Essays on the U.S. financial cycle: construction, real effects and cross-border spill-overs

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CHAPTER 3

Manufacturing industries investment and market sentiment *

3.1 Introduction

Classical finance theory posits that equity prices equal the rationally discounted value of expected cash flows. Expected returns only depend on expected risks, because in equilibrium any deviations will be arbitraged away. However, several recent studies reviewed in Baker and Wurgler (2013), building on older work (e.g., De Long et al 1990; Blanchard et al, 1993), consider how mispricing may result from an uninformed demand shock due to sentiment in combination with limits to arbitrage. Mispricing especially affects stocks that are more difficult to arbitrage due to transaction and valuation costs. Baker and Wurgler (2013) show that both this sensitivity and limits to arbitrage are linked to firms' size, age, volatility, profitability and growth prospects. This recent work establishes a role for investor sentiment in price formation.

The present paper addresses a question that follows from these findings: does investor sentiment also affect firms' fixed capital investment? If investment decisions are guided by market valuations and those valuations in turn are sensitive to investor sentiment, then the link between capital investment and investor sentiment appears to be a natural one. Researchers have suggested several motivations for this link (Morck et al., 1990). First, the stock market may simply be a passive predictor of future activity, without managers reacting to market dynamics. Second, the market may be a source of information for managers when making investment decisions. Third, market conditions which set the cost of funds and other external financing conditions may influence investment decisions through an equity channel. Fourth, the market may influence investment by exerting direct pressure on managers, if managers must

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cater to market opinion by cutting investment when markets are pessimistic and prices decline, and by investing more when prices rise.

We consider two transmission channels from investor sentiment to industry investment. The first is dependence on external finance (Rajan & Zingales, 1998). To the extent that investment depends on the ability to borrow, investor sentiment determines financing conditions through demand and supply conditions. On the demand side, higher collateral values ensure a better credit rating and lower borrowing cost for managers (e.g., Shleifer & Vishny, 2010). On the supply side, when markets are optimistic, financial intermediaries expand their balance sheets and managers can borrow and invest more. In both ways, positive investor sentiment may increase investment, more so with larger external dependence on finance.

We develop new measures for investor sentiment and for external dependence. Our measure for investor sentiment is based on the first principal component of indicators describing the three major asset markets for real estate, stocks and bonds. This is related to, but goes beyond equity market-based measures (Baker and Wurgler, 2006). Building on the literature on external dependence (Guevara & Maudos, 2009; Laeven & Valencia, 2013), we construct a regression-based measure that accounts for time and industry fixed effects, and allows for cross-sectional dependence of errors.

We capture the second transmission channel by Tobin's Q, the ratio of market valuation to book value. Tobin's Q proxies growth prospects (Gilchrist et al. 2005; Malmendier & Tate, 2005; Chen et al., 2007). Baker and Wurgler (2006) argue that firms in industries with better growth prospects are subject to more speculative demand and therefore more sensitive to investor sentiment (see also Gaspar et al. 2005). Blanchard et al.(1993) show that prices may be high relative to fundamentals because they are expected to increase even further, or low because they are expected to decrease further, consistent with a link between Tobin's Q and susceptibility to speculative demand (also, Stein, 1996). Likewise, Baker et al. (2003) argue that long-horizon managers of equity-dependent firms are less likely to invest if they must issue undervalued shares to finance the investment (see also Malmendier & Tate, 2005).

However, the interpretation of Tobin's Q is not straigtforward. It may also indicate mispricing, leading to lower investment (Blanchard et al., 1993, Baker et al, 2003, Gilchrist et al., 2005). If markets over-value the firm and are ready to accept a lower rate of return than the firm's marginal product of capital, then current shareholders may prefer to issue new shares and invest in outside opportunities instead of decreasing the marginal product of capital even further by investing in their fixed capital. In this way, positive sentiment combined with higher Tobin's Q may hinder rather than help investment. A priori, the sign of the Tobin's Q transition channel is ambiguous.

This study is most closely related to Baker et al. (2003), who examine the link between firm investment, the market value of equity and a modified time-varying Kaplan-Zingales index. This index captures the sensitivity of the financing of marginal investment to a firm's equity dependence (Kaplan & Zingales, 1997). They find empirical support for the hypothesis that investment rates of firms that depend more on equity are more sensitive to non-fundamental price movements in stock prices.

Our results on debt finance are consistent with those of Baker et al. (2003) on equity. In years when our U.S. investor sentiment measure takes higher values, growth in industry-level investment is stronger. This positive correlation is stronger in industries that depend more on external finance. We observe no evidence that Tobin's Q moderates the sentiment-investment relationship. Our results are robust to instrumenting and to a variety of specifications.

The remainder of this paper is organized as follows. In the next section we describe our empirical methodology. We describe the data and construction of variables in Section 4.2 and present our empirical results in Section 3.4. Section 4.7 concludes.

3.2 Empirical strategy

Model

We investigate the impact of investor sentiment on fixed capital investment in 16 U.S. manufacturing industries over 1974–2014. We model this relation as moderated by industry-specific dependence on external finance and Tobin's Q, conditioning on control variables. Our empirical specification is inspired by Malmendier and Tate (2005) and Baker and Wurgler (2006):

$$\begin{aligned}\frac{I_{i,t}}{A_{i,t-1}} &= \alpha_i + \alpha_1 \text{ED}_i \times S_{t-1} + \alpha_2 \text{ptb}_{i,t-1} \times S_{t-1} + \alpha_3 \text{ED}_i \times S_{t-1} \times \text{ptb}_{i,t-1} + \\ &+ \alpha_4 S_{t-1} + \alpha_5 \frac{\pi_{i,t-1}}{A_{i,t-2}} + \alpha_6 \text{ptb}_{i,t-1} + \alpha_7 \frac{1}{A_{i,t-1}} + \epsilon_{i,t}, \\ &\qquad i = 1, \dots, N;\ t = 1, \dots, T \end{aligned} \tag{3.1}$$

where the endogenous variable ($I_{i,t}$) is investment at time t normalized by capital at time $t-1$ ($A_{i,t-1}$), α_i are industry fixed effects, S_{t-1} is a proxy for investor sentiment, ED_i is a modified measure of Rajan and Zingales's (1998) external financial dependence, $\text{ptb}_{i,t-1}$ is a market price-to-book value, $\pi_{i,t-1}/A_{i,t-2}$ is profit scaled by asset value, inverted assets $1/A_{i,t-1}$ captures spurious correlation due to the scaling of the lefthand side and $\epsilon_{i,t}$ is a within-industry error that is potentially correlated to its own past values and to errors in other industries. All regressors enter the model with a one-period lag to mitigate endogeneity (Gomes, 2001). The specification controls for generic, industry-specific characteristics and for generic effects of investor sentiment across time. Significant estimates for the interaction of S_{t-1} with $\text{ptb}_{i,t-1}$ and with ED_i are consistent with the view that investor sentiment affects investment more if growth opportunities are better and dependence on external finance is larger, respectively.

