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Abstract

The paper revisits the link between financial market investors' sentiment and capital investment. We make two contributions. We construct new measures for investor sentiment and for dependence on debt finance, and we offer new evidence based on 40 years of data and 16 U.S. manufacturing industries. Fixed capital investment increases more in response to changes in investor sentiment in industries that are more dependent on debt finance. We find no evidence for a direct effect of sentiment, nor for an effect that varies with Tobin's Q.

JEL classification: E22, G18

Keywords: investor sentiment, investment decisions, U.S. manufacturing industries; Tobin's Q; external financial dependence

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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 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 **??** and present our empirical results in Section **??**. Section **??** concludes.

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):

$$\frac{I_{i,t}}{A_{i,t-1}} = \alpha_i + \alpha_1 \mathrm{ED}_i \times S_{t-1} + \alpha_2 \mathrm{ptb}_{i,t-1} \times S_{t-1} + \alpha_3 \mathrm{ED}_i \times S_{t-1} \times \mathrm{ptb}_{i,t-1} + \\ + \alpha_4 S_{t-1} + \alpha_5 \frac{\pi_{i,t-1}}{A_{i,t-2}} + \alpha_6 \mathrm{ptb}_{i,t-1} + \alpha_7 \frac{1}{A_{i,t-1}} + \epsilon_{i,t}, \\ i = 1, \ldots, N;\ t = 1, \ldots, T \qquad (1)$$

where the endogenous variable ($I_{i,t}$) is investment in industry i at time t normalized by capital at time $t-1$ ($A_{i,t-1}$), S_{t-1} is a proxy for investor sentiment, ED_i is a modified measure of the Rajan and Zingales's (1998) external financial dependence, $\mathrm{ptb}_{i,t-1}$ is a market price-to-book value (Tobin's Q), $\pi_{i,t-1}/A_{i,t-2}$ is profit scaled by asset value, inverted assets $1/A_{i,t-1}$ captures spurious correlation due to the scaling of the left-hand 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 industry-specifics and for generic effects of investor sentiment across time by industry fixed effects α_i and time fixed effects. Significant estimates for the interaction of S_{t-1} with $\mathrm{ptb}_{i,t-1}$ 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 **??**, we summarize the specifications we will 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 time variation in the sensitivity of investment to industry-specific fundamentals.

Table 1: Parameter restrictions for different specifications and three types of control variables.

Model	Restrictions	Additional control variables	
		Time FE	$S_{t-1} \times \pi_{i,t-1}/A_{i,t-2}$
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:

$$S_t = \boldsymbol{\gamma} \boldsymbol{z}_t + u_t, \tag{2}$$

$$u_t = \rho_u u_{t-1} + v_t. \tag{3}$$

Here $\boldsymbol{z}_t$ is a vector of instruments with parameters $\boldsymbol{\gamma}$, v_t is an i.i.d. error term, and $|\rho_u| < 1$. From (**??**), we construct $\hat{S}_t = \hat{\boldsymbol{\gamma}} \boldsymbol{z}_t$.

In the second stage, we use OLS to regress the standardized value of the dependent variable in (1) on a k row vector $\tilde{\boldsymbol{X}}_{i,t}$, 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 the standardized values of exogenous regressors, where T is the number of time periods, G the number of cross-section units and K the number of regressors.

To estimate the standard deviation of $\hat{\boldsymbol{\beta}}_{2SLS}$, we calculate the second stage residuals $\hat{v}_{i,t} = \tilde{y}_{i,t} - \boldsymbol{X}'_{i,t}\hat{\boldsymbol{\beta}}_{2SLS}$, where the K row vector $\boldsymbol{X}_i$ contains the standardized value of the (possibly endogenous) regressors measured. Since we will estimate across industry clusters, we use a robust covariance–variance estimator that is equal to

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

where the block diagonal matrix $\hat{\boldsymbol{\Omega}} = \text{diag}(\hat{\boldsymbol{v}}_1\hat{\boldsymbol{v}}_1', \ldots, \hat{\boldsymbol{v}}_G\hat{\boldsymbol{v}}_G')$, G is the number of clusters and $\hat{\boldsymbol{v}}_i, i = 1, \ldots G$ is a T vector with the ith entry $\hat{v}_{i,t}$ as defined previously. 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 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 **??**). Other authors measure external dependence differently, using data on new equity and debt issues; still others use only data on debt.

