The Investment-Sales Sensitivity

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This version: May 2022

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I would like to thank Jason Chen, Sean Cleary, Jacob Oded, for helpful comments on earlier versions. Zhiwen (Ryan) Zhuang provided excellent assistance. All remaining errors are mine.

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Abstract

There has been an investment-sales sensitivity among US manufacturing firms. Unlike the investment-cash flow sensitivity which declined to near zero in recent years, the investment-sales sensitivity has remained economically and statistically strong. The finding of the investment-sales sensitivity lends support to the Q-theory explanation over the financial-constraint explanation of the investment-cash flow sensitivity. The contrast between the two sensitivities in more recent years reveals the difference in the informational role for the investment of tangible assets between sales and cash flow. The difference is mainly driven by the need to accumulate organizational capital in new-economy firms.

Key words: Investment-sales sensitivity, investment-cash flow sensitivity, Q-theory, financial constraint, cash flow predictability, new economy, organizational capital, operating leverage.

JEL codes: D22, D25, G31

1. Introduction

There has been an extensive empirical literature on corporate investment decisions. A large part of it centers on the discussion of the investment-cash flow sensitivity, which is the finding that corporate investment depends on cash flow, initially discovered by Fazzari, Hubbard and Petersen (1988). A debate lasted for more than twenty years between two schools of thoughts. One school, represented by the authors cited above, asserts that the investment-cash flow sensitivity is indicative of the existence of financial constraint. The other school, initiated by Kaplan and Zingales (1997), contends that investment depends on cash flow because current cash flow contains information about future cash flow and serves as a proxy for marginal productivity, so the existence of the investment-cash flow sensitivity is consistent with the classical Q-theory proposed by Tobin (1969). The debate subsided gradually, however, as the investment-cash flow sensitivity declined over time and disappeared around the year 2000.[1]

In this paper I document that there is an investment-sales sensitivity during the period 1970-2019 for all manufacturing firms in the US. Unlike the investment-cash flow sensitivity, the investment-sales sensitivity remains economically and statistically strong throughout the sample period. A direct reason for sales to be a better predictor for investment than cash flow is that current sales turn out to be a better predictor for future cash flow than current cash flow. Unlike cash flow, which becomes a poor predictor for investment for new economy firms, the predictive power of sales for investment is slightly higher for new-economy firms than old-economy firms.

Why is investment sensitive to sales? Based on the facts documented in this paper, I develop a model to explain the reasons behind. The model is rooted in the neoclassic economic theory

[1]Poterba (1988) gives a remark on the result of Fazzari, Hubbard and Petersen (1988), suggesting that the investment-cash flow *could* be consistent with the Q-theory in spirit. Alti (2003), Moyen (2004), and Abel (2018) build theoretical models in which cash flow provides information about marginal productivity without financial constraint. Cleary (1999) and Grullon, Hund and Weston (2013) provide empirical support of the Q-theory explanation of the investment-cash flow sensitivity. Allayannis and Mozumdar (2004) first document the decline of the investment-cash flow sensitivity. Chen and Chen (2012) conclude that the investment-cash flow sensitivity remains as a puzzle. Wang and Zhang (2021) show that the investment-cash flow sensitivity manifests the productivity of tangible capital, whose decline is responsible for the decline of the investment-cash flow sensitivity.

of investment and is broadly consistent with the Q-theory, under the assumption that marginal product of capital is unobservable, similar to the models of Alti (2003) and Moyen (2004) in explaining the investment-cash flow sensitivity. To highlight the difference between sales and cash flow, the model focuses on the role of the rising operating leverage (i.e., declining profit margin) and its volatility, especially for the new-economy firms with intensified competition among them. The model implies that investment depends on sales due to its informational advantage over cash flow. In addition, the model describes the economic rationale for sales to guide investment especially for new-economy firms with high expected value and variation of operating leverage.

The paper makes two contributions to the literature. The first is to establish the role of sales in the decision of corporate investment from both empirical and theoretical perspectives. Corporate investment is no doubt a very important variable in economic theory to be explained. There is no lack of theories on how corporate investment should be determined and on how it is actually determined in practice. The aforementioned Q-theory and financial constraint theory are examples. The problem with these theories is that there are no good measures of marginal Q and there are no clean measures of financial constraints.[2] The market-to-book value, the usual measure of Tobin's Q, does not explain investment by itself as conditions outlined by Hayashi (1982) for it to be the only variable to explain investment do not hold in reality, as well documented in the literature. Other attempts to modify it are still subject to measurement errors. Recent work, by Peters and Taylor (2017) for example, in refining the Q measure makes some advances, but still leaves a big gap to be filled. Cash flow used to be able to explain investment, reasons aside, but is no more. The finding of the investment-sale sensitivity therefore fills a void and has its importance per se. The researchers have been discussing the investment-cash flow sensitivity for more than thirty years, but never paid attention to the investment-sales sensitivity, which is of independent interest, irrespective its relation to the investment-cash flow sensitivity. It is documented in this paper that future cash flow can be better predicted by current sales than

[2]For the Q-theory, there is a large literature on its measurement errors. For financial constraint measures, see Bodnaruk, Loughran, and McDonald (2015), Hoberg and Maksimovic (2015), and Farre-Mensa and Ljungqvist (2016).

by current cash flow. Beside the informational role of sales, there can be a more fundamental role of sales in investment decisions. While long term growth of cash flow is firms' ultimate goal, sales are also important in the following sense. The basic idea can be traced to the so-called DuPont analysis, which is a traditional method of analysis, popular among practitioners. The thrust of this analysis is that the profit margin of a firm is more or less industry specific and also depends on the competitive position of the firm within the industry. Given the profit margin, maximizing cash flow is equivalent to maximizing sales. For firms in industries with low average profit margin, sales are key to increase cash flow. Low average profit margin of an industry is often caused by the competition of firms within the industry. Competition often forces firms to forgo current cash flow, boost sales, in a bid to expand their market share and to survive in competition, before eventually and hopefully raising profit margin and increasing cash flow in future. The informational reason given before is from a statistical point of view, while the argument related to DuPont analysis provides more economic reasons.

The second contribution of the paper is to abjudicate the debate between the Q-theory and financial constraint explanations of the investment-cash flow sensitivity. The finding of the investment-sales sensitivity is illuminating. Sales do not have the natural interpretation of financial constraint. Yet, investment is sensitive to sales. Firms with large sales have large investment, exceeding their cash flows, so financial constraint certainly cannot be the cause of the investment-sales sensitivity. But why is investment sensitive to sales? Can a generalized Q-theory explain the investment-sales sensitivity? The empirical results and the theoretical model presented in this paper provide evidence and logic leading to an affirmative answer. To understand the reasons behind, we begin with how the Q-theory explains the investment-cash flow sensitivity. According to the Q-theory explanation, investment is sensitive to cash flow because current cash flow, generated from previous investment, contains useful information about the productivity of the previous investment and, therefore, provides guidance to current investment for future cash flow. When cash flow provides right guidance to investment, current cash flow predicts future cash flow and the time series of cash flow is highly autocorrelated. This is indeed the case in the earlier years of the sample. In fact, sales also fit for the role, although sales tie less closely to the productivity of capital. What happened to cash flow in the later years of the sample is that current cash flow gradually lost its predictive power for future cash flow. As such, investment became less dependant on current cash flow. Wang and Zhang (2021) document such a pattern in a fifty-year sample period ending 2016. The time series of sales, on the other hand, remained highly autocorrelated. In fact, current sales became a better predictor of future cash flow than current cash flow, as will be shown in this paper. Therefore, although the purpose of investment is for future cash flow instead of just sales, investment became more dependant on current sales than on current cash flow, simply because current sales contain more information than current cash flow about future cash flow. The investment-sales sensitivity is thus explainable by the Q-theory, but not by the financial constraint theory.