In Table 3.2.1, we summarize the specifications we estimate, their restrictions and controls. Note that the direct sentiment effect is not identified when time effects are included. We include $\frac{\pi_{i,t-1}}{A_{i,t-2}} \times S_{t-1}$ to capture the time variation in the sensitivity between investment and industry-specific fundamentals.

Table 3.2.1: Parameter restrictions for different specifications and different types of control variables.

Model	Restrictions	Additional control variables	
		Time FE	$S_{t-1} \times \frac{\pi_{i,t-1}}{A_{i,t-2}}$
Baseline	$\alpha_1 = 0, \alpha_2 = 0, \alpha_3 = 0, \alpha_4 = 0$	No	No
Baseline	$\alpha_1 = 0, \alpha_2 = 0, \alpha_3 = 0, \alpha_4 = 0$	Yes	No
Direct sentiment effect	$\alpha_1 = 0, \alpha_2 = 0, \alpha_3 = 0$	No	No
Direct sentiment effect	$\alpha_1 = 0, \alpha_2 = 0, \alpha_3 = 0$	No	Yes
External dependence (ED) channel	$\alpha_2 = 0, \alpha_3 = 0$	Yes	No
	$\alpha_2 = 0, \alpha_3 = 0$	No	Yes
	$\alpha_2 = 0, \alpha_3 = 0$	Yes	Yes
Tobin's Q channel	$\alpha_1 = 0, \alpha_3 = 0$	Yes	No
	$\alpha_1 = 0, \alpha_3 = 0$	No	Yes
	$\alpha_1 = 0, \alpha_3 = 0$	Yes	Yes
Both channels	$\alpha_3 = 0$	Yes	No
	$\alpha_3 = 0$	No	Yes
	$\alpha_3 = 0$	Yes	Yes
ED channel and Tobin's Q–through–ED channel	$\alpha_2 = 0$	Yes	No
	$\alpha_2 = 0$	No	Yes
	$\alpha_2 = 0$	Yes	Yes

Notes: In all specifications, we include industry fixed effects.

Instrumental variable estimation

Investment and investor sentiment may be endogenous due to unobserved variables. We need an instrument that affects investment through the investor sentiment proxy, but not directly. Finding an effective instrument in this context is challenging. Time-varying instruments for financial variables are typically weak, or they are strongly correlated with a growth variable such as investment. The weak instrument problem renders instrumental variable estimations inconsistent in small samples (Bound et al. 1995; Guggenberger, 2012). Alternatively, using lags of the endogenous variable as instruments (Levine et al., 2000) requires serial correlation in the potentially endogenous explanatory variable and no serial correlation among the unobserved sources of endogeneity, which is a strong assumption. The lagged proxy of investor sentiment may be correlated with the error term $\epsilon_{i,t}$ due to persistence of common shocks over time(Bellemare et al. (2017)).

Our approach to this challenge is a two-stage procedure. In the first stage, we calculate $\hat{S}_t$, $\text{ED}_i \times \hat{S}_t$ and $\text{ptb}_{i,t-1} \times \hat{S}_t$, where $\hat{S}_t$ is an estimate based on the Prais-Winsten regression with parametric residuals, which follow a stationary AR(1) process:

$$S_t = \gamma z_t + u_t, \tag{3.2}$$

$$u_t = \rho_u u_{t-1} + e_t. \tag{3.3}$$

Here z_t is an instrument with a parameter γ, e_t is an i.i.d. error term, and $|\rho_u| < 1$. From (3.2), we construct $\hat{S}_t = \hat{\gamma} z_t$.

In the second stage, we use OLS to regress the $(T \times G)$ vector $\tilde{\boldsymbol{y}}_t$, expressed in deviations from its mean value, on a $(T \times G) \times K$ matrix $\tilde{\boldsymbol{X}}_t$, to obtain the two-stage least squares (2SLS) estimator $\hat{\boldsymbol{\beta}}_{2SLS} = (\tilde{\boldsymbol{X}}'\tilde{\boldsymbol{X}})^{-1}\tilde{\boldsymbol{X}}'\tilde{\boldsymbol{y}}$. Here the $(T \times G) \times K$ matrix $\tilde{\boldsymbol{X}}$ contains by assumption or construction exogenous regressors measured in deviation from their mean value, G is the number of cross-section units, T is the number of time periods and K the number of regressors.

To estimate the standard errors of $\hat{\boldsymbol{\beta}}_{2SLS}$, we calculate the second stage residuals $\hat{\boldsymbol{v}}_t = \tilde{\boldsymbol{y}}_t - \boldsymbol{X}_t\hat{\boldsymbol{\beta}}_{2SLS}$ where the $(T \times G) \times K$ matrix $\boldsymbol{X}_t$ contains the original, possibly endogenous regressors measured in deviations from their mean values. Since we will estimate across industry clusters, we use a robust covariance–variance estimator that is equal to

$$V(\hat{\boldsymbol{\beta}}_{\boldsymbol{\beta}_{2SLS}}) = (\tilde{\boldsymbol{X}}'\tilde{\boldsymbol{X}})^{-1}\tilde{\boldsymbol{X}}'\hat{\boldsymbol{\Omega}}\tilde{\boldsymbol{X}}(\tilde{\boldsymbol{X}}'\tilde{\boldsymbol{X}})^{-1},$$

where the block diagonal matrix $\hat{\boldsymbol{\Omega}} = \text{diag}(\hat{\boldsymbol{v}}_1\hat{\boldsymbol{v}}_1', \ldots, \hat{\boldsymbol{v}}_G\hat{\boldsymbol{v}}_G')$. When the number of cross-section units is small as in our case, robust variance estimates are likely to be biased downward. The proposed correction is to scale $\hat{\boldsymbol{\Omega}}$ with $G/(G-1)K$ (Cameron & Miller, 2015).

