capital stock, the marginal product of capital rises. In steady state, the marginal product of capital equals the user cost of capital. In order to restore this equality, the firm increases its capital stock, causing the marginal product of capital to decline. In the presence of adjustment costs, this process will take several years, leading to a time path of gradually declining marginal products of capital in the wake of a favorable fundamental shock. Thus, fundamental shocks have a clear implication for the

[12] Strictly speaking, the result presented in Table 7 differs from the previously documented fact that value firms outperform glamour firms, because Table 7 focuses exclusively on firms with high levels of investment at the time of portfolio formation.

time path of the marginal product of capital, as illustrated in the graph on the right hand side of Figure 4. A favorable fundamental shock leads to an increasing marginal product of capital around the time of portfolio formation and a declining marginal product capital in subsequent years.

The effect of fundamental shocks is symmetric. Unfavorable fundamental shocks (which will tend to push firms into the value portfolio) will lead to a decreasing marginal product of capital around the time of portfolio formation and an increasing marginal product capital in subsequent years.

If it affects the cost of equity financing, a positive misvaluation shock will shift down the capital supply curve, as illustrated in Figure 5. If the cost of capital (at least as perceived by managers) decreases, the firm will tend to increase its capital stock in an effort to equate the marginal product of capital to the new, lower cost of capital (r_1). Such increases in the capital stock cause the marginal product of capital to decline around the time of portfolio formation. As the misvaluation dissipates, the perceived cost of capital will rise and the desired capital stock will fall. As firms adjust their capital stock downward, the marginal product of capital will rise.

Thus misvaluation shocks also have a clear empirical implication for the time path of the marginal product capital -- exactly the opposite implication of favorable fundamental shocks. A positive misvaluation shock leads to a decrease in the marginal product of capital around the time of portfolio formation and an increase in the marginal product of capital in subsequent years.

Figure 6 plots the marginal product of capital for glamour firms. The time path of the marginal product of capital corresponds better with misvaluation shocks than fundamental shocks. The marginal product of capital declines around the time of portfolio formation and rises in subsequent years.

Misvaluation shocks have asymmetric effects on glamour and value firms. Glamour firms are heavy issuers of new shares (cf. Table 4). For value firms, equity is unlikely to be the marginal source of finance. (The median value firm issues no new shares.) Misvaluation shocks will therefore tend to have a small effect on the marginal product of capital for value firms.

Figure 7 plots the marginal product capital for value firms. There is little change in the marginal product of capital around the time of portfolio formation. The subsequent movement of the marginal product of capital is modest compared to glamour firms.

Overreaction tests

As noted above, Barberis, Shleifer, and Vishny (1998) suggest that misvaluation is driven by extrapolative errors on the part of investors. In particular, they argue that investors tend to see patterns where none exist. For example, a series of positive shocks to sales may give investors the illusion that a firm has moved into a new, higher sales growth regime that will persist for some time.

If firms enter the glamour portfolio because investors make extrapolative errors and there is an active financing mechanism at work, then the response of investment to sales is likely to be stronger for glamour firms than for value firms around the time a firm enters the glamour portfolio. Why? If investors make extrapolative errors, investment responds both to the rational expectations estimate of the increase in the present value of future marginal products of capital (i.e., to the increase in marginal q) and to the stock market overvaluation associated with glamour firms.

A second testable implication of extrapolative errors is that the investment of glamour firms will be more hump-shaped in response to sales. This is because the overvaluation will tend to be transitory. The market eventually realizes that these firms are overvalued. Investment will then decline more for glamour firms than value firms.[13]

To test the first implication (the greater response of investment to sales shocks for glamour firms than value firms), the relevant statistic is the increase in investment from the date of the shock to the peak of the impulse response function. To test the second implication (a more hump-shaped response for glamour firms than value firms), the relevant statistic is the fall in investment from the peak to a specified time (e.g., three years) after the peak. We focus on the change in investment from the peak response to three years after the peak, but the results are not sensitive to this choice.

The tests based on the impulse response function of investment to sales differ from the investment reversals tests because the investment reversals tests do not condition on sales surprises. This VAR approach is especially appealing because it is closely linked to the Barberis, Shleifer, and Vishny (1998) model. (In fact, Lakonishok, Shleifer, and Vishny (1994) use a variable based on recent sales growth as another way of defining glamour firms.) The impulse response function measures *overreaction*.

We implement the overreaction tests by estimating a bivariate VAR of sales (normalized by K) and I/K using two lags. Sales is ordered first in the VAR since, under the assumption that the only shocks are to fundamentals, firms base their investment on

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[13] If fundamental shocks are transitory, the increase in investment for value firms may also be transitory, leading to a hump-shaped response of investment to sales shocks, but the part of the surge in investment that is due to overvaluation in the case of glamour firms will not be present for value firms.

shocks to demand and technology that are reflected in sales. We estimate the VAR for glamour and value firms separately and examine the difference in the impulse response functions.[14] In estimating the VAR, we are careful to include the necessary lagged values of variables for a firm that is in the glamour portfolio in period t even though that firm was not in the glamour portfolio in t-1.

Figure 8 presents the impulse response functions. The rate of investment of glamour firms responds about three times as much as that of value firms to a one standard deviation sales shock. For glamour firms, the increase in I/K is substantial -- about 0.08. The impulse response function for glamour firms is also more hump-shaped than that of value firms, with a much sharper drop in investment after the peak response. I/K drops by about 0.02 for glamour firms from the peak to three years after the peak. For value firms, the decline in I/K from the peak to three years after the peak is less than half as large.[15]

6. How large an effect does misvaluation have on investment?

In previous sections, we have provided evidence on whether misvaluation affects investment. In this section, we provide quantitative estimates of the effect of misvaluation on investment. In order to do this, we must construct a measure of misvaluation. The measure of misvaluation is stock market Q minus fundamental Q.

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[14] Gilchrist, Himmelburg, and Hubermann (2002) also estimate firm-level VARs to evaluate the effect of misvaluation on investment. Their empirical work is aimed at finding a link between a measure of misvaluation (dispersion in analysts' forecasts) and investment. Our test differs, although it also uses VAR techniques.

[15] It is unlikely that the substantially larger response of glamour firms to a sales shock reflects a greater likelihood of glamour firms facing binding finance constraints, since about three-quarters of glamour firms issue new shares in the year of portfolio formation and therefore probably do not encounter major difficulties in accessing external capital markets.

Stock market Q is the market value of the firm's shares divided by the replacement cost of the firm's capital stock. Details are provided in the data appendix.

In standard models of investment, key variables in the determination of investment are the cost of capital, the relative price of investment goods, and output. Lagged I/K is frequently included in investment specifications to allow for dynamics. In Table 9, we present a generic investment specification in which I/K is regressed on the lagged percentage changes in real sales, the relative price of investment goods, and the cost of capital, lagged I/K, and misvaluation for the full sample of observations for which all the necessary data are available.