To further understand what makes cash flow and sales behave differently in the later years of the sample, analyses from several perspectives are conducted. First, I contrast firms of different features: NASDAQ-listed vs. NYSE/AMEX-listed firms, and high-tech vs. low-tech firms. The results show that the difference between the investment-cash flow sensitivity and the investment-sales sensitivity manifests mostly among NASDAQ-listed and high-tech firms, which represent new-economy firms. It is more for new-economy firms than for old-economy firms that future cash flow is difficult to predict, but sales played more important role than cash flow to predict future cash flow. It is more for new-economy firms than for old-economy firms that investment shifted its dependence on cash flow to its dependence on sales. Second, I investigate how the investment-sales sensitivity depends on other firm characteristics. Among several commonly used firm characteristics, the investment-sales sensitivity is positively related to tangible capital, but negatively related to book-to-market ratio and firm leverage. The former is similar to the investment-cash flow sensitivity, documented in Wang and Zhang (2021). The latter means that growth firms and low leverage firms tend to have a high investment-sales sensitivity. Such evidence collaborates with that obtained from the analyses of the new- and old-economy firms. New-economy firms tend to be growth firms and, due to their long cash flow duration and low survival rates, they tend to have more difficulty in raising debt, so most of them are low leverage firms. Third, I examine the source of the variation between sales and cash flow, which causes the difference between the investment-sales sensitivity and the investment-cash flow sensitivity. The examination is based on the accounting identity that Sales (SA) equal the sum of cost of goods sold (COGS), selling, general and administrative expenses (XSGA), miscellaneous items involving taxes, interest payments etc. (MISC) and cash flow (CF). The sensitivity of investment to sales is largely derived from the sensitivity of investment to XSGA, which can be regarded as investment in intangible or organizational capital.[3]

Combining the analyses from the above three angles, a clear picture emerges. In the early years of the sample, old-economy firms dominate, so both cash flow and sales provide useful guidance to the decisions on physical investment. These firms are mostly listed on NYSE or AMEX, and are mostly in low-tech industries. Over the time, however, more and more new-economy firms enter the sample. More such firms are listed in NASDAQ and many of them are in high-tech industries. For most of new-economy firms, making profits right away after they are listed on exchanges is a luxury. The priority is to quickly expand and to increase their market share by increasing their sales. In competing with their peers, they are forced to spend more heavily on advertisement, research and development, and perks for retaining talents, in order to build up their intangible/organizational capital. All of these go into XSGA, which reduces cash flow for given sales. In the meantime, physical investment of such firms are made in line with the investment in intangible/organizational capital. As a result, cash flow for these new-economy firms becomes more volatile and less self-predictable, while tangible capital investment is positively related to intangible/organizational capital investment and, hence, to sales. In this sense, the dependence of investment on sales is from the fundamentals channel, as well as from the information channel.

The paper makes three contributions to the literature. The first is to shed light on the debate between the Q-theory and the financial constraint theory in explaining the investment-cash flow sensitivity. By showing that investment is also sensitive to sales, it offers direct evidence that investment is not confined by cash flow, so it cannot be caused by financial constraint as the

[3]There is no need to distinguish intangible capital and organizational capital in this paper, so no attempt is made here.

main reason. All the findings related to the investment-sales sensitivity are consistent with the extended Q-theory in which a distinction of productivity between tangible capital and intangible capital is made. The second contribution pertains to the understanding of investment.

The third contribution is related to the reason behind the investment-sales sensitivity. The sensitivity of investment to sales is particularly high for new-economy firms, indicating the importance of gaining market share relative to making profits in competitive environment for such firms. The fact that the investment-sales sensitivity can be traced to the sensitivity of physical investment to the selling, general and administrative expenses, which can be viewed as investment in intangible/organizational capital, reflects the notion that tangible capital and intangible/organizational capital are less substitutable in the new-economy.

The rest of the paper is organized as follows. Section 2 introduces data and reports summary statistics of the key variables used in the paper. Section 3 presents the main results of investment regressions with sensitivities to cash flow and sales, as well as the results of cash flow regressions. Section 4 contrasts new-economy firms with old-economy firms in terms of their investment sensitivities. Section 5 presents the investment-sales sensitivity as a function of other firm characteristics. Section 6 shows that, among several components of sales, investment is mostly sensitive to the selling, general and administrative expenses and discusses its implications. Section 7 concludes.

2. Data and Summary Statistics

2.1. Data

The sample used in this paper is the US manufacturing firms (SIC codes from 2000 to 3999) in the COMPUSTAT annual file from 1970 to 2019. The sample is divided between firms listed on NASDAQ and those listed on NYSE/AMEX. The sample is also divided between high-tech manufacturing firms and low-tech manufacturing firms, where high-tech firms are those with their three-digit SIC codes being 283, 357, 366, 367, 382, or 384, following the literature, and the low-tech firms are the rest of the firms. NASDAQ and high-tech are used as identifiers of new-economy firms, although such identifiers are not perfect. Certain NASDAQ firms are producing traditional products. Certain firms in a high-tech industry may not produce high-tech products only, while certain firms in traditional, low-tech industries are actually producing high-tech products.[4] These shortcomings, however, work against finding differences between old- and new-economy firms.

Physical investment, Inv, is the capital expenditure (COMPUSTAT item, CAPX) of a firm-year (i,t), scaled by the total assets (AT) at the beginning of the year. Sales are the total sales (SA) of a firm-year (i,t) scaled by the beginning-of-the-year total assets AT. Sales minus cost of goods sold (COGS) is known as gross profit (GP). GP minus selling, general, and administrative expenses (XSGA) is known as operating income before depreciation (OI). OI minus a few miscellaneous items is the cash flow (CF) measure adopted in the literature of the investment-cash flow sensitivity.[5] All of these variables are scaled by the beginning-of-the-year total assets AT. The accounting relationship among these variables is

$$\begin{aligned} \text{SA} &= \text{COGS} + \text{XSGA} + \text{OI} \quad (1) \\ &= \text{COGS} + \text{XSGA} + \text{Misc} + \text{CF}. \quad (2) \end{aligned}$$

Tangible capital, TC, is the net property, plant and equipment (PPENT), which is a stock variable scaled by the total assets of the same year. Firm-years (i,t) with missing value of Inv_{it}, SA_{it}, COGS_{it}, CF_{it}, $\text{TC}_{i,t-1}$ $\text{SA}_{i,t-1}$ or $\text{CF}_{i,t-1}$ are deleted. All the variables are winsorized at 1% on both sides.