3.3 Data and variables

Profit, investment and Tobin's Q

We collected data from the U.S. Bureau of Economic Analysis over the period 1974–2014 on profit and on fixed assets (National Income and Product accounts, Sections 5 and 6). Fixed assets are defined as the aggregate book values of fixed assets (property, plant and equipment), land and mineral rights and all other non-current assets including investment in non-consolidated entities, long-term investment and intangibles. By taking first differences, we obtain a quarterly investment series. We collected annual (December) observations of price-to-book ratios (Tobin's Q) for 49-industry portfolios from the Fama and French data and from the 10-industry portfolios of Wharton Research Data Services. In the Appendix we provide details on the matching of data from the different sources.

External dependence

Following the seminal Rajan and Zingales (1998) paper, many measures for external dependence on finance have been constructed. The results depend on the kind of external dependence, the methodology and sample periods. For instance, Valencia and Laeven (2013) obtained a different set of estimates of external dependence using the same methodology as Rajan and Zingales on 1980–2006 data, as shown in the third column of Table 3.3.1). Other authors measure external dependence differently, using data on new equity and debt issues; still others use only data on debt.

We base our estimates of external financial dependence on Quarterly Financial Reports data over 2001:Q1–2015:Q4 provided by the U.S. Census Bureau. Rajan and Zingales measure for external financial dependence ED_i (where $i = 1, \ldots, 16$) of the sample median firm belonging to an industry i is given by

$$\mathrm{ED}_i = \frac{\sum_{t=1}^{T} (\text{Capital Expenditures}_{i,t} - \text{Cash Flows}_{i,t})}{\sum_{t=1}^{T} \text{Capital Expenditures}_{i,t}}.$$

Our measure is a variation of the original measure. We assume that the excess of capital expenditures over cash flow is covered by the change in the stock of long-term debt ($\Delta\mathrm{Debt}_{i,t}$). We obtain the stock of long-term debt by aggregating long-term debt stocks due in less than one year and more than one year. Capital expenditures, or investment ($I_{i,t}$) is proxied by the change in fixed asset values. Visual inspection suggests that changes in debt and investment co-move strongly. We define a panel data model and estimate ED_i as $\text{Cov}(\Delta\text{Debt}_{i,t}, I_{i,t})/\text{Var}(I_{i,t})$ from

$$\Delta\text{Debt}_{i,t} = \beta_i I_{i,t} + e_{i,t}, \tag{3.4}$$

$$e_{i,t} = \alpha_i + \delta_t + u_{i,t}, \quad i = 1, \ldots, N; t = 1, \ldots T \tag{3.5}$$

where α_i denotes fixed industry effects, δ_t denotes fixed time (business cycle) effects and $u_{i,t}$ is an error term with $\mathbb{E}(u_{i,t}) = 0$, possibly autocorrelated within industry. In this model, the $\hat{\beta}_i$'s are estimates of industry-specific external dependence measure (ED_i). We expect ED_i to be non-negative meaning that an increase (decrease) in industry-wide investment typically increases (decreases) the overall long-term debt or has no effect. This is confirmed in the second column of Table 3.3.1, which shows our estimation results, based on the 2001:Q1–2015:Q4 sample. All ED_i estimates based on our time-industry FE model are significant at the 1% level, except for the industries 'Wood' and 'Textile mills and textile product mills', where the coefficients are significant at the 10% level

The second column of Table 3.3.1 shows estimation results. For purposes of comparison, the third column presents Valencia and Laeven's (2013) calculations, and the fourth column presents Rajan and Zingales's original calculations based on data over 1980–1989 (ISIC8089). We obtain different results from Rajan and Zingales's (1998) original estimates, due to the different sample periods, the new estimation method, data aggregation and definitional differences (e.g., Rajan and Zingales include equity issues).

In our model specification, external dependence on finance is an endogenous and unobserved variable, also known as a generated regressor (Wooldridge, 2010). We estimate ED_i with Eq.(3.4) and in the second stage (panel) regression treat it as if observed. Consequently, the standard errors for coefficients of endogenous variables will be too small and the t-ratios too high because we did not account for ED_i being a random variable. However, our second-stage OLS estimator is still consistent, and given high p-values, we do expect our qualitative inference to be robust to this shortfall. Alternatively, the generalized method of moments estimation would provide the correct standard errors but requires pooling two data sets with different data frequency and sample periods.

Investor sentiment

To construct an investor sentiment indicator, we use three financial indicators that reflect the three major asset markets (for bonds, stocks and real estate): the slope of the

Table 3.3.1: The external dependence estimates for the U.S. manufacturing industries.

Industry	Our study	Laeven–Valencia	Rajan–Zingales
Wood products	0.15	0.14	0.28
Nonmetallic mineral products	0.18	–	–
Nonmetal products		0.09	0.06
Glass		0.24	0.53
Primary metals	0.13	–	–
Iron and steel		0.24	0.09
Nonferrous metal		0.32	0.01
Fabricated metal products	0.28	0.19	0.24
Machinery	0.15	0.50	0.45
Electric,electronic equipment, computers, instruments	0.17	–	–
Office and computing		0.66	1.06
Electric machinery		0.39	0.77
Professional goods		0.85	0.96
Radio		0.93	1.04
Motor vehicles, bodies and trailers, and parts	0.16	–	–
Ship		0.30	0.46
Transportation equipment		0.13	0.31
Motor vehicle		0.38	0.39
Furniture and related products	0.44	-0.07	0.24
Miscellaneous manufacturing	0.28	0.52	0.47
Food and beverage and tobacco products	0.28	–	–
Food products		0.14	0.14
Tobacco		-1.76	-0.45
Beverages		0.06	0.08
Textile mills and textile product mills	0.21	–	–
Spinning		0.08	-0.09
Textile		0.17	0.40
Apparel and leather and allied products	0.46	–	–
Apparel		0.05	0.03
Leather		-0.98	-0.14
Footwear		-0.56	-0.08
Paper products	0.28	–	–
Pulp, paper		0.1	0.15
Paper and products		0.13	0.18
Printing and related support activities	0.62	0.06	0.20
Petroleum and coal products	0.11	–	–
Petroleum refineries		0.03	0.04
Petroleum and coal products		0.27	0.33
Chemical products	0.12	–	–
Other chemicals		-0.07	0.22
Basic excluding fertilizers		0.06	0.25
Drugs		0.78	1.49
Plastics and rubber products	0.40	–	–
Synthetic resins		0.10	0.16
Rubber products		0.37	0.23
Plastic products		0.24	1.14