We base our measure on the U.S. Census Bureau Quarterly Financial Reports over 2001:Q1–2015:Q4 and employ a regression-based approach that accounts for time and industry effects. For a firm in industry i, external dependence is defined in the Rajan and Zingales measure ED_i as

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

where $i = 1, \ldots, 16$. We proxy the excess of capital expenditures over cash flow in the numerator by the change in the stock of long-term debt ($\Delta\mathrm{Debt}_{i,t}$). Capital expenditures in the denominator, or investment ($I_{i,t}$), is proxied by the change in fixed asset values. We take the conditional correlation of changes in debt and investment as a proxy for external dependence. We estimate the following system:

$$\Delta\mathrm{Debt}_{i,t} = \beta_i I_{i,t} + e_{i,t}, \tag{4}$$

$$e_{i,t} = \alpha_i + \delta_t + u_{i,t}, \quad i = 1, \ldots, N; t = 1, \ldots T \tag{5}$$

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 industries and heteroskedastic. The estimates $\hat{\beta}_i$ are interpreted as measures of industry-specific external dependence (ED_i). In this interpretation, ED_i must be non-negative. This is confirmed in the second column of Table **??**, 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.[1] For purposes of comparison, we include external dependence as in Laeven and Valencia (2013) (based on 1980–2006 data) in the third column and the Rajan and Zingales (1998) measure (based on 1980–1989 data) in the fourth column. The ED_ivalues differ between the three measures due to the different sample periods, the new estimation method, data aggregation, and definitional differences.

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 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 1-year and 10-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

[1]In our specification, external dependence is a so-called generated regressor (Pagan, 1984). We estimate ED_i with Eq.(**??**) and in the second stage (panel) regression we treat it as an observed variable. This raises some questions over our standard errors, but we note that our second-stage OLS estimator is still consistent

Table 2: External dependence estimates for 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: Source: U.S. Census Bureau Quarterly Financial Reports (2001:Q1–2015:Q4) and authors' calculations.

Rozite et al. (2019)[2]. 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

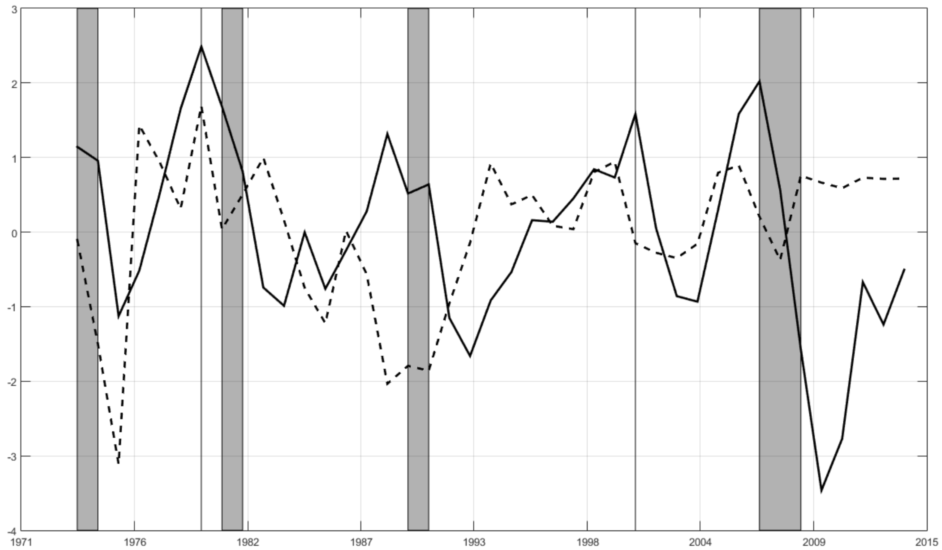
$$S_t = -\,0.688\ \mathrm{SYC}_t + 0.660\ \mathrm{REP}_{t-6} + 0.299\ \mathrm{SP}_{t-3}.$$

We take December data to obtain annual values.

We address endogeneity concerns by instrumenting S_i with global investor sentiment, proxied by the log spread between the three-month Eurodollar deposit rate and the three-month London interbank offered rates (LIBOR), both obtained from ALFRED, the database of the Federal Reserve Bank of St. Louis. The Eurodollar market is the world's premier capital market, providing over 90% of all international loans. Eurodollar deposit rates are considered forward rates on the U.S. dollar and LIBOR is the spot rate; the difference is the profit margin, intuitively a plausible instrument. Figure **??** shows standardized values of the instrumental variable ($\mathrm{DED3LIBOR}_t$) and the investor sentiment index S_i. Visual inspection suggests good correspondence between the two series. Peaks in investor sentiment precede NBER recessions.

[2] 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 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.

Table **??** 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 sentiment index.