[4]For example, Boeing is in the aircraft industry, which has existed for a long time and is classified as a low-tech industry. Another example is Tesla, which belongs to the motor vehicle industry, also classified as low-tech. Less strikingly but more pervasively are many firms like Nike, which belongs to apparel industry, a traditional low-tech industry, but is making all kinds of high-tech gadgets related to sports and health.

[5]The miscellaneous items, Misc, is the sum of miscellaneous items including interest expenses (XINT), non-operating income (NOPI), special items (SPI), taxes (TXT), and minority interest (MII).

2.2. Summary Statistics

Table 1 reports the mean value of the key variables used in this paper. Panel A is for all the manufacturing firms during the five decades. Panels B and C separate the whole sample of all manufacturing firms into those listed on NASDAQ and NYSE/AMEX, respectively. Panels D and E are divided between high-tech and low-tech firms. Several other firm characteristics will also be used in a later section. Since they are widely used in the literature with known statistical properties, they are not reported here for saving space.

Table 1 here

As seen in Panel A, the number of all manufacturing firms with non-missing variables started around 1,500 in the first decade of the sample, climbed to 2,172 in the 1990s, and fell back to 1535 by 2010s. The mean physical investments as a fraction of total assets, Inv, declined from 7% in the first decade to 4% by the last decade of the sample. The mean sales, SA, declined from 167% to 89% of total assets over the same period. The mean cost of goods sold, COGS, is a major component of sales, with its proportion to sales being around 70%. The selling, general and administrative expenses, XSGA, are the next major component of sales, with its mean value relative to total assets rising from 29% in the first decade to 35% in the middle decade, then falling back to 29% in the last decade. The mean total-assets-scaled operating income before depreciation, OI and cash flow, CF, experienced the most drastic decline from 18% and 11% respectively in the first decade to zero and -4% respectively in the last decade.

Among all these variables, XSGA deserves special attention. XSGA contains all the expenses that are not tied to any specific product of the firm, but needed to support the overall operations of the firm. Advertisement and other marketing expenses are typical items of XSGA, which raise awareness about the firm among consumers or clients. Research and development expenses are another important component of XSGA, which has an obvious connection to the buildup of intangible capital. Another important component of XSGA is the perks paid to the top executives of the firm. Eisfeldt and Papanikolaou (2013, 2014) have extensive discussion on that aspect.

For all these reasons, XSGA is rightfully regarded by many financial economists and analysts as investment in intangible or organization capital.

From Panels B and C, we see that the number of NASDAQ listed firms more than tripled from less than 510 in the first decade to about 1,530 in the third decade and then fell back to 1,002 in the last decade, while the number of NYSE/AMEX listed firms declined sharply from 1099 in the first decade to 788 in the second decade, and then declined steadily to 533 in the last decade. The major differences between NASDAQ and NYSE/AMEX firms are that XSGA tended to be higher for NASDAQ firms than for NYSE/AMEX firms, that the average CF of the NASDAQ firms started at a higher level than NYSE/AMEX firms, but dropped much faster than those of NYSE/AMEX firms to the negative region in the last two decades, and that the tangible capital was lower for NASDAQ firms than for NYSE/AMEX firms on average.

As seen in Panels D and E, the number of high-tech firms increased quickly from an average of 253 in the first decade to 926 in the penultimate decade and fell back to 773 in the last decade, while the number of low-tech firms held steady between 1,253 and 1,295 in the first three decades and then declined to 762 in the last decades. The major differences between high-tech and low-tech firms are very much like those between NASDAQ firms and NYSE/AMEX firms, as most high-tech firms are listed on NASDAQ and they tend to rely less on tangible capital. In particular, cash flow of high-tech firms declined to be negative on average, while cash flow of low-tech firms declined only slightly. Further more, high-tech firms tended to have higher XSGA than low-tech firms.

The standard deviations of the key variables in Table 2 provide further characteristics of firms with various features. For the sample of all manufacturing firms in Panel A, the standard deviations of gross profits, GP, operating income before depreciation, OI, and cash flow, CF, increased over time by and large, especially for OI and CF, while their means declined as seen in Table 1. The standard deviation of sales, on the other hand, did not fluctuate much during the first three decades and actually declined in the last two decades. The results from Panels B to G reveal that the increase in standard deviations of GP, OI and CF, manifests mainly in NASDAQ listed and high-tech firms. Those of NYSE/AMEX listed and low-tech firms also increased somewhat, but the magnitude is much smaller. These patterns are helpful in understanding the cause of the differences between the investment-cash flow sensitivity and the investment-sales sensitivity.

Table 2 here

3. Main Results

I examine investment regressions of the following type

$$\text{Inv}_{it} = a_0 + a_1\text{CF}_{it} + a_2\text{SA}_{it} + \varepsilon_{it}. \tag{3}$$

where a_1 measures the investment-cash flow sensitivity, a_2 measures the investment-sales sensitivity, and ε_{it} is the generic term for regression errors. Since the main interest is in the time-variation of these sensitivities, the regressions are run for each of the five decades separately. As a standard practice in the literature of the investment-cash flow sensitivity, both firm and year fixed effects are included in the regressions and t-ratios of the parameters are based on standard errors that cluster by both firm and year. Table 3 reports the baseline results of the investment regressions. Only slope coefficients are reported, as the intercept term and fixed effects are of less interest.

Table 3 here

The first part of Table 3 reports the investment-cash flow sensitivity. The significant investment-cash flow sensitivity in the early decades and its decline in later decades have been widely documented, in Allayannis and Mozumdar (2004), Chen and Chen (2012), and Wang and Zhang (2021), for example, in their respective samples. In the literature, the investment regressions are usually run with the market-to-book asset ratio (i.e., the average Q) as one explanatory variable. While its slope coefficient is marginally, statistically significant, it is economically insignificant, as shown in many studies such as those cited above. Moreover, it does not affect the explanatory power of other potential variables that have been considered. For that reason, it is not included here to avoid distraction. Various firm-specific variables have also been used to form a cross product term with cash flow, in order to explain the sensitivity and its decline. Very few succeed as discovered by Chen and Chen (2012), especially those suggested by the financial constraint theory which often have estimated coefficients with a wrong sign. Again, inclusion of these variables does not affect the results reported in the paper, so to save space, they are not included either, except for ones to be discussed in a later section.

The middle part of Table 3 contains the main results. There is an investment-sales sensitivity and it has been statistically and economically strong throughout the five decades of the sample period.[6] The last part of Table 3 reports the investment-cash flow sensitivity and the investment-sales sensitivity in multiple regressions. In the early decades, cash flow and sales share the predictive power. But even then, investment is more sensitive to sales than to cash flow. By the 1990s, sales have taken over cash flow in explaining investment. The coefficients of cash flow in the last three decades are negative, indicating that, compared with other components of sales, cash flow is less important in guiding investment decisions. The results are robust to inclusion of many other potential explanatory variables.