Notes: The second column is our method, which controls for time and industry fixed effects based on the sample period 2001:Q1–2015:Q4; the third column is external dependence as in Laeven and Valencia (2013) based on the sample period 1980–2006 and the fourth column shows external dependence as in Rajan and Zingales (1998) based on the sample period 1980–1989.

yield curve (SYC_t), S&P price returns (SP_{t-3}), and real estate price returns (REP_{t-6}). We use Bank of International Settlements data for real estate price returns and the S&P stock price index from Robert Shiller's Online data. We construct the slope of the yield curve as the difference between 10-year and 1-year bond yields, available from ALFRED, the Federal Reserve Bank of St.Louis data base. The indicators are observed at the quarterly frequency, standardized and adjusted for lead and lags as in Rozite et al. (2019)[1]. We calculate investor sentiment as the first principal component of these three indicators, which explains just over 50% of the common variance. Our indicator S_t (for sentiment) is given by

$$S_t = -\,0.688\,\text{SYC}_t + 0.660\,\text{REP}_{t-6} + 0.299\,\text{SP}_{t-3}.$$

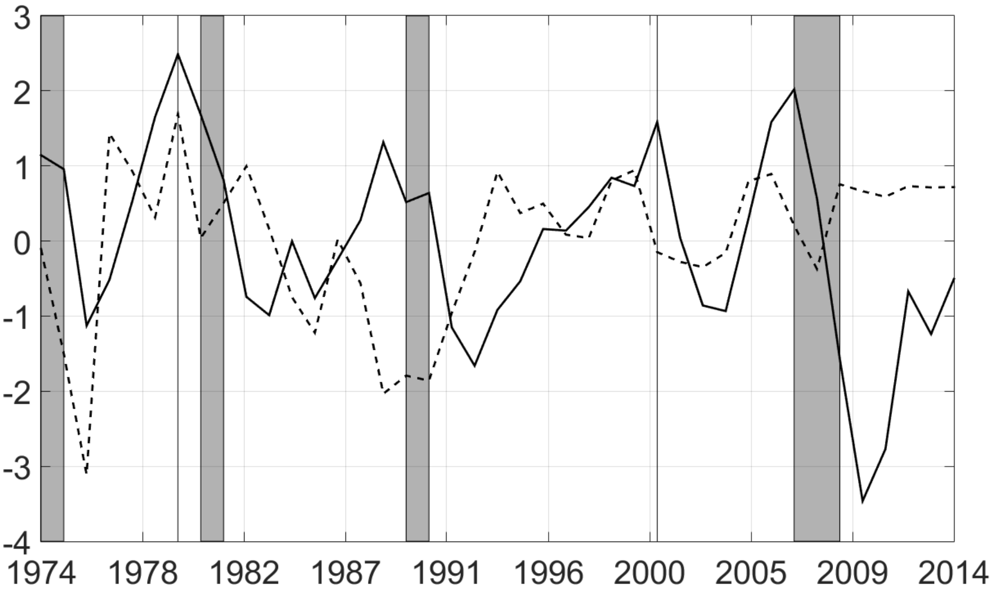
We take December data to arrive at annual frequencies.

We address endogeneity concerns by instrumenting S_t with global financial market profit margin, proxied by the $\log$ spread between the three-month Eurodollar deposit rates in London and the three-month London interbank lending rates (LIBORs) (DED3LIBOR_t), both obtained from the database of the Federal Reserve of St. Louis. The Eurodollar market is the international capital market of the world, providing 90% of all international loans; Eurodollar deposit rates are considered forward rates on the U.S. dollar, and LIBORs are current spot rates. We calculate spreads to exclude inflation effects. The difference between deposit and interbank lending rates also indicates the prevailing profit margin in the capital markets. Figure 3.3.1 shows our instrumental variable (DED3LIBOR_t) together with the investor sentiment index. Both indicators are measured in deviations from their historic average and scaled by their sample standard deviations. Visual inspection suggests good correspondence between the two series. In addition, the data show that National Bureau of Economic Research (NBER) recessions are preceded by peaks in investor sentiment.

Appendix B.1.2 shows correlations and summary statistics for all variables and for the interaction terms to be used in the analysis below. We note that investment is most strongly correlated with lagged profit and with variables that contain the investor

[1] A brief summary of our approach is as follows. To measure lead-lag relations in the data, we compute sample-based estimates of the spectrum. The cross-spectrum is decomposed into a real and an imaginary component. In order to calculate phase shifts, we apply this decomposition to pairs of indicators. We choose the slope of the yield curve as the reference indicator. We use the signs of the dynamic correlation to classify non-reference indicators as cyclical or counter-cyclical with respect to our reference indicator. The time-shifts are then estimated for indicators, and these are aligned with respect to our reference indicator. A full description of the procedure is available on request, or could be added to this paper as an Appendix

Figure 3.3.1: U.S. investor sentiment and the spread between Eurodollar three-month deposit rates and LIBOR three-month rates.



Notes: Investor sentiment are represented by the solid line and the spread between Eurodollar three-month deposit rates and LIBOR three-month rates are represented by the dashed line. Shaded bars indicate NBER recessions.

sentiment index.

3.4 Results

Recall that we previously discuss four possible explanations proposed by Morck et al. (1990) for a rationale to link market sentiments with real investment. In particular, we ask if investor sentiment has an effect on the level of real investment beyond that maintained by managers and their views about the future fundamentals. The effects may be due to market mispricing (i.e., cost of funds) caused by some information content conveyed in market valuations or direct pressure on managers.

We report the estimation results in Tables 3.4.1 to 3.4.5. The columns in each table correspond to investment regressions estimated with and without sentiment effects. To check the robustness of our results, we do it across different specifications provided in Table 3.2.1.

The first column in Table 3.4.1 reports the “baseline” model without investor sentiment or its channels, but with standard controls: profit scaled by assets, Tobin‘s Q and the inverse of assets (to account for any spurious correlation effects in the profit variable). We estimate the baseline model because it provides a benchmark against which we can evaluate the marginal importance of investor sentiment in determining investment. We find that past profits increase investment, in line with earlier work (Fazzari et. al, 1988; Baker et al., 2003). Market valuation (Tobin's Q) carries the expected positive sign, consistent with Blanchard et al. (1993); however, the coefficient is not significant. The baseline findings are robust throughout 3.4.1 to 3.4.5, where we add profit interacted with sentiment (Table 3.4.2), time fixed effects but no sentiment (Table 3.4.3), profit interacted with sentiment and time fixed effects (Table 3.4.4) and instrumented sentiment with time and industry fixed effects (Table 3.4.5). Comparing the baseline model in Table 3.4.1 with Table 3.4.3 suggests that common cross-sectional movements in investment constitute at least 12%.