The coefficient on misvaluation in the generic investment specification is positive and highly significant (with a t statistic of 59). The coefficient estimate of 0.0015 implies that a one standard deviation increase in misvaluation increases I/K by 0.035 (a little over 20 percent of the mean I/K of 0.153).

Much recent research has suggested that investment is sensitive to cash flow, so in the second column of Table 9 we estimate a similar specification, this time including the ratio of cash flow to the capital stock.[16] Including cash flow in the specification has little effect on the misvaluation coefficient.

The neoclassical investment model [Jorgenson (1967), Hall and Jorgenson (1971), Eisner and Nadiri (1968)] suggests a specification in which investment is regressed on distributed lags of the change in output and the cost of capital and on lagged investment. In Table 10, we add misvaluation to a standard neoclassical investment specification. The coefficient on misvaluation is similar to the coefficient in the generic investment

[16] A leading interpretation is that cash flow enters due to finance constraints [Fazzari, Hubbard, and Petersen (1988)]. See Hubbard (1998) for a survey. This interpretation has been contested by Kaplan and Zingales (1998) and Gomes (2001).

specification and is again highly significant, with a t statistic of 56. Including cash flow in the specification has little effect on the misvaluation coefficient.

The flexible accelerator model is similar to the neoclassical model except that the cost of capital terms are omitted. As column 3 and 4 of Table 10 show, misvaluation also has and economically and statistically significant effect on investment in the flexible accelerator model.

Finally, in Table 11, we estimate a Q model of investment. A conceptual advantage of the Q model is that Q, unlike the variables that appear in the generic, neoclassical, or flexible accelerator specifications, is explicitly forward-looking. A potential problem with the Q model is that stock market Q will be affected by any misvaluation in the stock market. To avoid this problem, we use fundamental Q in the regression. Like stock market Q, fundamental Q reflects expectations of future discount rates and the future stream of marginal products of capital.

The coefficient on misvaluation in the Q specification is larger than the estimated coefficients in previous tables, possibly because Q does a better job of capturing fundamentals. The estimated coefficient on misvaluation is 0.0020. This implies that a one standard deviation increase in misvaluation raises I/K by 0.048 -- slightly more than 30%, relative to the sample mean of I/K. Again, the estimated effect of misvaluation is highly significant, with a t statistic of 74. Specifications including and excluding cash flow are presented in the table; the coefficient estimates and t statistics for misvaluation are similar, irrespective of whether or not cash flow is included in the specification.

7. Active financing mechanism or managerial excess optimism?

The above evidence shows that glamour firms are issuing large amounts of new shares, making substantially larger capital expenditures than other firms (even after accounting for fundamentals in various ways), and subsequently reversing those capital expenditures. This behavior suggests an active financing mechanism where equity misvaluations temporarily lower the cost of equity and temporarily stimulate investment. However, there are other possible mechanisms through which sentiment might affect investment.

As noted above, a leading explanation of underreaction and overreaction in the stock market [Barberis, Shleifer, and Vishny (1998)] is based on extrapolative expectations by investors. Managers could suffer from similar behavioral biases. In particular, managers might depart from rational expectations. Psychological evidence suggests that individuals tend to see patterns even when no patterns are present (as, for example, when a data series is produced by a random number generator). For example, sales might be generated by a random walk with drift, but managers might see high and low growth regimes. A sequence of positive shocks to sales might lead managers to believe that they were in a new high-growth regime and to extrapolate future sales based on expectations of continued high growth. As Barberis, Shleifer, and Vishny (1998) show, departures from rational expectations need not be large in order to induce substantially different economic behavior. For example, they provide evidence that even sophisticated econometric procedures would require very long time series of data to distinguish between a random walk and regime switching. Yet, if investors interpret the data in terms of regime switching when the actual data correspond to a random walk, phenomena (such as underreaction and overreaction) appear that would not appear in a market where investors had rational expectations.

If managers have extrapolative expectations, then they may sometimes become excessively optimistic and invest in negative NPV projects. To the extent that managerial excess optimism is correlated with broader investor sentiment in the stock market (as seems plausible), overvaluation will be linked with high investment.

Empirically, it is difficult to distinguish between an active financing mechanism and managerial excess optimism. For example, proxies for managerial expectations based on publicly available information may actually measure investor sentiment, and it could be investor excess optimism that leads to overvaluation, cheap equity financing, and high investment. A clean test would therefore be one that depends on information available to managers but not outside investors and on managerial actions that are not driven by current overvaluation. If a test depends on information that is available to outside investors, then it may capture investor sentiment rather than managerial excess optimism. A test that is based on managerial actions that might be motivated by overvaluation (such as new share issues) would also fail to distinguish between an active financing mechanism and managerial excess optimism.

One set of tests that avoids both of these difficulties is based on managers' personal investment decisions. The first measure of managerial excess optimism (the ownership measure) focuses on whether the CEO is a net buyer of shares in the firm in the current year. A second measure of managerial optimism (the options measure) is based on how long the CEO holds options. First, we choose a threshold by which an option is in the money, specifically 67%.[17] We create a dummy variable that is equal to 1 if the option exceeds this threshold five years after it is granted and if the CEO fails to exercise at least part of the options package before or during the fifth year after the options are granted. (We wait until five years after the grant of the option to ensure that at least some portion of the option package is beyond the vesting period.) Our measure is close to the Malmendier and Tate (2002) measure of overconfidence, but we are trying to measure managerial excess optimism at a particular moment in time, rather than a general managerial characteristic of overconfidence. The key difference is that our measure of managerial excess optimism is allowed to vary over time.

The active financing mechanism suggests that overvaluation leads to a low cost of equity financing and that firms issue new shares to take advantage of the opportunity for cheap financing. A natural measure of the active financing mechanism is the volume of new share issues. We normalize the dollar value of new share issues by the capital stock.

Our tests focus on differences in investment expenditures among glamour firms. Since we are interested in the question of what mechanisms are responsible for overinvestment, the dependent variable is overinvestment (based on the comparable firms benchmark). The independent variables are the measures of the active financing mechanism and managerial excess optimism.

The active financing mechanism predicts that the active financing measure should enter with a positive coefficient. Managerial excess optimism predicts that the managerial excess optimism measures should enter with a positive coefficient. On the other hand, suppose managers are not affected by sentiment. There are two possible interpretations of the managerial excess optimism variables. First, managers who

[17] Malmendier and Tate (2002), in a related exercise, set thresholds of 67% and 100% in the money.

increase their ownership stake in their own firm will have their incentives more firmly aligned with shareholders and will be more reluctant to overinvest. Second, managers who increase their ownership stake may have private signals of favorable investment opportunities. Both of these interpretations predict that the managerial excess optimism variables should enter with a negative coefficient.

Table 12 presents OLS estimates, including year effects. The first column of Table 12 provides support for the active financing mechanism. The active financing mechanism variable enters with a positive coefficient and a t statistic of 9.