The rest of the paper is devoted to understanding what causes investment to be sensitive to sales and what makes sales different from cash flow. We begin with the cash flow predictability. According to the Q-theory explanation of the investment-cash flow sensitivity which prevailed in the early decades, investment is sensitive to cash flow because current cash flow predicts future cash flow in the early decades, and moreover, the investment-cash flow declined later because cash flow autocorrelation declined later. To put the investment-sales sensitivity in the perspective, consider the cash flow regression of the form

$$\mathrm{CF}_{it} = b_0 + b_1 \mathrm{CF}_{i,t-1} + b_2 \mathrm{SA}_{i,t-1} + \varepsilon_{it}. \tag{4}$$

Table 4 reports the result of the cash flow regressions.

[6]The slope coefficient in the last decade appears to be smaller than those in earlier decades. Part of the reason is that the standard deviation of investment becomes smaller in the last decade.

Table 4 here

When current cash flow alone is used to predict future cash flow, the slope coefficient is statistically significant, but the magnitude and significance are declining over time. When current sales alone are used to predict future cash flow, the slope coefficient is also statistically significant, and the magnitude is increasing over time and statistical significance remains strong. When both current cash flow and sales are used to predict future cash flow, sales do not help much in the first decade. But from the second decade on, while future cash flow can still be predicted by current cash flow, current sales become a better predictor. Therefore, a reconciliation of the results in Table 3 is straightforward. Since cash flow loses its predictive power for future cash flow to sales in later decades, it is just natural that investment becomes sensitive to sales instead of cash flow. What causes cash flow to lose its predictive power for its own future value and why sales can beat current cash flow to predict future cash flow can be further analyzed in a later section. Irrespective the causes, the reason why investment becomes sensitive to sales is a no-brainer, given the fact that sales predict future cash flow better.

4. Differences in Investment Sensitivities between New- and Old-economy Firms

In this section we compare the difference in the investment-sales sensitivity and the investment-cash flow sensitivity between new-economy firms and old-economy firms. This difference-in-differences approach can help us understand why investment is sensitive to sales. We present investment and cash flow regressions for new-economy and old-economy firms separately, based on the classification of exchanges, and high- and low-tech sectors.

Table 5 reports the results of the investment regressions for NASDAQ listed and NYSE/AMEX listed firms separately. It can be seen that the decline of the investment-cash flow sensitivity and the rise of the investment-sales sensitivity are more obvious in the NASDAQ subsample. From goodness-of-fit measures, it can be inferred that cash flow and sales share similar information in the early decades. But in the late decades, cash flow loses its explanatory power. For NYSE/AMEX listed firms, the investment-cash flow sensitivity remains positive and statistically significant even for the last decade, although it declines over time. Relatively speaking, sales of NYSE/AMEX firms contribute less than sales of NASDAQ firms in making investment decisions. For NYSE/AMEX firms, cash flow and sales tend to share their predictive power for investment throughout the entire sample.

Table 5 here

Table 6 reports the results of cash flow regressions for NASDAQ listed and NYSE/AMEX listed firms separately. Comparing the results reported in Table 4 that current sales predict future cash flow better than current cash flow does, we see that this is mainly driven by the NASDAQ firms. For NASDAQ firms, sales dominate cash flow in predicting future cash flow for the entire sample period, starting from the first decade. For NYSE/AMEX firms, future cash flow is better predicted by current cash flow than by sales in the first two decades. Only in the later decades, do sales start to play more important role than current cash flow in predicting future cash flow.

Table 6 here

Table 7 reports the results of the investment regressions for high-tech and low-tech firms separately. The difference between high-tech and low-tech is more obvious than that between NASDAQ and NYSE/AMEX listed firms. The disappearance of the investment-cash flow sensitivity for high-tech firms occurred in 1990s. By the last decade of the sample, it even became significantly negative. When cash flow and sales are jointly used to track investment, cash flow is completely subsumed by sales and contributes negatively. For low-tech firms, while cash flow gradually loses its explanatory power for investment, it remains useful even towards the last decade. Sales have strong explanatory power for investment since the first decade, but sales do not edge out cash flow completely.

Table 7 here

Table 8 reports the results of cash flow regressions for high-tech and low-tech firms separately. For high-tech firms, current cash flow and sales have about equal explanatory power for future cash flow when used alone. When both current cash flow and current sales are used to predict future cash flow, sales dominate current cash flow. For low-tech firms, the contrast between cash flow and sales is reversed. The predictive power of current cash flow and current sales for future cash flow appears similar when they are used alone. But when they are used together, sales were inferior to cash flow in the first decade, gained explanatory power in later decades, but did not become much more useful than cash flow even in the last decade.

Table 8 here

Overall, the results presented in this section show that it is the new-economy firms for which cash flow has lost its predictive power for future cash flow over time and for which sales have gain predictive power for future cash flow. It is because of this, the investment-cash flow sensitivity has declined over time, while investment-sales sensitivity have become the major predictor of investment. Among old-economy firms there has been such a tendency as well, as they have also been evolving and embracing new technologies, but the magnitude is much smaller, so the investment continues to partially depend on cash flow.

This observed pattern is consistent with the explanation given in the last section via the DoPont analysis. New-economy firms have lower profit margin on average, especially those enter the sample in later decades, as seen from Table 1. Thus, sales are more important for new-economy firms. This means, the dependence of investment on sales could go beyond the information channel. Investment of new-economy firms is made to pursue sales per se, in order to increase their market shares within the industries.

5. The Investment-sales Sensitivity as a Linear Function of Firm Characteristics

The base-line investment regression with firm-year fixed effects treats the sensitivity of investment to a certain variable, cash flow or sales, as a constant over a period for all the firms (e.g., Table 3), for firms listed on particular exchange (e.g., Table 5), or for firms in particular sectors (e.g., Table 7). This constant can be viewed as an average of the sensitivities across firms and across time in a dynamic setting with heterogeneous firms. Deviation of this along certain dimensions can shed light on the reasons why the constant sensitivity changes over subperiods. This can be done by adding a cross-product term of sales with other firm characteristics, which is equivalent to specifying the investment-sales sensitivity as a linear function of the firm characteristics. Such an analysis can reveal how the investment-sales sensitivity differ across firms of different characteristics.

The investment regressions take the following form

$$\mathrm{Inv}_{it} = c_0 + c_1\mathrm{CF}_{it} + c_2'\mathrm{CF}_{it}\mathrm{X}_{i,t-1} + c_3'\mathrm{X}_{i,t-1} + \varepsilon_{it}, \tag{5}$$

$$\mathrm{Inv}_{it} = d_0 + d_1\mathrm{SA}_{it} + d_2'\mathrm{SA}_{it}\mathrm{X}_{i,t-1} + d_3'\mathrm{X}_{i,t-1} + \varepsilon_{it}, \tag{6}$$

where $X_{i,t-1}$ is a vector of firm characteristics and c_2, c_3, d_2, d_3 are conformable vector coefficients. I consider several firm characteristics which are widely used in finance research: TC is tangible capital, SZ is the log of total assets, BM is the log of book-to-market asset ratio, LV is the leverage ratio defined as debt over total assets, and Age is the listing age in years. The linear terms of firm characteristics are included in the regression because they may affect investment directly. Regression specifications excluding the linear terms of firm characteristics themselves may distort the coefficients of the cross-product terms. For example, $\mathrm{BM}_{i,t-1} = -\log Q_{i,t-1}$ where $Q_{i,t-1}$, Tobin's Q, is supposed to explain investment all by itself according to the prototype of the Q-theory, although its performance is far from being satisfactory. The results in Panel A of Table 9 are for the investment-cash flow sensitivity. Some of it have been reported in Wang and Zhang (2021). They are included mainly for comparison purposes. The discussion below focuses on the investment-sales sensitivity as a function of firm characteristics in Panel B.