In column (2) of Table 3.4.1, we add investor sentiment. The coefficient for this direct effect is positive, but only significantly so in column (2). Note that the increase in explained variation between columns (1) and (2) is 3%. To put this in context, note that accounting for common cross-section variation by adding time fixed effects to column (1), as we do in Table 3.4.2, produces an increase in explained variation of 11.3% (from 45.3% to 56.5%). This suggests that variation in investor sentiment explains a substantial part (3% of 11%) of the cross-section variation in investment.

When we add in column (3) the interaction of investor sentiment with external dependence, we find that this external dependence channel carries a positive and significant coefficient. Its significance will increase when we add profit levels and time fixed effects in subsequent tables, and also when we instrument investor sentiment in Table 3.4.5. This is the first key finding of the paper. Using our new measure for investor sentiment, and applying our new, regression-based proxy for external dependence, we find that investor sentiment has a positive and robustly significant effect dependent on the level of external financial dependence. When we add the "external dependence" channel, the explained variation increases from 45% to 49% in Table 3.4.1 and from 57% to 58% in Table 3.4.2.

In column (4) we replace external dependence with the Tobin's Q. The coefficient is insignificant and adding Tobin's Q does not appreciably increase explained variation, here or in subsequent tables. This findings stands in contrast to, for instance, Chen et al. (2007). They argue that firms are motivated to issue more equity when the cost of outside finance is relatively low, which would lead to increased investment. However, following Blanchard et al.'s (1993) argument, low financing cost does not necessarily imply an increase in investment. We conclude that there is no evidence that the investor sentiment effect on investment is moderated by the value of Tobin's Q.

In columns (5) and (6) we examine, respectively, the two channels simultaneously and a three-way interaction that combines both channels[2]. As noted, the external dependence channel is robust to adding the Tobin's Q channel, except when we omit both time fixed effects and a profit interaction term. The three-way interaction coefficient suggests that the "external dependence" channel is stronger at higher values of Tobin's Q. This coefficient is not significant here in Table 3.4.1, but it is when adding either an investment-profit interaction in Table 3.4.1) or time fixed effects in Table 3.4.2).

In Table 3.4.5, we test the robustness of the Table 3.4.3 results by instrumenting investor sentiment with the spread between Eurodollar deposit rates in London and LIBOR in dollars for the three-month maturity. We take the log difference of the spread to smooth out the heterogeneity in variance ($\log \text{DED3LIBOR}_t$). We also include a dummy variable for 2009 and 2010 to control for the Great Financial Crisis in the United States ($D_{2009,2010}$). In the first stage, we obtain estimation results given by

$$\hat{S}_t = \underset{(4.15)}{0.43^c} \; \log \text{DED3LIBOR}_t \underset{(-4.50)}{-2.15^c} \; D_{2009,2010} + 0.51 \; \hat{u}_{t-1} + \hat{v}_t$$

Note: t statistics in parentheses; ^{c} $p < 0.01$, Adj. R square = 0.430; F(2, 39) = 16.48; $T = 41$.

The first-stage estimation results indicate that the instrument is not weak. Table 3.4.5 reports the second-stage estimation results. They support the findings in Tables 3.4.1–3.4.4. In particular, investor sentiment has a positive marginal effect on investment through the external dependence channel. As before, Tobin's Q channel remains insignificant.

In summary, our estimations suggest a positive effect of investor sentiment on industry-level real investment, depending positively on the level of the industry's dependence on debt finance. We do not find evidence of a role for market valuations in a Tobin's Q transmission channel.

[2]We do not include Tobin's Q channel because this channel is not significant in our prior estimations and it is also highly collinear with the three-way interaction term

Table 3.4.1: Effects of investor sentiment on investment with industry fixed effects.

	(1) Baseline	(2) Direct effect	(3) ED channel	(4) Tobin's Q channel	(5) Both channels	(6) ED channel Tobin's Q through ED
$\text{ED}_i \times S_{t-1}$			0.0131^a		0.0119	0.0248
			(2.17)		(1.77)	(1.49)
$\text{ptb}_{i,t-1} \times S_{t-1}$				-0.0045	-0.0043	
				(-1.26)	(-1.18)	
$\text{ED}_i \times S_{t-1} \times \text{ptb}_{i,t-1}$						-0.0082
						(-0.67)
S_{t-1}		0.0056^c	0.0021	0.0123	0.0088	0.0022
		(2.81)	(0.8)	(1.77)	(1.1)	(0.77)
$\text{ptb}_{i,t-1}$	0.0055	0.0065	0.0065	0.0077	0.0076	0.0068
	(0.88)	(1.09)	(1.1)	(1.23)	(1.23)	(1.12)
$\pi_{i,t-1}/A_{i,t-2}$	0.213^c	0.190^c	0.192^c	0.191^c	0.193^c	0.191^c
	(6.68)	(5.99)	(6.08)	(6.19)	(6.26)	(5.84)
$1/A_{i,t-1}$	699.9^c	700.9^c	676.8^c	690.3^c	668.9^c	657.8^c
	(2.94)	(3.24)	(3.22)	(3.5)	(3.48)	(3.47)
_cons	-0.0752^b	-0.0728^c	-0.0719^c	-0.0747^c	-0.0737^c	-0.0716^c
	(-3.56)	(-4.01)	(-4.11)	(-4.41)	(-4.49)	(-4.36)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	640	640	640	640	640	640
R-square	0.453	0.488	0.492	0.495	0.499	0.494

Notes: t statistics in parentheses are based on Driscoll and Kraay standard errors (Driscoll and Kraay,1998); a $p < 0.10$, b $p < 0.05$, c $p < 0.01$. The dependent variable is $I_{i,t}/A_{i,t-1}$. Fundamentals are measured with profit at time $t-1$ scaled by assets at time $t-1$ ($\pi_{i,t-1}/A_{i,t-1}$); growth opportunities are measured by market-book values of assets ($\text{ptb}_{i,t-1}$); investor sentiment is the first principal component of S&P stock price returns, real estate returns and slope of the yield curve and roughly corresponds to their average; and ED_i is the modified, external dependence measure based on the model, which controls for industry and time fixed effects. Spurious correlation due to scaling is captured by the inverse assets $1/A_{t-1}$.

Table 3.4.2: Effects of investor sentiment on investment with industry fixed effects and profit–sentiment interaction.