The second column of Table 12 provides evidence against managerial excess optimism. The coefficient on the ownership measure is negative and significant. In contrast, the third column provides some support for managerial excess optimism. The coefficient on the options measure is positive and significant.

The next two columns provide horse races between the active financing mechanism and managerial excess optimism. When both variables are entered, the results are qualitatively and quantitatively similar to the regressions with a single independent variable. The horse races continue to provide evidence for the active financing mechanism. As in the regressions reported in columns two and three, the evidence on managerial excess optimism is equivocal, depending on which measure we use.

The remaining five columns of Table 12 replicate the first five columns, this time including both industry and year effects. The only feature that differs from the preceding results is the significance of the coefficient on the options measure of managerial excess optimism; in columns eight and ten, the coefficient remains positive but is no longer significant.

It is possible that overinvestment is imprecisely measured. One solution is to treat overinvestment as a categorical variable. We define an overinvestment indicator variable that is equal to 1 if an observation is among the 20% of observations with the highest overinvestment (based on the comparable firms benchmark), 0 otherwise. In Table 13, we estimate a Probit regression with the same independent variables as in Table 12. The results are similar to those presented in Table 12. The active financing mechanism variable always enters with a positive sign and is generally significant.[18] The ownership measure of managerial excess optimism always enters with a negative coefficient and the options measure always enters with a positive coefficient (although it is insignificantly different from 0).

Tables 12 and 13 provide consistent evidence for the active financing mechanism. The evidence on managerial excess optimism is less clear. The ownership measure provides evidence against managerial excess optimism. The options measure provides evidence for managerial excess optimism, but this evidence is statistically weaker.

8. Conclusion

Do glamour firms invest more than value firms? The raw data show that they do -- about 50% more around the time of portfolio formation. The higher investment of glamour firms could be due to more favorable investment opportunities or overinvestment. We consider three different approaches designed to measure investment

[18] The only exception is when we include the options measure in the regression. Because of limited data availability, this reduces the sample to fewer than 250 observations.

opportunities and determine whether better fundamentals account for the higher investment of glamour firms. Each of these measures suggests that glamour firms invest more than is justified by fundamentals and that the difference between the investment of glamour and value firms cannot be accounted for by differences in investment opportunities.

What mechanisms might translate stock market overvaluation into excess investment? One possibility is an active financing mechanism. We find that the median glamour firm raises more in new share issues than its total capital expenditures for the year, despite the fact that the capital expenditures of glamour firms are high. More precisely, the median ratio of new share issues to capital expenditures for glamour firms is 1.2. In contrast, the new share issues of the median value firm are 0.

We present four new tests designed to determine whether glamour firms invest too much. One sign that firms invest too much would be retrenchment after a burst of overinvestment. For glamour firms, we find evidence of investment reversals. The magnitude of the investment reversals is substantial: glamour firms invest one-third less (relative to their capital stock) 5 years after portfolio formation than they did at the time of portfolio formation.

A second test compares the returns of subsets of high-investment firms. If fundamentals determine investment, high-investment firms should all have good investment opportunities regardless of whether they are glamour or value firms at the time of portfolio formation. On the other hand, if overvaluation induces some glamour firms to overinvest, high-investment glamour firms will tend to have low subsequent returns. The data show that high-investment glamour firms have significantly lower returns than high-investment value firms.

Third, we examine the path through time of the marginal product of capital. If a favorable fundamental shock pushes a firm into the glamour portfolio, the marginal product of capital should rise around the time of portfolio formation and fall subsequently as the firm gradually increases its capital stock. If a misvaluation shock pushes a firm into the glamour portfolio, the capital supply curve shifts down (as the equity cost of finance decreases) and the marginal product of capital falls around the time of portfolio formation (as the firm equates its marginal product of capital with a lower cost of capital). Eventually, the marginal product of capital rises as the misvaluation dissipates. In the data, the marginal product of capital falls around the time of portfolio formation for glamour firms and rises subsequently.

Fourth, we introduce a new type of overreaction test based on a comparison of the reaction of glamour and value firms to sales shocks. We find that the investment of glamour firms responds about three times as much as that of value firms to a one standard deviation sales shock.

How large an effect does misvaluation have on investment? We present parametric estimates based on four standard investment specifications -- a generic investment specification, the neoclassical model, the flexible accelerator model, and the Q model. Coefficient estimates from the first three specifications imply that a one standard deviation increase in misvaluation raises investment by more than 20%. Coefficient estimates from the Q model imply a larger effect, suggesting that a one standard deviation increase in misvaluation raises investment by more than 30%.

Firms might overinvest because they base their investment decisions on a temporarily cheap cost of equity finance. They might also overinvest because managers sometimes succumb to the same forces of sentiment that affect outside investors, a phenomenon that we dub "managerial excess optimism." Both mechanisms might play a role. We present tests designed to differentiate between the active financing mechanism and managerial excess optimism. We find consistent evidence for the active financing mechanism but equivocal evidence on managerial excess optimism.

While the evidence presented in this paper should be viewed as preliminary, it points towards the view that stock market misvaluations have real effects by lowering the perceived cost of finance for some glamour firms.

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Data appendix

Construction of Glamour and Value Portfolios

We construct the glamour and value portfolios using the sales/price ratio. The sales/price ratio is Net Sales (CompuStat item 12) divided by Common Shares Outstanding (CompuStat item 25) times Price – Fiscal Year – Close (CompuStat item 199). Observations with missing or non-positive values for the sales/price ratio are dropped. The remaining observations for a given year are sorted into deciles. The top two deciles are classified as value firms (i.e., firms with low stock market prices relative to the sales/price ratio). The bottom two deciles are classified as glamour firms (i.e., firms with high stock market prices), and the remaining deciles are classified as typical

Capital Stock and Investment

For the first observation for firm f, the capital stock is based on the net plant (NPLANT), the nominal book value of net property, plant, and equipment (CompuStat item 8). To convert this to real terms, we divide by the sector-specific price index for investment (p^I). Since book value is not adjusted for past changes in the value of capital equipment, we adjust the initial capital stock using a sector-specific adjustment factor (AF):

$$K_{f,t_0^f} = \frac{NPLANT_{f,t_0^f}}{p^I_{s,t_0^f}} \; AF_s$$

where s is a sector index (for firm f's sector) and t_0^f is the year of the first observation for firm f.

For subsequent observations, a standard perpetual inventory method is used to construct the capital stock,

$$K_{f,t+1} = (1-\delta_{s,t})K_{f,t} + \frac{KCHG_{f,t}}{p^{I}_{s,t}}$$

where δ is the depreciation rate and KCHG is gross additions to the firm's capital stock. The firm reports the additions in nominal terms, so we divide by p^I to convert to real terms.