Table 9 here

The investment-sales sensitivity positively depends on tangible capital. This is qualitatively the same as and quantitatively similar to the investment-cash flow sensitivity in Panel A. The common reason behind this is the fact that investment is increment of tangible capital and that the level of tangible capital itself proxies for its productivity.

The book-to-market ratio has a negative contribution to the investment-sales sensitivity, significantly and consistently, showing that growth firms (i.e., low book-to-market firms) have greater investment-sales sensitivity. This observation collaborates with the results from the previous section in the sense that many firms listed in NASDAQ and in high-tech industries are growth firms with low book-to-market ratios. Note that the investment-cash flow sensitivity does not depends on the book-to-market ratio in any consistent way, as seen in Panel A.

Leverage ratio also has a negative contribution to the investment-sales sensitivity, significantly and consistently. Among US manufacturing firms, high leverage firms tend to be well established firms with good credit record. Low leverage firms are less established firms with low credit status, so they face high borrowing costs and do not borrow much. In general, new-economy firms, manufacturing or not, tend to be equity based, as a general observation. Whether the negative contribution of firm leverage to the investment-sales sensitivity comes from the fact that less established firms tend to be new-economy firms or from leverage per se will be left for future studies.

Firm size contributes to the investment-sales sensitivity positively, though not always statistically significantly. This is the same as its contribution to the investment-cash flow sensitivity. The positive contribution runs against the financial constraint explanation as firm size is the most influential factor in all measures of financial constraint, with smaller firms regarded as more financially constrained. This sets an insurmountable hurdle for the financial constraint theory to explain the investment-cash flow sensitivity and the investment-sales sensitivity.

The investment-sales sensitivity is unrelated to firm's listing age. This may appear a bit surprising, as new-economy firms tend to be young. It turns out that this is because listing age is correlated with other firm characteristics. When listing age is used alone without other firm characteristics, it negatively affects both the investment-cash flow and the investment-sales sensitivity.

Some firm characteristics also affect investment directly. The most robust results are the book-to-market ratio and the leverage with a similar interpretation as their cross-product terms with sales. Others tend to be unstable. Since they are not the focus of the paper, they will not be discussed.

6. What Makes the Investment Sensitivities to Cash Flow and to Sales Different?

In this section we investigate what the difference is between sales and cash flow that makes investment sensitive to them differently, especially for new economy firms. We begin with the accounting relationships (1)-(2). Let GP be the gross profit, which equals sales minus cost of goods sold. Let OI be operating income which equals cash flow plus miscellaneous items. The difference between GP and OI is XSGA, selling, general and administrative expenses. The issue is examined in the investment regressions of the form

$$\text{Inv}_{it} = e_0 + e_1 \text{OI}_{it} + e_2 \text{GP}_{it} + \varepsilon_{it}. \tag{7}$$

The results for the entire sample, NASDAQ listed firms, NYSE/AMEX listed firms, high-tech firms and low-tech firms are reported in Panels A to E of Table 10.

Table 10 here

Panel A shows the results of simple and multiple regressions of investment on operating income and gross profit. They deliver a very similar pattern as the multiple regressions of investment on cash flow and sales reported in Table 3, especially for the last three decades. Basically, operating income behaves like cash flow, whose explanatory power is strong in the early decades, but declines over time, and almost disappears in the last decade, while gross profit behaves like sales with a strong explanatory power throughout the entire sample period. When both operating income and gross profit are used to explain investment, the effect of operating income becomes negative. Since the difference between GP and OI is XSGA, the results imply that investment is sensitive to XSGA.

Panels B to E of Table 10 report multiple regressions of investment on operating income and gross profit for NASDAQ, NYSE/AMEX, high-tech and low-tech subsamples respectively, while the simple regression results are omitted for brevity. The patterns observed from these panels look like those reported in Table 8 and Table 10 for cash flow and sales. It is the new-economy firms that exhibit difference between operating income and gross profit. For old-economy firms, the difference is smaller.

Another way of finding out what makes difference for cash flow and sales is to run a regression of investment on the four components of sales as follows.

$$\text{Inv}_{it} = f_0 + f_1\text{CF}_{it} + f_2\text{Misc}_{it} + f_3\text{XSGA}_{it} + f_4\text{COGS}_{it} + \varepsilon_{it}. \quad (8)$$

The results are reported in Table 11.

Table 11 here

Panel A of Table 11 shows that CF, XSGA and COGS have consistent and significantly positive explanatory power for investment, while Misc does not. Among the three, it is XSGA that has the strongest explanatory power. From Panels B to E, we see that the estimated coefficient of XSGA is smaller for the new-economy firms than for old-economy firms. However, the statistical significance of the estimated coefficient of XSGA is greater for the new-economy firms than for old-economy firms.

Why does investment depend on XSGA in particular? Recall that XSGA can be regarded as investment in intangible or organization capital. In a model of production process in which the production is a function of tangible capital and intangible/organizational capital and the two types of capital are not perfectly substitutable, the optimal amounts of the two types of capital are related to each other. One simple example given in Wang and Zhang (2021) is a Cobb-Douglas type production process with zero depreciation and zero adjustment costs. In that model, the optimal increment of tangible capital, i.e., physical investment is proportional to the optimal increment of intangible/organizational capital, which can be traced to XSGA.

In a situation where each firm has its own marginal product of tangible and marginal product of intangible/organizational capital, the coefficient of XSGA in the investment panel regression captures average coefficient of all firms. Since the ratio of marginal product of intangible/orgaizational capital to that of tangible capital is higher for new-economy firms than for old-economy firms, each one unit of XSGA corresponds to a smaller amount of physical investment for new-economy firms than for old-economy firms on average. Therefore, the estimated coefficient of XSGA in the investment regressions is smaller for new-economy firms than for old-economy firms. The greater statistical significance of the coefficient is a reflection of more concentrated ratio of two types of capital and more rigid substitution between the two types of capital for new-economy firms.

From Table 1 we know that new-economy firms tend to have higher total assets-scaled XSGA. A large proportion of new-economy firms have positive gross profit, but negative operating income, after the selling, general and administrative expenses. The XSGA expenses are sometimes mistakenly regarded as more discretionary ones due to following reasons. Expenses on advertisement may not have immediate effects. Much of research and development activities ends up with failure, or take years to realize their benefits. Yet, these expenses are necessary for new-economy firms to survive. Expenses on the perks of top executives are another component of XSGA. Unlike old-economy firms with clear direction and well established practices, new-economy firms rely on top talents to lead the firms in the competitive environment. In short, for new-economy firms XSGA is more of important investment than just discretionary expenses. Tangible capital investment is a relatively simpler decision compared with the investment on intangible/organizational capital. Tangible capital investment depends on intangible/organizational capital investment in a more stable way because they are not easily substitutable.