	(1) Direct effect	(2) ED channel	(3) Tobin's Q channel	(4) Both channels	(5) ED channel Tobin's Q through ED	(6) Tobin's Q channel ED through Tobin's Q
$\text{ED}_i \times S_{t-1}$		0.0163^b		0.0146^b	0.0271	
		(2.80)		(2.12)	(1.76)	
$\text{ptb}_{i,t-1} \times S_{t-1}$			-0.0043	-0.0039		-0.0064^b
			(-1.22)	(-1.08)		(-2.15)
$\text{ED}_i \times S_{t-1} \times \text{ptb}_{i,t-1}$					-0.00759	0.0107^b
					(-0.64)	(2.64)
$\pi_{i,t-1}/A_{i,t-2} \times S_{t-1}$	-0.0151	-0.0225^b	-0.0112	-0.0182^a	-0.0217^b	-0.0173^a
	(-1.53)	(-2.72)	(-1.12)	(-1.95)	(-2.54)	(-1.98)
S_{t-1}	0.0067^c	0.0030	0.0128	0.0089	0.0030	0.0123
	(2.91)	(1.04)	(1.88)	(1.13)	(1.01)	(1.84)
$\text{ptb}_{i,t-1}$	0.0067	0.0068	0.0077	0.00775	0.0071	0.0079
	(1.14)	(1.17)	(1.27)	(1.27)	(1.19)	(1.31)
$\pi_{i,t-1}/A_{i,t-2}$	0.194^c	0.198^c	0.194^c	0.199^c	0.197^c	0.201^c
	(6.09)	(6.25)	(6.05)	(6.15)	(5.95)	(6.29)
$1/A_{i,t-1}$	702.8^c	673.6^c	692.2^c	667.0^c	656.1^c	684.6^c
	(3.27)	(3.26)	(3.54)	(3.49)	(3.51)	(3.57)
_cons	-0.0737^c	-0.0729^c	-0.0752^c	-0.0743^c	-0.0726^c	-0.0756^c
	(-4.17)	(-4.37)	(-4.53)	(-4.68)	(-4.64)	(-4.71)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	640	640	640	640	640	640
R-square	0.489	0.496	0.496	0.501	0.497	0.500

Notes: t statistics in parentheses are based on Driscoll and Kraay standard errors; ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$. The dependent variable is $I_{i,t}/A_{i,t-1}$. Fundamentals are measured with profit at time $t-1$ scaled by assets at time $t-1$ ($\pi_{i,t-1}/A_{i,t-1}$); growth opportunities are measured by market–book values of assets ($\text{ptb}_{i,t-1}$); investor sentiment is the first principal component of S&P stock price returns, real estate returns and slope of the yield curve and roughly corresponds to their average; and ED_i is the modified, external dependence measure based on the model, which controls for industry, time fixed effects and time fixed effects interacted with an industry specific investment. Spurious correlation due to scaling is captured by the inverse assets $1/A_{t-1}$. D_{t-1} is a time dummy variable taking value one at time $t-1$.

Table 3.4.3: Effects of investor sentiment on investment with industry and time fixed effects.

	(1) Baseline	(2) ED channel	(3) Tobin's Q channel	(4) Both channels	(5) ED channel Tobin's Q through ED	(6) Tobin's Q channel ED through Tobin's Q
$\text{ED}_i \times S_{t-1}$		0.0140^b		0.0138^b	0.0095	
		(2.64)		(2.80)	(0.74)	
$\text{ptb}_{i,t-1} \times S_{t-1}$			-0.0012	-0.0007		-0.0028
			(-0.58)	(-0.36)		(-1.15)
$\text{ED}_i \times S_{t-1} \times \text{ptb}_{i,t-1}$					0.0032	0.0095^c
					(0.52)	(3.10)
$\text{ptb}_{i,t-1}$	0.0091	0.0094	0.0096	0.0097	0.0091	0.0099
	(1.22)	(1.34)	(1.48)	(1.55)	(1.34)	(1.63)
$\pi_{i,t-1}/A_{i,t-2}$	0.122^c	0.123^c	0.122^c	0.124^c	0.124^c	0.126^c
	(7.52)	(7.62)	(7.57)	(7.64)	(7.78)	(8.17)
$1/A_{i,t-1}$	80.85	50.72	82.30	51.97	55.40	68.91
	(0.92)	(0.59)	(0.94)	(0.60)	(0.64)	(0.82)
_cons	-0.0258	-0.0248	-0.0282	-0.0262	-0.0241	-0.0283
	(-1.19)	(-1.17)	(-1.56)	(-1.47)	(-1.18)	(-1.64)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
N	640	640	640	640	640	640
R-square	0.565	0.578	0.567	0.579	0.576	0.576

Notes: t statistics in parentheses are based on standard errors that are clustered according to industry; ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$. The dependent variable is $I_{i,t}/A_{i,t-1}$. Fundamentals are measured with profit at time $t-1$ scaled by assets at time $t-1$ ($\pi_{i,t-1}/A_{i,t-1}$); growth opportunities are measured by market-book values of assets ($\text{ptb}_{i,t-1}$); investor sentiment is the first principal component of S&P stock price returns, real estate returns and slope of the yield curve and roughly corresponds to their average; and ED_i is the modified, external dependence measure based on the model, which controls for industry and time fixed effects. Spurious correlation due to scaling is captured by the inverse assets $1/A_{t-1}$.

Table 3.4.4: Effects of investor sentiment on investment with industry and time fixed effects, and profit–sentiment interaction.

	(1) Baseline	(2) ED channel	(3) Tobin's Q channel	(4) Both channels	(5) ED channel Tobin's Q through ED	(6) Tobin's Q channel ED through Tobin's Q
$\text{ED}_i \times S_{t-1}$		0.0174^{b}		0.0181^{b}	0.0074	
		(3.62)		(4.05)	(0.68)	
$\text{ptb}_{i,t-1} \times S_{t-1}$			-0.0005	0.0012		-0.0015
			(-0.23)	(0.58)		(-0.74)
$\text{ED}_i \times S_{t-1} \times \text{ptb}_{i,t-1}$					0.0073	0.0117^{c}
					(1.21)	(4.42)
$\pi_{i,t-1}/A_{i,t-2} \times S_{t-1}$	-0.0121	-0.0228^{b}	-0.0112	-0.0255^{a}	-0.0260^{b}	-0.0241^{a}
	(-1.19)	(-2.96)	(-1.04)	(-2.51)	(-3.07)	(-2.40)
$\text{ptb}_{i,t-1}$	0.0097	0.0106	0.0099	0.0102	0.0103	0.0106
	(-1.42)	(1.71)	(1.56)	(1.76)	(1.69)	(1.84)
$\pi_{i,t-1}/A_{i,t-2}$	0.124^{c}	0.128^{c}	0.124^{c}	0.128^{c}	0.130^{c}	0.130^{c}
	(-7.44)	(7.54)	(7.44)	(7.58)	(7.90)	(8.18)
$1/A_{i,t-1}$	82.11	45.81	82.57	43.19	55.92	66.32
	(-0.94)	(0.54)	(0.94)	(0.51)	(0.66)	(0.80)
_cons	-0.0279	-0.0285	-0.0287	-0.0267	-0.0276	-0.0294
	(-1.4)	(-1.49)	(-1.62)	(-1.58)	(-1.47)	(-1.77)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
N	640	640	640	640	640	640
R-square	0.568	0.586	0.569	0.586	0.583	0.581