In the standard case, KCHG is gross investment (I), which is capital expenditures in the firm's financial statements (CompuStat item 128). CompuStat does not always have reliable data for the additions to the capital stock associated with large acquisitions. We use a modified version of the algorithm of Chirinko, Fazzari, and Meyer (1999) to adjust KCHG for acquisitions and divestitures. In the case of a substantial acquisition, we can use accounting identities to derive a more accurate measure of the additions to the capital stock:

$$DGPLANT_{f,t} = I_{f,t} + ACQUIS_{f,t} - RETIRE_{f,t}$$

where $DGPLANT_t$ is the change in GPLANT from the end of year t-1 to the end of year t and $GPLANT_t$ is gross property, plant, and equipment (CompuStat item 7), ACQUIS is acquisitions, and RETIRE is retirements of capital stock (CompuStat item 184). (When data on RETIRE is missing, we assume that the reason is that firms do not report any retirements in their financial statements, and we therefore assign a value of 0 to RETIRE for these observations.) We use the following screen to identify cases where there has been a substantial acquisition. If

$$\frac{DGPLANT_{f,t} - I_{f,t}}{GPLANT_{f,t-1}} > 0.1$$

then we calculate the gross change in the capital stock as

$$KCHG_t = DGPLANT_t + RETIRE_t$$

We also account for substantial divestitures, using the following screen. If

$$\frac{DGPLANT_{f,t} + RETIRE_{f,t}}{GPLANT_{f,t-1}} < -0.1$$

we calculate the change in the capital stock as

$$KCHG_{f,t} = DNPLANT_{f,t} + \delta K_{f,t-1} p^I_{s,t}$$

where DNPLANT is the change in NPLANT (as defined above).[19] Because NPLANT in the firm's financial statements will deduct depreciation (as well as accounting for the divestiture), depreciation must be added to KCHG to avoid deducting depreciation twice.

If $GPLANT_{f,t-1}$ is missing (or equal to zero) or $DGPLANT_{f,t}$ is missing, it is not feasible to use these screens, and we set KCHG equal to I.

In some cases, there is a data gap for a particular firm. In this case, we treat the first new observation for that firm in the same way as we would if it were the initial observation. This avoids any potential sample selection bias that would result from dropping firms with gaps in their data.

We construct sector-specific, time-varying depreciation rates using data from the BEA. Specifically,

$$\delta_{s,t} = \frac{D\$_{s,1996} DQUANT_{s,t}}{K\$_{s,1996} KQUANT_{s,t}}$$

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[19] To see this result, start with the perpetual inventory equation.

$$K_t = I_t + (1-\delta)K_{t-1}$$

$$K_t - K_{t-1} + \delta K_{t-1} = I_t$$

Now, put the previous equation in nominal terms.

$$[K_t - K_{t-1}]p^I_t + \delta K_{t-1} p^I_t = I_t p^I_t$$

$$DNPLANT + \delta K_{t-1} p^I_t = I_t p^I_t = KCHG$$

where D$ is current-cost depreciation of private fixed assets by sector (BEA, Table 3.4ES), DQUANT is the chain-type quantity index of depreciation of private fixed assets by sector (BEA, Table 3.5ES), K$ is the current cost net stock of private fixed assets by sector (as defined above), and KQUANT is the chain-type quantity index of the net stock of private fixed assets by sector (BEA, Table 3.2ES).

We construct the sector-specific price index for investment using BEA data:

$$p_{s,t}^{I} = \frac{100(I\$_{s,t} / I\$_{s,1996})}{IQUANT_{s,t}}$$

where I$ is historical-cost investment in private fixed assets by sector (BEA, Table 3.7ES) and IQUANT is the chain-type quantity index of investment in private fixed assets by sector (BEA, Table 3.8ES).

Table 1
Summary Statistics

	N	Mean	25%	50%	75%	Std Deviation	Skewness	Kurtosis
I	97958	115.200	0.694	4.986	34.492	661.182	28.135	1761.545
K	97958	1464.787	9.519	53.061	370.318	6892.648	13.227	254.928
I/K	97958	0.153	0.040	0.089	0.182	0.196	3.097	12.372
Sales Growth	96774	0.523	-0.037	0.078	0.243	23.183	234.681	64218.468
Sales/K	97958	4.144	0.597	1.848	4.187	10.424	18.437	721.620
Cost/K	97958	4.117	0.619	1.844	4.148	10.298	17.851	663.992
MPK	97958	0.027	0.018	0.128	0.342	2.598	-20.184	1004.068
NSI	94655	17.494	0.000	0.137	2.630	153.549	46.390	3583.814
Returns	70872	0.160	-0.275	0.030	0.364	0.894	8.584	185.567

See the Data Appendix for variable definitions.

Table 2
Investment of Glamour, Typical, and Value Firms

	Glamour	Typical	Value	Difference (Glamour vs Value)	Test Statistic [p-Value]
Mean	0.269	0.155	0.105	0.164	71.33 [0.000]
Median	0.156	0.100	0.068	0.087	58.65 [0.000]

The table presents investment/capital (I/K) ratios. Glamour, typical, and value portfolios are based on the sales/price ratio. See the Data Appendix for variable definitions and portfolio construction.

Table 3
Investment of Glamour, Typical, and Value Firms
Controlling for Fundamentals

	Glamour	Typical	Value	Difference (Glamour vs. Value)	Test Statistic [p-value]
Comparable Firm Benchmark					
Mean	0.096	-0.007	-0.058	0.154	62.50 [0.000]
Median	0.052	0.003	-0.027	0.079	57.68 [0.000]
Fundamental Q Benchmark					
Mean	0.012	-0.002	-0.015	0.026	15.88 [0.000]
Median	-0.004	-0.009	-0.014	0.010	9.00 [0.000]
Augmented Fundamental Q Benchmark					
Mean	0.027	-0.005	-0.027	0.054	30.97 [0.000]
Median	-0.013	-0.020	-0.031	0.018	16.81 [0.000]

This table presents investment/capital (I/K) ratios relative to three different benchmarks for fundamentals (described more fully in the text). The test statistic for the difference in medians is a nonparametric test based on analysis of variance on ranks. Glamour, typical, and value portfolios are based on the sales/price ratio. See the Data Appendix for variable definitions and portfolio construction.

Table 4
New Share Issues

	Glamour	Value	Difference	Test Statistic [p-value]
Median	1.196	0.000	1.196	105.92 [0.000]
Aggregated (standard deviation)	0.584 (0.246)	0.114 (0.041)	0.470 (0.205)	3.71 [0.001]

Scaled by investment spending. Aggregated new share issues equal (sum of new share issues)/(sum of investment spending), where the sums are taken over a given portfolio in a particular year. Test statistics for the aggregated variables are therefore based on 22 annual observations for each portfolio (1980-2001). The test statistic for the difference in medians is a nonparametric test based on analysis of variance on ranks. See the Data Appendix for variable definitions and portfolio construction.