7. Discussion

In fact, in the early years, corporate investment is sensitive to many variables between cash flow and sales in the accounting relationships. Until now, only cash flow received attention from academics. The reason is simple. Cash flow, defined as net income plus depreciation, is literally the upper bound of investment without external financing or internal cash holding. The focus on the investment-cash flow sensitivity is natural from the proponents of the financial-constraint explanation of the sensitivity. It should be emphasized here that the logic of the financial-constraint explanation is theoretically sound. If a firm is financially constrained, its investment has to be limited by the available cash flow and therefore the investment-cash flow sensitivity will be observed in data if many firms are financially constrained. The empirical question is whether financially constrained firms are indeed large in number and the observed investment-cash flow sensitivity is the reflection of financial constraint of these firms.

8. Conclusions

I document in this paper that there is an investment-sales sensitivity during the period 1970-2019 for all US manufacturing firms. The investment-sales sensitivity has existed for the entire sample period, has been economically and statistically significant, but never received attention until now. It overtakes the investment-cash flow sensitivity, which declined and disappeared post millennium. I show that, while the investment-sales sensitivity exists for all firms, it is particularly strong for firms listed on NASDAQ and firms in high-tech industries, which represent the new economy. Beside, the investment-sales sensitivity is also more pronounced for growth firms and firms with low leverage. Among several components of sales: cost of goods sold, selling, general and administrative expenses (XSGA), miscellaneous items, and cash flow, it is XSGA that investment is most sensitive to. New-economy firms also tend to have higher proportion of XSGA to total assets than old-economy firms.

The finding of the investment-sales sensitivity makes three contributions to the literature. The first is to provide supporting evidence for the Q-theory explanation of the investment-cash flow sensitivity over the financial constraint explanation. Sales do not have a natural connection with financial constraint, so the existence of the investment-sales sensitivity cannot be logically tied to financial constraint. The fact that investment can be greater than cash flow is direct evidence that financial constraint is not a problem for most firms when they have investment opportunities. The findings related to the feature of the investment-sales sensitivity, such as the connection with new-economy firms, are consistent with the extended Q-theory proposed by Wang and Zhang (2021) in which a distinction of productivity between tangible capital and intangible/organizational capital is made.

The second contribution of the finding of the investment-sales sensitivity is that it leads to a better understanding of how corporate investment decisions are made. The standard Q-theory refers to the marginal productivity of capital which is too abstract to test. The traditional measure of the Q, the market-to-book ratio, has limited use, far from being satisfactory. In the early years of the sample, investment depends on cash flow because current cash flow predicts future cash flow. This sensitivity of investment to cash flow however, has largely disappeared. Some researchers, without fully understanding the cause of the sensitivity, think that the research on the investment-cash flow sensitivity has run its course. The finding of the investment-sales sensitivity is therefore timely and thought-provoking. It will rekindle the interest among finance researchers in how corporate investment depends on available information contained in various company data and what fundamental reasons are behind such dependence.

The third contribution of the finding of the investment-sales sensitivity lies with its connection to selling, general and administrative expenses (XSGA). The sensitivity of investment to sales is largely derived from the sensitivity of investment to XSGA, especially true for new-economy firms. The traditional treatment of XSGA is to view it as expenses, as its name implies, like cost of goods sold, except that XSGA appears more discretionary. The modern view of XSGA is to regard it as investment in intangible or organizational capital. A stronger tie between physical investment to increase tangible capital and the investment to increase intangible/organizational capital means that the two types of capital has become less substitutable with each other. The importance of intangible/organizational capital calls for better understanding of how it is measured and accumulated. Beyond the information role, investing in intangible/organizational capital and boosting sales can be an important strategy for new-economy firms to increase their market share and survive from competition.

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Table 1
Panel mean of key variables

This table reports the panel mean of key variables for US manufacturing firms for five 10-year subperiods during 1970-2019. Inv is physical investment defined as capital expenditure, SA is sales, COGS is cost of goods sold, GP (= SA - COGS) is gross profit, XSGA is selling, general and administrative expenses, OI (= GP - XGSA) is operating income before depreciation, CF is cash flow, defined as net income plus depreciation, equal to OI minus miscellaneous items. TC is tangible capital, defined as the net property, plant and equipment, at the end of last year. All flow variables are scaled by the total assets of the last year. The only stock variable, TC, is scaled by the total assets of the same year. $\bar{N}$ is the average number of the firms within the 10-year subperiod.

	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019
A. All firms					
INV	0.07	0.08	0.07	0.04	0.04
SA	1.67	1.50	1.31	1.04	0.89
COGS	1.19	1.03	0.87	0.70	0.61
GP	0.47	0.47	0.43	0.34	0.29
XSGA	0.29	0.34	0.35	0.30	0.29
OI	0.18	0.13	0.08	0.04	0.00
Misc	0.07	0.05	0.05	0.04	0.04
CF	0.11	0.08	0.03	-0.01	-0.04
TC	0.31	0.30	0.26	0.21	0.18
$\bar{N}$	1506.5	1835.9	2172.0	1935.4	1534.5
B. NASDAQ firms					
INV	0.08	0.08	0.07	0.04	0.03
SA	1.83	1.48	1.32	1.01	0.86
COGS	1.26	0.99	0.87	0.68	0.59
GP	0.56	0.50	0.44	0.34	0.28
XSGA	0.36	0.39	0.39	0.33	0.33
OI	0.20	0.11	0.06	0.00	-0.06
Misc	0.08	0.05	0.05	0.04	0.03
CF	0.12	0.06	0.01	-0.04	-0.09
TC	0.29	0.28	0.24	0.19	0.15
$\bar{N}$	509.6	1047.9	1530.6	1335.5	1001.9
C. NYSE/AMEX firms					
INV	0.07	0.07	0.06	0.05	0.04
SA	1.61	1.52	1.28	1.09	0.95
COGS	1.17	1.08	0.88	0.74	0.64
GP	0.44	0.44	0.40	0.35	0.31
XSGA	0.27	0.28	0.26	0.23	0.21
OI	0.17	0.15	0.15	0.12	0.10
Misc	0.07	0.06	0.05	0.05	0.04
CF	0.10	0.10	0.09	0.07	0.06
TC	0.32	0.33	0.32	0.27	0.25
$\bar{N}$	1098.8	788.0	641.4	599.9	532.6

Table 1 (cont'd)