Notes: t statistics in parentheses are based on standard errors that are clustered according to industry; $^{a}\ p < 0.10$, $^{b}\ p < 0.05$, $^{c}\ p < 0.01$. The dependent variable is $I_{i,t}/A_{i,t-1}$. Fundamentals are measured with profit at time $t-1$ scaled by assets at time $t-1$ ($\pi_{i,t-1}/A_{i,t-1}$); growth opportunities are measured by market-book values of assets ($\text{ptb}_{i,t-1}$); investor sentiment is the first principal component of S&P stock price returns, real estate returns and slope of the yield curve and roughly corresponds to their average; and ED_i is the modified, external dependence measure based on the model, which controls for industry and time fixed effects. Spurious correlation due to scaling is captured by the inverse assets $1/A_{t-1}$.

Table 3.4.5: Effects of investor instrumented sentiment on investment and industry and time fixed effects

	(1) ED channel	(2) Tobin's Q channel	(3) Both channels	(4) ED channel Tobin's Q through ED	(5) Tobin's Q channel ED through Tobin's Q
$\text{ED}_i \times \hat{S}_t$	0.0287[a]		0.0285[a]	0.0407[a]	
	(1.80)		(1.91)	(2.02)	
$\text{ptb}_{i,t-1} \times \hat{S}_t$		-0.0032	-0.0027		-0.0070
		(-0.574)	(-0.49)		(-1.02)
$\text{ED}_i \times \hat{S}_t \times \text{ptb}_{i,t-1}$				-0.0091	0.0175
				(-0.89)	(1.71)
$\text{ptb}_{i,t-1}$	0.0094	0.0095	0.0098	0.0096	0.0010
	(1.37)	(1.41)	(1.54)	(1.37)	(1.70)
$\pi_{i,t-1}/A_{i,t-2}$	0.118[c]	0.122[c]	0.1176[c]	0.1169[c]	0.1195[c]
	(9.39)	(6.74)	(8.04)	(5.94)	(7.55)
$1/A_{i,t-1}$	-4.568	82.32	-2.597	-7.72	21.529
	(-0.05)	(0.979)	(-0.03)	(-0.09)	(0.24)
FE Industry	Yes	Yes	Yes	Yes	
FE Year	Yes	Yes	Yes	Yes	
N	640	640	640	640	640
R square	0.579	0.556	0.594	0.582	0.583

Notes: Standard errors are cluster robust. The dependent variable is $I_{i,t}/A_{i,t-1}$. Fundamentals are measured with profit at time $t-1$ scaled by assets at time $t-1$ ($\pi_{i,t-1}/A_{i,t-1}$); growth opportunities are measured by market–book values of assets ($\text{ptb}_{i,t-1}$); $\hat{S}_{t-1}$ is instrumented and standardized investor sentiment; and ED_i is the modified, external dependence measure based on the model, which controls for industry and time fixed effects. Spurious correlation due to scaling is captured by the inverse assets $1/A_{t-1}$.

3.5 Conclusion

In this paper, we examine whether investor sentiment in financial markets affects industry-level investment in real capital. We investigate three possible ways in which this effect might occur: directly, through firm's industry-specific dependence on debt finance, and through firms' industry-specific market valuations. We examine these effects using U.S. data for the period 1974–2014. We develop a novel measure for investor sentiment as the first principal components of three lead-lag adjusted indicators that reflect the three major asset markets (for bonds, stocks and real estate): the slope of the bond yield curve, S&P returns and real estate returns. We also construct a novel, regression-based measure for external dependence on finance, which takes industry and time effects into account.

Our findings suggest positive effects of investor sentiment on manufacturing industries' real investment, which depend on the level of external financial dependence. This result is robust to variations in the model specification, to adding time fixed effects, and to instrumenting U.S. investor sentiment by global bond spreads. When market investors are more optimistic, industries that depend more on external finance invest more in fixed capital. We find no evidence for a direct effect of investor sentiment on investment, nor for an effect mediated by market valuations expressed in Tobin's Q. The findings are novel, and they add to related findings on real consequences of financial market sentiment (Baker et al. (2003), Malmendier & Tate, 2005).

In future research, it will be worthwhile to examine the same question using firm-level data, which broadens the scope for identification strategies. A second point of note is that external dependence measures appear to vary a great deal, as our comparisons with existing measures show. Some of this variance may be due to differences in time period and sample, but it is quite likely that unobserved effects explain some of the differences. We offer our treatment of industry-specific errors as one way to address this shortcoming, but more remains to be done. The broader implication of our findings for future research is that studying the dynamics of financial market sentiment is important not only for understanding those markets themselves, but also for understanding real dynamics, including investment.

Appendix B.

B.1 Classification of industries

We use several data sources and long time series; as a result, some variations are evident in our manufacturing industry classifications. In 1998, the industry classification for national income and product accounts (NIPA) and labor statistics changed, which creates a mapping problem for some industries before and after 1998. First, the tobacco industry was merged together with the food industry.Computer and electronic products was not a separate industry before 1998; the classification was divided into instruments and related products and electronic and other electric equipment. We choose to merge computer and electronic products with the electrical equipment, appliances and components industry. We also merge the apparel and leather industries which were two separate industries before 1998. Finally, the naming convention for stone, clay, and glass product industry after 1998 was changed to nonmetallic mineral products.