Table 5
Investment After Portfolio Formation

Years after portfolio formation	Glamour	Typical	Value	Difference G vs. V	Test Statistic [p-value]
0					
Mean	0.269176	0.155449	0.105237	0.163939	71.33 [0.000]
Median	0.155739	0.100006	0.068373	0.087366	58.65 [0.000]
1					
Mean	0.236327	0.149607	0.113110	0.123217	51.62 [0.000]
Median	0.143883	0.099781	0.069689	0.074194	46.56 [0.000]
2					
Mean	0.201427	0.142600	0.119824	0.081603	34.00 [0.000]
Median	0.128337	0.096656	0.075028	0.053309	31.68 [0.000]
3					
Mean	0.178128	0.137585	0.125413	0.052715	21.42 [0.000]
Median	0.115389	0.094045	0.080254	0.035135	19.92 [0.000]
4					
Mean	0.163467	0.134401	0.125027	0.038440	15.18 [0.000]
Median	0.107663	0.092717	0.080949	0.026714	13.96 [0.000]
5					
Mean	0.154513	0.130679	0.124268	0.030245	11.41 [0.000]
Median	0.103196	0.090887	0.083068	0.020128	9.97 [0.000]

This table presents investment/capital (I/K) ratios. The test statistic for the difference in medians is a nonparametric test based on analysis of variance on ranks. Glamour, typical and value portfolios are based on the sales/price ratio. See the Data Appendix for variable definitions and portfolio construction.

Table 6
Investment After Portfolio Formation
Controlling for Fundamentals

Years after portfolio formation	Glamour	Typical	Value	Difference G vs. V	Test Statistic [p-value]
0					
Mean	0.09580	-0.00745	-0.05841	0.15421	62.50 [0.000]
Median	0.05233	0.00282	-0.02682	0.07915	57.68 [0.000]
1					
Mean	0.09507	-0.00729	-0.05754	0.15261	61.31 [0.000]
Median	0.05553	0.00275	-0.02827	0.08380	57.63 [0.000]
2					
Mean	0.06556	-0.00347	-0.04386	0.10942	45.60 [0.000]
Median	0.03675	0.00214	-0.02368	0.06043	42.33 [0.000]
3					
Mean	0.05082	-0.00260	-0.03426	0.08508	34.87 [0.000]
Median	0.02819	0.00159	-0.02096	0.04915	31.77 [0.000]
4					
Mean	0.04303	-0.00263	-0.02756	0.07059	27.41 [0.000]
Median	0.02247	0.00092	-0.01788	0.04035	25.42 [0.000]
5					
Mean	0.03793	-0.00297	-0.02181	0.05974	22.03 [0.000]
Median	0.01837	0.00036	-0.01483	0.03320	21.13 [0.000]

This table presents investment/capital (I/K), controlling for fundamentals. The control for fundamentals is I/K for comparable firms (those in the same industry in the same year). Mean I/K for comparable firms is subtracted from the firm's I/K to obtain the statistics for means, median I/K to obtain the statistics for medians. The test statistic for the difference in medians is a nonparametric test based on analysis of variance on ranks. Glamour, typical, and value portfolios are based on the sales/price ratio. See the Data Appendix for variable definitions and portfolio construction.

Table 7
Cumulative Returns of High-investment Firms
(reported as average annual returns)

Returns over	Glamour	Value	Difference G vs. V	Test Statistic [p-value]
Initial year	0.465	-0.056	0.521	4.12 [0.001]
1 year	0.100	0.128	-0.028	-0.40 [0.692]
2 years	0.043	0.099	-0.057	-1.57 [0.131]
3 years	0.048	0.101	-0.053	-2.17 [0.042]
4 years	0.059	0.118	-0.058	-2.95 [0.008]
5 years	0.071	0.117	-0.046	-2.47 [0.022]

The returns in the row labeled Initial Year are for the year of portfolio formation. The remaining returns are cumulative (for the N years subsequent to portfolio formation). The columns labeled Glamour and Value present returns for the subset of high-investment firms in the glamour and value portfolios, respectively. High-investment firms are defined as those that have investment/capital ratios in the top 20% for all firms in the sample in the given year. Glamour and value portfolios are based on the sales/price ratio. See the Data Appendix for variable definitions and portfolio construction.

Table 8
Cumulative Returns of High-investment Firms
(reported as average annual returns)

Returns over	Glamour	Typical	Difference G vs. T	Test Statistic [p-value]
Initial year	0.465	0.142	0.323	3.65 [0.002]
1 year	0.100	0.143	-0.043	-1.03 [0.316]
2 years	0.043	0.076	-0.033	-1.50 [0.148]
3 years	0.048	0.083	-0.035	-2.42 [0.025]
4 years	0.059	0.083	-0.024	-2.14 [0.044]
5 years	0.071	0.092	-0.021	-2.08 [0.050]

The returns in the row labeled Initial Year are for the year of portfolio formation. The remaining returns are cumulative (for the N years subsequent to portfolio formation). The columns labeled Glamour and Typical present returns for the subset of high-investment firms in the glamour and typical portfolios, respectively. High-investment firms are defined as those that have investment/capital ratios in the top 20% for all firms in the sample in the given year. Glamour and typical portfolios are based on the sales/price ratio. See the Data Appendix for variable definitions and portfolio construction.

Table 9
Parametric Estimates of The Effect of Misvaluation on Investment
Generic Investment Specification

	(1)	(2)
Output	0.000001 (0.000021) [0.06]	0.000002 (0.000021) [0.09]
Relative Price of Investment Goods	-0.049789 (0.006352) [-7.84]	-0.050148 (0.006343) [-7.91]
Cost of Capital	-0.000361 (0.001727) [-0.21]	-0.000273 (0.001724) [-0.16]
Lagged I/K	0.434994 (0.003074) [141.53]	0.435297 (0.003070) [141.81]
Cash Flow		0.007069 (0.000436) [16.23]
Misvaluation	0.001486 (0.000025) [59.49]	0.001478 (0.000025) [59.25]
Constant	0.056379 (0.003010) [18.73]	0.055475 (0.003006) [18.46]
Number of Obs	63189	63105
Number of Firms	9172	9165
F	1193.30	1159.94
Prob. > F	0.0000	0.0000
R^2	0.3208	0.3235

Each cell shows the point estimate, standard error (in parenthesis), and t statistic (in brackets). Output, the relative price of investment goods, and the cost of capital enter as lagged percentage changes. Cash flow is the ratio of cash flow to the capital stock. Misvaluation is the difference between stock market Q and fundamental Q, as defined in the text.