Table 3: 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}	$\text{ED}_i \times S_{t-1}$	$\text{ptb}_{i,t-1} \times S_{t-1}$	$\text{ED}_i \times S_{t-1} \times \text{ptb}_{i,t-1}$
Correlation							
$I_{i,t}/A_{i,t-1}$	1						
$\text{ptb}_{i,t-1}$	0.23	1					
$\pi_{i,t-1}/A_{i,t-2}$	0.43	0.14	1				
S_{t-1}	0.31	−0.07	0.21	1			
$\text{ED}_i \times S_{t-1}$	0.29	−0.07	0.16	0.88	1		
$\text{ptb}_{i,t-1} \times S_{t-1}$	0.27	0.024	0.23	0.93	0.80	1	
$\text{ED}_i \times S_{t-1} \times \text{ptb}_{i,t-1}$	0.26	−0.02	0.14	0.83	0.94	0.86	
$1/A_{i,t-1}$	−0.03	−0.17	0.31	0.02	0.03	−0.00	−0.02
Other statistics							
Mean	0.02	1.45	0.09	−0.01	−0.00	−0.07	−0.23
SD	0.03	0.61	0.08	1.24	0.37	1.95	0.56
Min	−0.07	0.26	−0.13	−3.46	−2.15	−6.94	−2.88
Max	0.14	5.08	0.57	2.49	2.30	8.16	2.30

Notes: Investment is $I_{i,t}/A_{i,t-1}$. $S_{i,t-1}$ is lagged investor sentiment (the first principal component of S&P stock price returns, real estate returns and slope of the yield curve); ED_i is dependence on debt finance; $\text{ptb}_{i,t-1}$ is the lagged price-to-book value (Tobin's Q); $\pi_{i,t-1}/A_{i,t-1}$ is lagged profit scaled by assets; and the inverse of lagged assets $1/A_{t-1}$ captures any spurious correlation due to scaling.

4 Results

In the next five tables we report estimation results of investment regressions across the different specifications given in Table **??**, with and without investor sentiment effects and with and without moderation by an external dependence channel and a Tobin's Q channel. Our benchmark results are in Table **??**.

The first column in Table **??** reports a baseline model without investor sentiment or its channels, but with standard controls: profit scaled by assets, Tobin's Q and the

Table 4: The investment effect of investor sentiment

	(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: The dependent variable is investment $I_{i,t}/A_{i,t-1}$. t statistics in parentheses are based on Driscoll-Kraay [ADD YEAR; INCLUDE IN REFS]standard errors. Superscript ^{a} denotes $p < 0.10$, ^{b} denotes $p < 0.05$, and ^{c} denotes $p < 0.01$. $S_{i,t-1}$ is lagged investor sentiment (the first principal component of S&P stock price returns, real estate returns and slope of the yield curve); ED_i is lagged dependence on debt finance (external dependence); $\text{ptb}_{i,t-1}$ is the lagged price-to-book value (Tobin's Q); $\pi_{i,t-1}/A_{i,t-1}$ is lagged profit scaled by assets; and the inverse of assets $1/A_{t-1}$ captures any spurious correlation due to scaling.

inverse of assets (to account for any spurious correlation effects in the profit variable). Past profit tends to increase investment, in line with earlier work (Fazzari et. al, 1988 ; Baker et al., 2003). Tobin‘s Q carries the expected positive sign, although the coefficient is not significant. These baseline findings will be robust throughout the explorations reported in the other table below.

In column (2) of Table **??**, 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 **??**, 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 weakly 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 **??**. 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 **??** and from 57% to 58% in Table **??**.

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) but it is consistent with Blanchard et al. (1993). 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[3]. 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 **??**, but it is when adding either an investment-profit interaction in Table **??**) or time fixed effects in Table **??**).

As already noted in the discussion, we demonstrate the robustness of these benchmark results to adding profit levels and to time and industry fixed effects in Tables **??** to **??**. In sum, these tables provide an extensive empirical exploration of the ways in which investor sentiment may affect investment in fixed capital.

[3]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 5: Is the investment effect of investor sentiment moderated by profit levels?

	(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: The dependent variable is investment $I_{i,t}/A_{i,t-1}$. t statistics in parentheses are based on Driscoll-Kraay standard errors. Superscript ^{a} denotes $p < 0.10$, ^{b} denotes $p < 0.05$, and ^{c} denotes $p < 0.01$. $S_{i,t-1}$ is lagged investor sentiment (the first principal component of S&P stock price returns, real estate returns and slope of the yield curve); ED_i is lagged dependence on debt finance (external dependence); $\text{ptb}_{i,t-1}$ is the lagged price-to-book value (Tobin's Q); $\pi_{i,t-1}/A_{i,t-1}$ is lagged profit scaled by lagged assets; and the inverse of assets $1/A_{t-1}$ captures any spurious correlation due to scaling.

Table 6: The investment effect of investor sentiment, with 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: The dependent variable is investment $I_{i,t}/A_{i,t-1}$. t statistics in parentheses are based on Driscoll-Kraay standard errors. Superscript ^{a} denotes $p < 0.10$, ^{b} denotes $p < 0.05$, and ^{c} denotes $p < 0.01$. $S_{i,t-1}$ is lagged investor sentiment (the first principal component of S&P stock price returns, real estate returns and slope of the yield curve); ED_i is lagged dependence on debt finance (external dependence); $\text{ptb}_{i,t-1}$ is the lagged price-to-book value (Tobin's Q); $\pi_{i,t-1}/A_{i,t-1}$ is lagged profit scaled by lagged assets; and the inverse of assets $1/A_{t-1}$ captures any spurious correlation due to scaling.