Quarterly Financial Reports (QFRs) have different industry classification as compared to the NIPA tables. For example, they separately report information for aerospace products, foundries, pharmaceuticals and communication equipment. We report more detailed information on industry naming conventions in Table B.1.1. The last two columns explain how we merged QFRs with NIPA and labor statistics categories and how we merged industries to deal with the change in naming conventions after 1998. We ultimately have 17 manufacturing industries.

Fama and French industry portfolio classifications have different naming conventions than NIPA and QFR data tables. We use 10 industry portfolios to obtain information on Hitec (computers, software and electronic equipment) and Energy (oil, gas and coal) industries' financial ratios. We use 49 industry portfolio classifications to obtain information on the remaining industries. The furniture industry in the Fama and French data set corresponds to consumer goods. Nonmetallic minerals and wood industries are both mapped to construction materials as the closest match.

Table B.1.1: Manufacturing industries naming correspondence between datasets.

QFA from 2000Q1	NIPA tables prior to 1998	NIPA tables from 1998	Our study: QFA data aggregation	Our study: Main Regression data aggregation
Food	Food and kindred products	Food and beverage and tobacco products	Food + Beverage and Tobacco products	Food and beverage and tobacco products
Beverage and Tobacco Products	Tobacco products			
Textile Mills and Textile Product Mills	Textile mill products	Textile mills and textile product mills	Textile Mills	Textile mills and textile product mills
Apparel and Leather Products	Apparel and other textile products	Apparel and leather and allied products	Apparel, Leather	Apparel and leather and allied products
	Leather and leather products			
Wood Products	Lumber and wood products	Wood products	Wood products	Wood products
Paper	Paper and allied products	Paper products	Paper Products	Paper products
Printing and Related Support Activities	Printing and publishing	Printing and related support activities	Printing	Printing and related support activities
Petroleum and Coal Products	Petroleum and coal products	Petroleum and coal products	Petroleum and Coal products	Petroleum and Coal products
Basic Chemicals, Resins, and Synthetics				
All Other Chemicals	Chemicals and allied products	Chemical products	All other chemicals plus basic chemicals, resins and synthetics plus pharmaceuticals and medicines	Chemical products
Pharmaceuticals and Medicines				
Plastics and Rubber Products	Rubber and miscellaneous plastics products	Plastics and rubber products	Plastics and rubber products	Plastics and rubber products
Nonmetallic Mineral Products	Stone, clay, and glass products	Nonmetallic mineral products	Nonmetallic Mineral	Nonmetallic mineral products
Fabricated Metal Products	Fabricated metal products	Fabricated metal products	Fabricated Metal	Fabricated metal products
Machinery	Industrial machinery and equipment	Machinery	Machinery	Machinery
All Other Electronic Products	Electronic and other electric equipment			
Electrical Equipment, Appliances, and Components		Electrical equipment, appliances, and components	Electrical equipment plus other electronic plus Electronic equipment and appliances plus Computer plus Instruments plus Communications equipment	Electronics, electrical, computer and peripheral equipment
Computer and Peripheral Equipment		Computer and electronic products		
Communications Equipment				
	Instruments and related products			
Furniture and Related Products	Furniture and fixtures	Furniture and related products	Furniture	Furniture and related products
Miscellaneous Manufacturing	Miscellaneous manufacturing industries	Miscellaneous manufacturing	Miscellaneous Manufacturing	Miscellaneous Manufacturing
Iron, Steel, and Ferro-alloys	Primary metal industries	Primary metals	Foundries plus Iron Steel plus Ferro-alloys plus Nonferrous Metals	Primary metals
Nonferrous Metals				
Foundries				
Motor Vehicles and Parts	Motor vehicles and equipment	Motor vehicles, bodies and trailers, and parts	Motor Vehicles plus aerospace products	Motor vehicles, bodies and trailers, and parts plus other transportation equipment
Aerospace Products and Parts				
	Other transportation equipment	Other transportation equipment		

Table B.1.2: Summary statistics

	$I_{i,t}/A_{i,t-1}$	$\text{ptb}_{i,t-1}$	$\pi_{i,t-1}/A_{i,t-2}$	S_{t-1}	$\text{ED}_i \times S_{t-1}$	$\text{ptb}_{i,t-1} \times S_{t-1}$	$\text{ED}_i \times S_{t-1} \times \text{ptb}_{i,t-1}$	$\pi_{i,t-1}/A_{i,t-2} \times S_{t-1}$
Pearson's correlation								
$I_{i,t}/A_{i,t-1}$	1							
$\text{ptb}_{i,t-1}$	0.16^c	1						
$\pi_{i,t-1}/A_{i,t-2}$	0.34^c	0.08^c	1					
S_{t-1}	0.17^c	-0.06^b	0.14^c	1				
$\text{ED}_i \times S_{t-1}$	0.16^c	-0.07^b	0.13^c	0.81^c	1			
$\text{ptb}_{i,t-1} \times S_{t-1}$	0.16^c	-0.04	0.13^c	0.81^c	0.75^c	1		
$\text{ED}_i \times S_{t-1} \times \text{ptb}_{i,t-1}$	0.17^c	-0.04	0.13^c	0.75^c	0.85^c	0.83^c	1	
$\pi_{i,t-1}/A_{i,t-2} \times S_{t-1}$	0.13^c	-0.06^b	0.09^c	0.68^c	0.70^c	0.66^c	0.69^c	1
$1/A_{i,t-1}$	-0.09^c	-0.18^c	0.21^c	0.02	0.02	0.003	0.013	0.03
Other statistics								
Mean	0.02	1.45	0.08	0.01	0.00	0.02	0	0.02
SD	0.03	0.61	0.08	1.00	0.30	1.58	0.45	0.12
Min	−0.07	0.26	−0.13	−2.74	−1.70	−5.47	−2.28	0.43
Max	0.14	5.08	0.57	2.03	1.26	6.73	1.90	0.95

Notes: a $p < 0.10$, b $p < 0.05$, c $p < 0.01$. There are 656 observations, with 40 annual observations for each of 16 cross-sections (manufacturing industries) over 1974–2014. $I_{i,t}/A_{i,t-1}$ is an industry specific investment to asset ratio; fundamentals are measured with profit at time $t-1$ scaled by assets at time $t-1$ ($\pi_{i,t-1}/A_{i,t-1}$); growth opportunities are measured by Market–book values of assets ($\text{ptb}_{i,t-1}$); investor sentiment is the first principal component of S&P stock price returns, real estate returns and slope of the yield curve; it roughly corresponds to their average; and ED_i is the equation (5) external dependence measure, estimated with industry and time fixed effects; $1/A_{i,t-1}$ is inverse assets.