Table 10

Parametric Estimates of The Effect of Misvaluation on Investment
Neoclassical and Accelerator Specifications

	Neoclassical (1)	(2)	Accelerator (3)	(4)
Output $_t$	0.000081 (0.000019) [4.24]	0.000081 (0.000019) [4.23]	0.000081 (0.000019) [4.24]	0.000081 (0.000019) [4.24]
Output $_{t-1}$	-0.000003 (0.000019) [-0.18]	-0.000003 (0.000019) [-0.17]	-0.000004 (0.000019) [-0.19]	-0.000004 (0.000019) [-0.18]
Output $_{t-2}$	0.000004 (0.000019) [0.21]	0.000005 (0.000019) [0.24]	0.000005 (0.000019) [0.25]	0.000005 (0.000019) [0.28]
Cost of Capital $_t$	-0.009298 (0.001611) [-5.77]	-0.009415 (0.001609) [-5.85]		
Cost of Capital $_{t-1}$	-0.010920 (0.001658) [-6.59]	-0.010935 (0.001657) [-6.60]		
Cost of Capital $_{t-2}$	-0.006708 (0.001556) [-4.31]	-0.006822 (0.001554) [-4.39]		
Lagged I/K	0.453248 (0.003360) [134.91]	0.452636 (0.003357) [134.82]	0.454531 (0.003357) [135.40]	0.453935 (0.003355) [135.32]
Cash Flow		0.005900 (0.000454) [13.00]		0.005888 (0.000454) [12.96]
Misvaluation	0.001488 (0.000026) [56.38]	0.001472 (0.000026) [55.79]	0.001489 (0.000026) [56.38]	0.001473 (0.000026) [55.79]
Constant	0.061803 (0.002938) [21.04]	0.061233 (0.002934) [20.87]	0.053086 (0.002921) [18.18]	0.071225 (0.002948) [24.16]
Number of Obs	55869	55797	55869	55797
Number of Firms	8035	8029	8035	8029
F	970.65	944.09	1083.53	1049.49
Prob. > F	0.0000	0.0000	0.0000	0.0000
R^2	0.3274	0.3293	0.3266	0.3285

Each cell shows the point estimate, standard error (in parenthesis), and t statistic (in brackets). Output and the cost of capital enter as percentage changes. Cash flow is the ratio of cash flow to the capital stock. Misvaluation is the difference between stock market Q and fundamental Q, as defined in the text.

Table 11
Parametric Estimates of The Effect of Misvaluation on Investment
Q Specification

	(1)	(2)
Fundamental Q	0.014889 (0.000314) [47.49]	0.017139 (0.000364) [47.12]
Cash Flow		-0.006887 (0.000571) [-12.06]
Misvaluation	0.002043 (0.000028) [73.72]	0.002041 (0.000028) [73.71]
Constant	0.050559 (0.003651) [13.85]	0.058643 (0.003788) [15.48]
Number of Obs	63222	63137
Number of Firms	9176	9169
F	445.26	432.31
Prob. > F	0.0000	0.0000
R^2	0.1342	0.1361

Each cell shows the point estimate, standard error (in parenthesis), and t statistic (in brackets). Cash flow is the ratio of cash flow to the capital stock. Misvaluation is the difference between stock market Q and fundamental Q, as defined in the text.

Table 12
Active Financing Mechanism or Managerial Excess Optimism?
OLS Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Active financing mechanism (new share issues)	0.0237			0.0241	0.0608	0.0200			0.0185	0.0594
	(9.30)			(7.76)	(2.13)	(8.12)			(6.08)	(2.03)
Managerial excess optimism (ownership measure)		-0.1031		-0.1004			-0.0659		-0.0623	
		(-5.32)		(-5.13)			(-3.49)		(-3.25)	
Managerial excess optimism (options measure)			0.0667		0.0590			0.0354		0.0237
			(2.72)		(2.32)			(1.37)		(0.91)
CONSTANT	0.1912	0.2464	0.1079	0.2255	0.0939	0.0271	0.0622	-0.0098	0.1011	0.1415
	(22.60)	(21.56)	(7.92)	(18.67)	(6.13)	(0.20)	(0.39)	(-0.05)	(0.64)	(0.61)
N	1301	1034	256	947	239	1299	1031	254	945	239
F	86.45	28.33	7.38	44.94	5.92	6.36	5.21	2.35	6.15	2.65
Prob. > F	0.0000	0.0000	0.0070	0.0000	0.0031	0.0000	0.0000	0.0001	0.0000	0.0000
R2	0.0624	0.0267	0.0282	0.0869	0.0478	0.2098	0.2031	0.2996	0.2436	0.3420

Table 13
Active Financing Mechanism or Managerial Excess Optimism?
Probit Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8
Active (new share issues)	0.0741			0.0635	0.3850	0.0565		
	(4.71)			(3.76)	(1.84)	(3.45)		
Managerial excess optimism (ownership measure)		-0.4200		-0.4091			-0.2861	
		(-5.08)		(-4.72)			(-3.14)	
Managerial excess optimism (options measure)			0.2004		0.2421			0.06
			(1.18)		(1.34)			(0.2
CONSTANT	-0.0405	0.1305	-0.2798	0.0854	-0.3886	-0.0713	-0.5393	0.04
	(-1.09)	(2.70)	(-2.93)	(1.61)	(-3.51)	(-0.11)	(-0.67)	(0.0
N	1301	1034	256	947	239	1267	1010	22
LR chi2(1)	27.69	25.99	1.38	40.44	6.29	195.51	190.31	48.
Prob. > chi2	0.0000	0.0000	0.2400	0.0000	0.0431	0.0000	0.0000	0.01
Psuedo R2	0.0154	0.0181	0.0040	0.0308	0.0194	0.1114	0.1359	0.15