	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019
D. High-tech firms					
INV	0.08	0.09	0.07	0.04	0.03
SA	1.49	1.26	1.14	0.81	0.67
COGS	0.91	0.76	0.71	0.52	0.44
GP	0.57	0.51	0.43	0.29	0.23
XSGA	0.38	0.42	0.41	0.34	0.36
OI	0.19	0.09	0.02	-0.05	-0.13
Misc	0.08	0.04	0.05	0.04	0.03
CF	0.12	0.05	-0.03	-0.09	-0.16
TC	0.26	0.25	0.20	0.15	0.11
$\bar{N}$	253.3	552.0	876.7	925.9	772.5
E. Low-tech firms					
INV	0.07	0.07	0.06	0.05	0.04
SA	1.71	1.60	1.42	1.25	1.12
COGS	1.25	1.14	0.99	0.86	0.77
GP	0.45	0.46	0.43	0.38	0.34
XSGA	0.28	0.31	0.31	0.26	0.22
OI	0.18	0.14	0.13	0.12	0.12
Misc	0.07	0.06	0.05	0.05	0.04
CF	0.10	0.09	0.07	0.07	0.07
TC	0.32	0.32	0.31	0.27	0.26
$\bar{N}$	1253.2	1283.9	1295.3	1009.5	762.0

Table 2
Panel standard deviaion of key variables

This table reports the panel standard deviation of key variables for US manufacturing firms for five 10-year subperiods during 1970-2019. Inv is physical investment defined as capital expenditure, SA is sales, COGS is cost of goods sold, GP (= SA - COGS) is gross profit, XSGA is selling, general and administrative expenses, OI (= GP - XGSA) is operating income before depreciation, CF is cash flow, defined as net income plus depreciation, equal to OI minus miscellaneous items. TC is tangible capital, defined as the net property, plant and equipment, at the end of last year. All flow variables are scaled by the total assets of the last year. The only stock variable, TC, is scaled by the total assets of the same year. $\bar{N}$ is the average number of the firms within the 10-year subperiod.

	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019
A. All firms					
INV	0.06	0.07	0.06	0.05	0.04
SA	0.71	0.73	0.72	0.66	0.61
COGS	0.63	0.60	0.56	0.51	0.48
GP	0.24	0.28	0.34	0.33	0.34
XSGA	0.19	0.23	0.27	0.26	0.30
OI	0.11	0.16	0.24	0.26	0.33
Misc	0.05	0.06	0.07	0.08	0.07
CF	0.07	0.14	0.23	0.26	0.33
TC	0.15	0.16	0.17	0.17	0.17
$\bar{N}$	1506.5	1835.9	2172.0	1935.4	1534.5
B. NASDAQ firms					
INV	0.08	0.08	0.07	0.05	0.04
SA	0.79	0.80	0.77	0.69	0.64
COGS	0.70	0.66	0.58	0.52	0.48
GP	0.28	0.32	0.38	0.37	0.40
XSGA	0.21	0.26	0.30	0.28	0.33
OI	0.14	0.20	0.28	0.29	0.37
Misc	0.06	0.07	0.08	0.09	0.09
CF	0.09	0.17	0.27	0.30	0.38
TC	0.15	0.16	0.16	0.15	0.14
$\bar{N}$	509.6	1047.9	1530.6	1335.5	1001.9
C. NYSE/AMEX firms					
INV	0.05	0.05	0.05	0.04	0.04
SA	0.67	0.62	0.58	0.58	0.53
COGS	0.61	0.53	0.49	0.50	0.47
GP	0.22	0.23	0.24	0.24	0.23
XSGA	0.17	0.18	0.19	0.20	0.22
OI	0.10	0.10	0.11	0.16	0.20
Misc	0.05	0.05	0.05	0.05	0.05
CF	0.06	0.07	0.09	0.16	0.19
TC	0.14	0.16	0.17	0.18	0.18
$\bar{N}$	1098.8	788.0	641.4	599.9	532.6

Table 2 (cont'd)

	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019
D. High-tech firms					
INV	0.08	0.09	0.07	0.05	0.04
SA	0.51	0.62	0.72	0.62	0.55
COGS	0.40	0.45	0.50	0.45	0.40
GP	0.26	0.32	0.44	0.41	0.44
XSGA	0.18	0.25	0.32	0.30	0.38
OI	0.14	0.24	0.33	0.33	0.43
Misc	0.06	0.07	0.10	0.11	0.10
CF	0.09	0.21	0.33	0.35	0.44
TC	0.11	0.13	0.13	0.13	0.12
$\bar{N}$	253.3	552.0	876.7	925.9	772.5
E. Low-tech firms					
INV	0.06	0.06	0.06	0.04	0.04
SA	0.75	0.75	0.70	0.62	0.59
COGS	0.67	0.64	0.57	0.51	0.49
GP	0.23	0.26	0.27	0.24	0.22
XSGA	0.18	0.22	0.23	0.21	0.19
OI	0.10	0.13	0.14	0.13	0.12
Misc	0.05	0.05	0.05	0.05	0.05
CF	0.07	0.10	0.13	0.13	0.12
TC	0.15	0.16	0.18	0.17	0.18
$\bar{N}$	1253.2	1283.9	1295.3	1009.5	762.0

Table 3
Simple regressions of investment on sales and the components of sales

This table reports the result of simple panel regressions of investment on sales and sales components with firm and year fixed effects for all manufacturing firms in five 10-year subperiods. The dependent variable is physical investment, Inv_t. The independent variable is sales (SA), cost of goods sold (COGS), gross profit (GP), expense of selling, general and administration (XSGA), operating income (OI), or cash flow (CF). The numbers in parentheses are t-ratios clustering at firm and year. R^2 is the proportion of explained sample variance of the raw dependent variable by independent variables including fixed effects. R^2_* is the proportion of explained sample variance of the dependent variable net of fixed effects by independent variables excluding fixed effects.

	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019
SA	0.041	0.044	0.038	0.035	0.024
t-stat	(15.59)	(20.53)	(21.48)	(8.49)	(13.32)
R^2	0.56	0.51	0.55	0.57	0.64
R^2_*	0.09	0.10	0.10	0.11	0.06
COGS	0.047	0.053	0.047	0.042	0.023
t-stat	(13.42)	(15.79)	(18.71)	(7.68)	(10.58)
R^2	0.55	0.49	0.54	0.56	0.63
R^2_*	0.07	0.08	0.08	0.09	0.04
GP	0.124	0.116	0.073	0.045	0.027
t-stat	(16.53)	(21.87)	(18.77)	(15.05)	(8.46)
R^2	0.56	0.51	0.54	0.54	0.63
R^2_*	0.10	0.11	0.08	0.05	0.03
XSGA	0.187	0.157	0.087	0.054	0.026
t-stat	(12.35)	(13.21)	(18.68)	(9.17)	(9.91)
R^2	0.55	0.50	0.53	0.54	0.62
R^2_*	0.07	0.09	0.06	0.04	0.02
OI	0.160	0.129	0.047	0.019	0.005
t-stat	(13.60)	(12.29)	(7.11)	(3.86)	(1.01)
R^2	0.55	0.48	0.51	0.52	0.61
R^2_*	0.07	0.05	0.02	0.01	0.00
CF	0.269	0.146	0.026	0.009	0.000
t-stat	(11.99)	(7.93)	(4.58)	(2.28)	(0.03)
R^2	0.55	0.48	0.50	0.52	0.61
R^2_*	0.07	0.05	0.01	0.00	0.00

Table 4
Multiple regressions of investment on the components of sales

This table reports the result of multiple panel regressions of investment on the components of sales with firm and year fixed effects for all manufacturing firms in five 10-year subperiods. The dependent variable is physical investment, Inv_t. The independent variables are cost of goods sold (COGS), gross profit (GP), expense of selling, general and administration (XSGA), operating income (OI), or cash flow (CF) in three ways of decomposition in (??)-(??). The numbers in parentheses are t-ratios clustering at firm and year. R^2 is the proportion of explained sample variance of the raw dependent variable by independent variables including fixed effects. R^2_* is the proportion of explained sample variance of the dependent variable net of fixed effects by independent variables excluding fixed effects.