Table 7: The investment effect of investor sentiment, with profit interaction 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
$\text{ED}_i \times S_{t-1}$		0.0174^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: The dependent variable is investment $I_{i,t}/A_{i,t-1}$. t statistics in parentheses are based on Driscoll-Kraay standard errors. Superscript ^{a} denotes $p < 0.10$, ^{b} denotes $p < 0.05$, and ^{c} denotes $p < 0.01$. $S_{i,t-1}$ is lagged investor sentiment (the first principal component of S&P stock price returns, real estate returns and slope of the yield curve); ED_i is lagged dependence on debt finance (external dependence); $\text{ptb}_{i,t-1}$ is the lagged price-to-book value (Tobin's Q); $\pi_{i,t-1}/A_{i,t-1}$ is lagged profit scaled by lagged assets; and the inverse of assets $1/A_{t-1}$ captures any spurious correlation due to scaling.

Finally in Table **??** we instrument investor sentiment with the log difference of the spread in dollars between the three-month Eurodollar deposit rates and LIBOR ($\log \text{DED3LIBOR}_t$). We also include dummy variables for 2009 and 2010 to control for crisis effects. In the first stage, we obtain the following estimation results.

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

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 **??** reports the second-stage estimation results. They support most of the findings in Tables **??**–**??**. In particular, investor sentiment has a positive marginal effect on investment through the external dependence channel. As before, the Tobin's Q channel coefficient is insignificant. However, the three-way interaction term no longer carries a significant coefficient.

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.

Table 8: The investment effect of instrumented investor sentiment

	(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: The dependent variable is investment $I_{i,t}/A_{i,t-1}$. t statistics in parentheses are based on Driscoll-Kraay standard errors. Superscript ^{a} denotes $p < 0.10$, ^{b} denotes $p < 0.05$, and ^{c} denotes $p < 0.01$. $S_{i,t-1}$ is lagged investor sentiment (the first principal component of S&P stock price returns, real estate returns and slope of the yield curve); ED_i is lagged dependence on debt finance (external dependence); $\text{ptb}_{i,t-1}$ is the lagged price-to-book value (Tobin's Q); $\pi_{i,t-1}/A_{i,t-1}$ is lagged profit scaled by lagged assets; and the inverse of assets $1/A_{t-1}$ captures any spurious correlation due to scaling.

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.

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A Classification of industries

In order to obtain financial ratios and investment data, we use four data sources and long time series. We matched the data from different sources as shown in Table A.1. There are two versions of data from the National Income and Product Accounts (NIPA): before and after 1998, when the NIPA industry classification changed. We matched the two sources mostly by merging pre-1998 industries. For instance, 'Tobacco' and 'Food' were separate industries before 1998. They were merged so as to correspond to the single post-1998 industry 'Food and beverages and tobacco products'. Likewise, the pre-1998 industries 'Apparel' and 'Leather' were merged into one. The change in classification also needed to take account of the structure of the Bureau of Economic Analyses Quarterly Financial Reports (QFR), which for some industries have different industry classifications from the NIPA tables (both before and after 1998). For instance, the QFR has seperate 'Food' and 'Beverage and Tobacco Products', which we merged into the same 'Food and beverages and tobacco products' industries as above. For another example, we also merged several industries producing electronics, appliances, computers and communications equipment with two pre-1998 NIPA industries producing electronic equipment and instruments, and with two (slightly differently named) post-1998 NIPA industries producing (close to) the same products. In Table A.1. we detail these re-classifications. We end up with data on 17 manufacturing industries.

The combined NIPA and QFR industries were matched to industry classifications in the Fama and French data (`https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`) and the Wharton Research Data Services (`https://wrds-web.wharton.upenn.edu/wrds/`), which provide data on financial ratios. These source use different naming conventions from the NIPA and QFR data. We used the Fama and French 10-industry portfolio classification to obtain the data the ‘Hitec’ (Computers, software and electronic equipment) and ‘Energy’ (Oil, Gas and Coal) industries. We used the 49-industry classification of the Wharton Research Data Services.to obtain information on the remaining industries. We let the ‘Furniture’ industry correspond to ’Consumer goods’ in the Wharton data. We let ’Nonmetallic minerals and Wood’ correspond to ‘Construction Materials’ in the Wharton data.

Table A.1: Matching industry data from three data sets: naming correspondence.

Quart. Fin. Reports from 2000Q1	NIPA tables prior to 1998	NIPA tables from 1998	Our study: QFR 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		

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