Figure 1

q Theory

Favorable Fundamental Shock

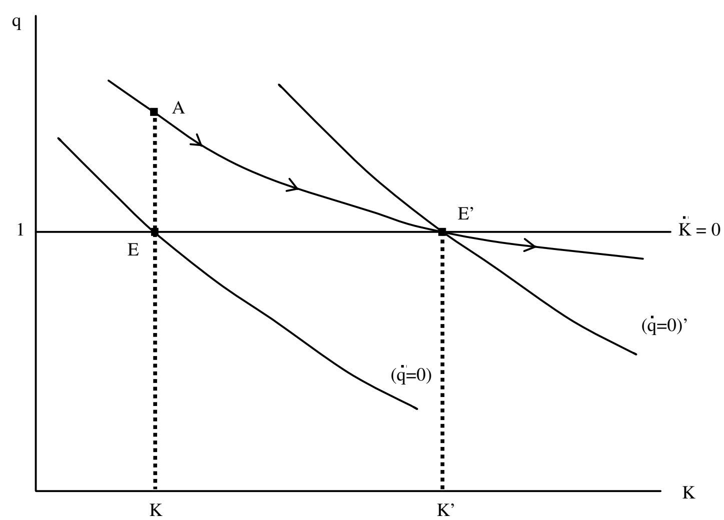


Figure 2

q Theory

Favorable Misvaluation Shock

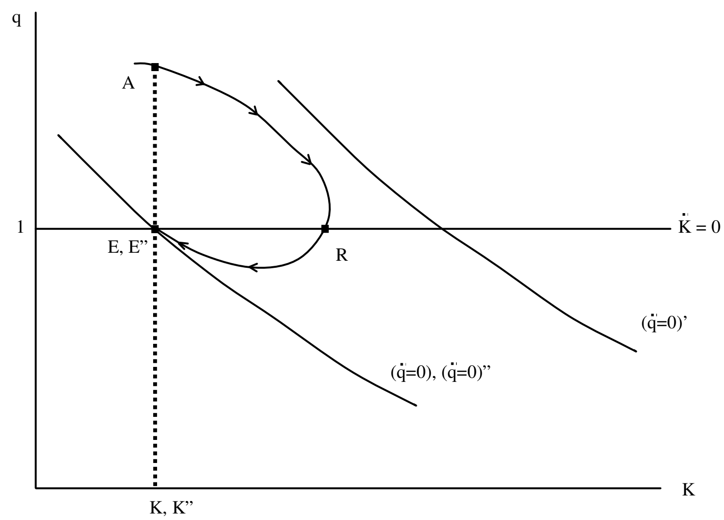


Figure 3

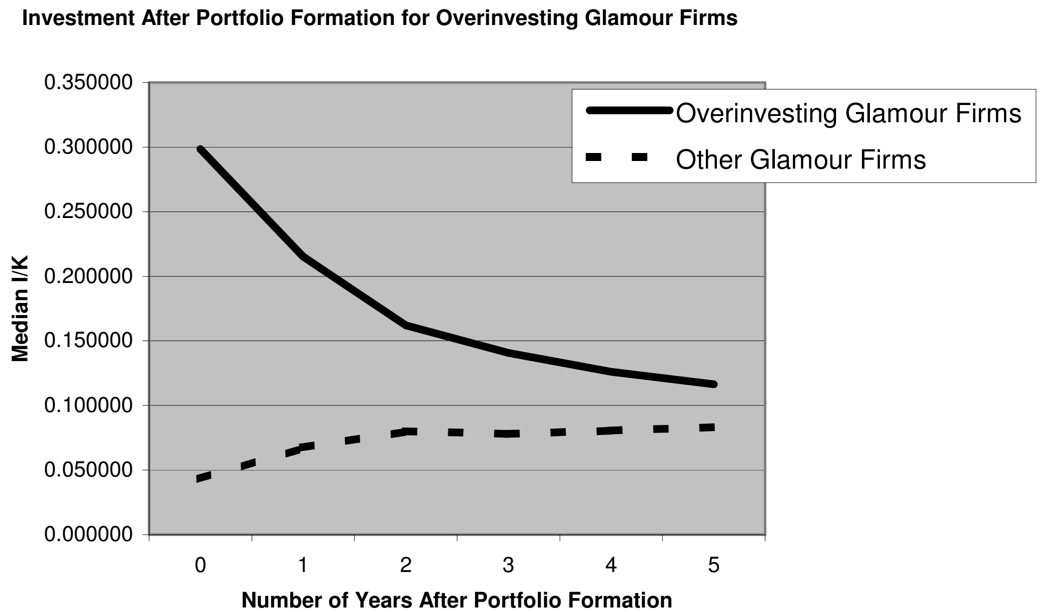

Investment After Portfolio Formation for Overinvesting Glamour Firms
Median I/K
0.350000
0.300000
0.250000
0.200000
0.150000
0.100000
0.050000
0.000000
0
1
2
3
4
5
Number of Years After Portfolio Formation
Overinvesting Glamour Firms
Other Glamour Firms