	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019
A. Sales as the sum of COGS and GP					
COGS	0.023	0.023	0.034	0.036	0.023
t-stat	(7.11)	(7.36)	(11.20)	(6.12)	(10.12)
GP	0.094	0.090	0.048	0.032	0.027
t-stat	(14.64)	(15.22)	(11.98)	(13.23)	(9.19)
R^2	0.57	0.52	0.56	0.57	0.64
R^2_*	0.11	0.12	0.11	0.11	0.07
B. Sales as the sum of COGS, XSGA and OI					
COGS	0.023	0.024	0.035	0.037	0.024
t-stat	(7.21)	(7.63)	(11.59)	(6.46)	(10.90)
XSGA	0.105	0.107	0.062	0.043	0.032
t-stat	(9.44)	(10.46)	(12.50)	(9.04)	(13.93)
OI	0.090	0.070	0.025	0.019	0.017
t-stat	(7.34)	(6.53)	(4.45)	(5.25)	(4.23)
R^2	0.57	0.52	0.56	0.58	0.64
R^2_*	0.11	0.12	0.12	0.12	0.07
C. Sales as the sum of COGS, XSGA, Misc and CF					
COGS	0.023	0.026	0.034	0.036	0.024
t-stat	(7.58)	(7.90)	(12.33)	(6.31)	(10.60)
XSGA	0.103	0.108	0.061	0.043	0.032
t-stat	(9.74)	(10.30)	(12.14)	(8.97)	(13.17)
Misc	-0.061	-0.002	0.043	0.031	0.030
t-stat	(-3.76)	(-0.09)	(3.69)	(4.58)	(7.23)
CF	0.193	0.091	0.023	0.017	0.016
t-stat	(8.53)	(6.19)	(5.05)	(4.39)	(4.16)
R^2	0.57	0.52	0.56	0.58	0.64
R^2_*	0.12	0.13	0.12	0.12	0.07

Table 5

Simple regressions of cash flow on lagged sales and components of lagged sales

This table reports the results of cash flow panel regressions with both firm and year fixed effects for all manufacturing firms in five 10-year subperiods. The dependent variable is cash flow. The independent variable is one-year lagged sales or a component of sales. The numbers in parentheses are t-ratios clustering at firm and year. R^2 is the proportion of explained sample variance of the raw dependent variable by independent variables including fixed effects. R^2_* is the proportion of explained sample variance of the dependent variable net of fixed effects by independent variables excluding fixed effects.

Lagged indep.	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019
SA	0.027	0.044	0.059	0.087	0.096
t-stat	(8.03)	(8.07)	(11.64)	(8.83)	(8.67)
R^2	0.64	0.66	0.71	0.72	0.79
R^2_*	0.04	0.05	0.03	0.04	0.03
COGS	0.026	0.043	0.052	0.051	0.053
t-stat	(7.99)	(8.34)	(9.34)	(7.20)	(3.90)
R^2	0.64	0.65	0.71	0.71	0.78
R^2_*	0.02	0.02	0.01	0.01	0.01
GP	0.109	0.137	0.150	0.205	0.164
t-stat	(7.66)	(7.93)	(9.64)	(5.72)	(6.72)
R^2	0.66	0.67	0.72	0.73	0.79
R^2_*	0.08	0.07	0.04	0.06	0.03
XSGA	0.088	0.113	0.055	0.057	-0.002
t-stat	(6.34)	(6.81)	(4.43)	(3.14)	(-0.08)
R^2	0.63	0.65	0.71	0.71	0.78
R^2_*	0.01	0.02	0.00	0.00	0.00
OI	0.205	0.226	0.236	0.297	0.21
t-stat	(7.09)	(7.62)	(6.69)	(4.73)	(5.21)
R^2	0.67	0.67	0.72	0.73	0.79
R^2_*	0.11	0.08	0.05	0.07	0.04
CF	0.320	0.209	0.163	0.207	0.146
t-stat	(5.71)	(4.23)	(4.33)	(3.93)	(3.59)
R^2	0.67	0.66	0.71	0.72	0.79
R^2_*	0.10	0.04	0.03	0.04	0.02

Table 6
Investment regressions on cash flow and sales with cross-product terms

The table reports regressions of investment on cash flow (sales) and its cross-product terms with Year (=1 for 1970 and 50 for 2019), NASDAQ dummy, High-tech (HT) dummy and tangible capital (TC). The numbers in parentheses are t-ratios clustering at firm and year. R^2 is the proportion of explained sample variance of the raw dependent variable by independent variables including fixed effects. R^2_* is the proportion of explained sample variance of the dependent variable net of fixed effects by independent variables excluding fixed effects.

A. Investment on cash flow and cross-products									
CF	0.036	0.154	0.105	0.095	-0.020	0.208	0.177	0.057	0.114
t-stat	(5.76)	(8.56)	(7.70)	(9.03)	(-6.93)	(11.12)	(10.25)	(3.86)	(7.21)
CF*t		-0.004				-0.003	-0.003	-0.002	-0.002
t-stat		(-7.89)				(-8.30)	(-7.24)	(-5.21)	(-5.09)
CF*NASDAQ			-0.080			-0.070			-0.046
t-stat			(-6.88)			(-7.63)			(-5.53)
CF*HT				-0.082			-0.059		-0.030
t-stat				(-8.66)			(-8.01)		(-4.40)
CF*TC					0.384			0.320	0.285
t-stat					(12.36)			(14.00)	(12.27)
R^2	0.43	0.44	0.43	0.44	0.45	0.44	0.44	0.45	0.45
R^2_*	0.01	0.03	0.02	0.02	0.04	0.03	0.03	0.04	0.05
B. Investment on sales flow and cross-products									
SA	0.032	0.029	0.029	0.029	0.023	0.028	0.029	0.019	0.015
t-stat	(27.67)	(15.13)	(17.56)	(24.77)	(16.13)	(11.82)	(14.36)	(9.07)	(5.98)
SA*t		0.000				0.000	0.000	0.000	0.000
t-stat		(1.18)				(0.95)	(0.58)	(1.98)	(0.90)
SA*NASDAQ			0.004			0.003			0.004
t-stat			(1.78)			(1.64)			(2.19)
SA*HT				0.006			0.006		0.008
t-stat				(3.00)			(2.91)		(4.02)
SA*TC					0.040			0.041	0.044
t-stat					(10.43)			(10.58)	(11.19)
R^2	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.48
R^2_*	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.09	0.09