Figure 4

Supply and Demand for Capital

Favorable Fundamental Shock

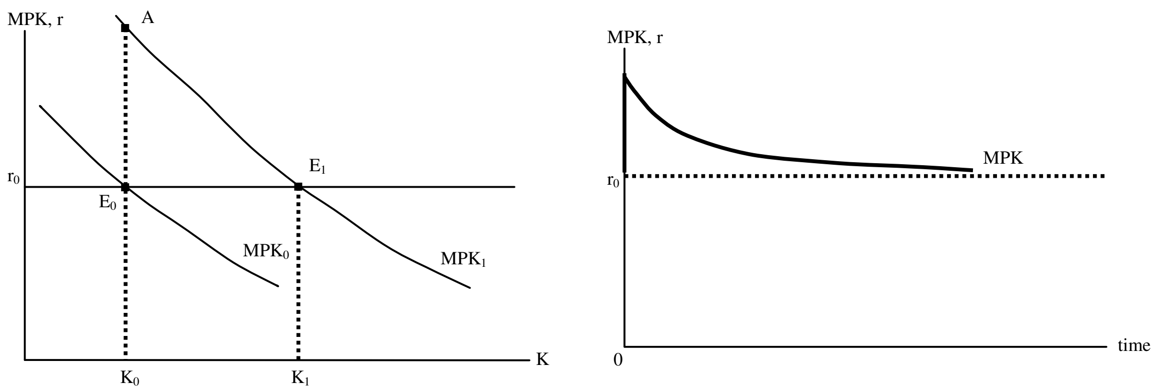


Figure 5

Supply and Demand for Capital

Favorable Misvaluation Shock

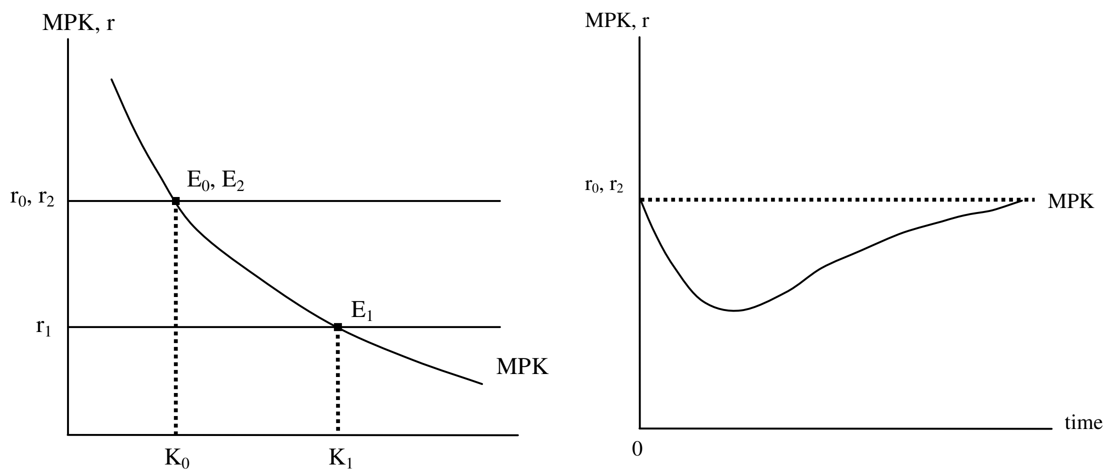


Figure 6

Marginal Product of Capital: Glamour Firms

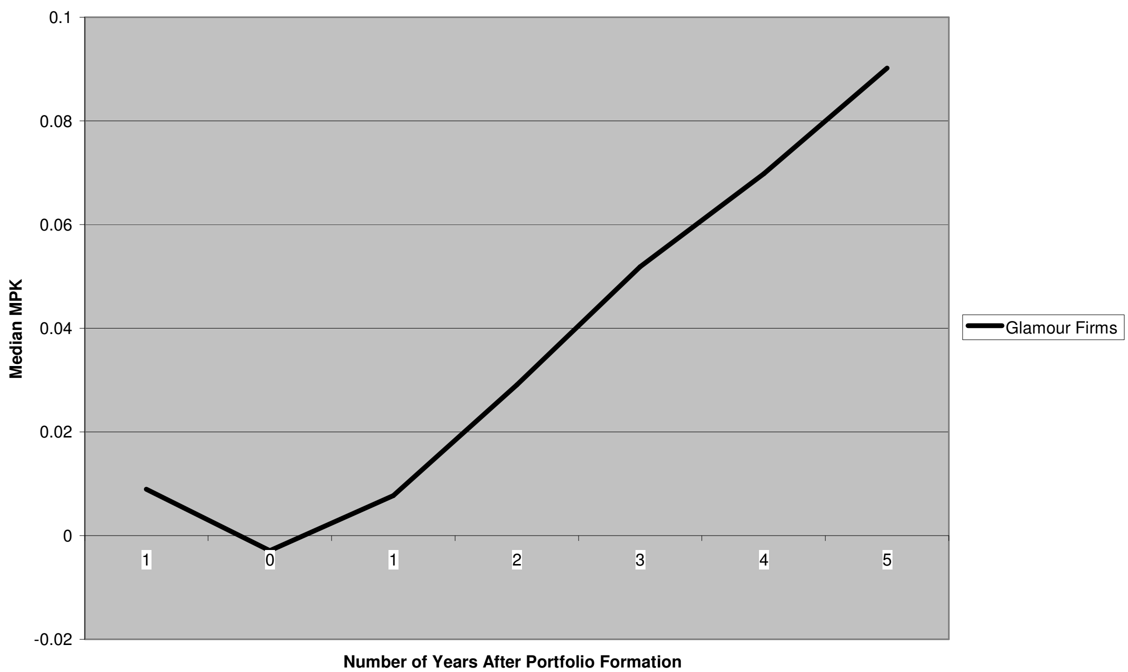


Figure 7

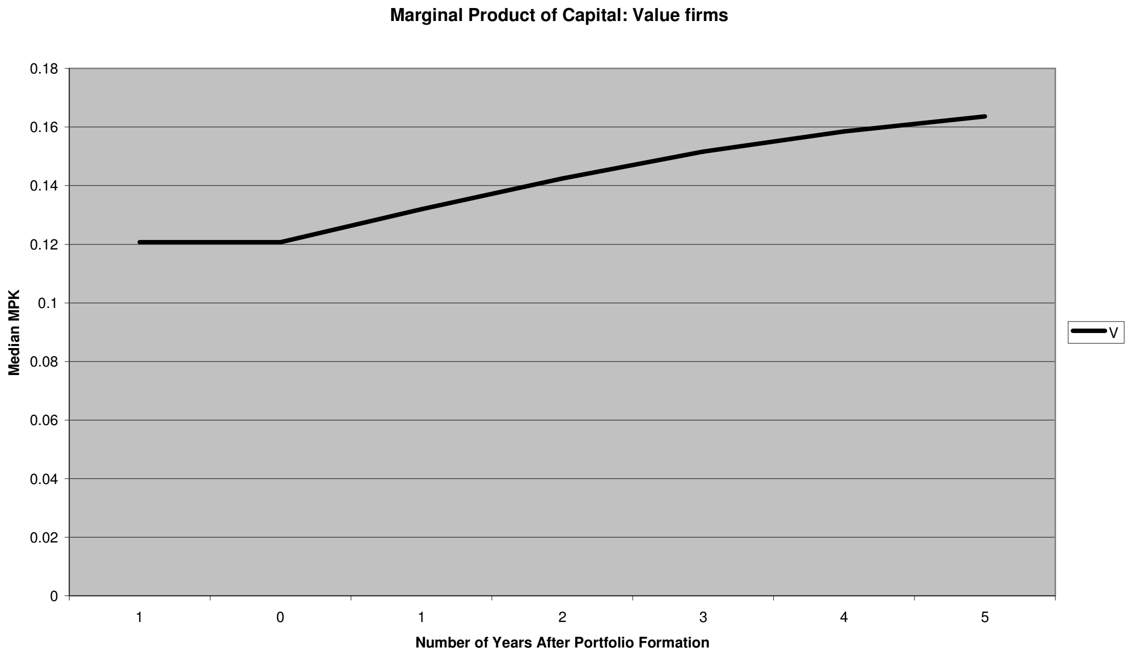
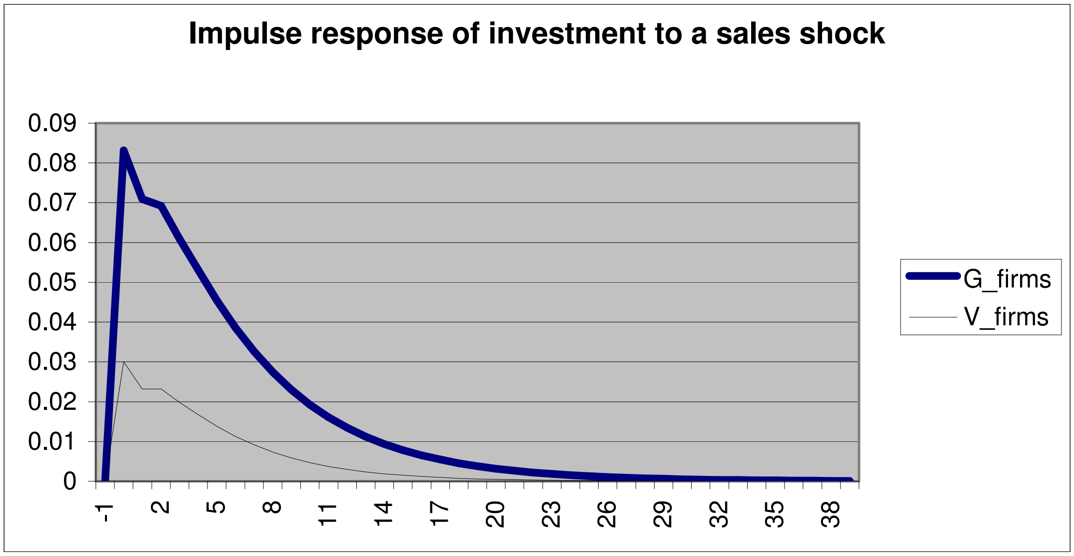

Marginal Product of Capital: Value firms
Median MPK
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1
0
1
2
3
4
5
Number of Years After Portfolio Formation
V

Figure 8


Impulse response of investment to a sales shock
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-1
2
5
8
11
14
17
20
23
26
29
32
35
38
G_firms
V_firms