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CORPORATE INVESTMENT WITH FINANCIAL CONSTRAINTS: SENSITIVITY OF INVESTMENT TO FUNDS FROM VOLUNTARY ASSET SALES

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ABSTRACT

This paper examines the importance of financial constraints for firm investment expenditures by looking at the relationship between investment expenditures and proceeds from voluntary asset sales in financially healthy US manufacturing companies. Specifically, we examine whether asset sales have a greater influence on investment expenditures for firms that are likely to be financially constrained. Asset sales may provide a cleaner indicator of liquidity than cash flow since it appears not to be positively correlated with future investment opportunities. The cross-sectional differences in firm investment expenditures are examined using an endogenous switching regression model with unknown sample separation, which does not require an a priori classification of firms or knowledge of their financial constraints. We find that after controlling for investment opportunities and cash generated from operations, cash obtained from asset sales is a significant determinant of corporate investment. Moreover, the sensitivity of investment to proceeds from asset sales is significantly stronger for firms that are likely to be associated with characteristics associated with financial constraints.

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1. Introduction

There is a growing literature that suggests that because of information asymmetries and capital market imperfections, corporate investment expenditures are strongly influenced by a firm's ability to internally generate cash flow. Consistent with the view that the correlation between investment expenditures and cash flows is due to financing constraints, researchers have found that the sensitivity of investment expenditures to cash flows are much stronger for firms that are likely to be financially constrained [Fazzari, Hubbard, and Petersen (1988), Hoshi, Kashyap, and Scharfstein (1988), Whited (1992), Gilchrist and Himmelberg (1995), Hubbard (1998), and other].

Recent papers by Kaplan and Zingales (1997) and Cleary (1999) question the interpretation advanced by the previous studies and suggest that the sensitivity of firm investment to internal capital might be caused by other factors that have been overlooked. Specifically, they report that the sensitivity of investment to cash flows is the lowest for firms that they classify as being the most likely to be financially constrained. Fazzari, Hubbard, and Petersen (2000), in a reply to Kaplan and Zingales (1997), take issue with their interpretation on a number of dimensions. In particular, they question the use of qualitative managerial statements about the firm's financial status and suggest that the Kaplan and Zingales (1997) as well as the Cleary (1999) methodology tend to classify financially distressed firms as being financially constrained.

To a large extent this controversy arises because of difficulties associated with measuring investment opportunities. If investment opportunities are not measured appropriately, then cash flows, in addition to conveying information about internal liquidity, may also reflect information about future investment opportunities that are not captured by proxies for q. Since the measurement of q incorporates firm market value, this effect is likely to be more severe for firms suffering from problems of information asymmetry, which are also the firms that are most likely

to be financially constrained. As a result, we might expect higher estimated coefficients of cash flow in investment regressions for firms *a priori* classified as financially constrained.

There have been a number of approaches to resolve this problem. One of them is to identify shifts in firms' internal funds that are uncorrelated with shifts in investment opportunities [e.g., Lamont (1997), Hubbard, Kashyap, and Whited (1995), and Fazzari and Petersen (1993)]. In general, the results suggest that investment is positively related with firms' internal sources of capital that are uncorrelated with their future profitability.

This study provides further evidence along these lines by exploring the relationship between funds obtained from voluntary divestitures and firm investment expenditures. Cash obtained from asset sales seems to be an appropriate variable for this purpose for a number of reasons. First, in contrast to the cash flow variables used in prior studies, cash obtained from voluntary divestitures is not likely to be positively related to the firm's investment opportunities. For example, the sale of assets not related to a firm's core operations is unlikely to convey information about the growth opportunities of the firm's remaining lines of business. Moreover, the sale of assets from a firm's core business may indicate that the selling firm's growth opportunities are unfavorable, which would bias the results against finding a liquidity effect.[1] Second, asset sales may increase the amount of funds under the managers' discretion without the monitoring that arises with a public securities offering.

The prior literature provides two motivations for why financially healthy firms undertake voluntary asset sell-offs. The first is that voluntary asset sales allow firms to restructure operations to achieve higher operating efficiencies by selling assets to more productive users or by selling assets that have negative synergies with the sellers' core businesses [Hite, Owers, and Rogers (1987) and John and Ofek (1995)]. With this motivation, asset sales are likely to

[1] Cash obtained from asset sales is also free of another possible caveat of cash flow. Kaplan and Zingales (1997) raise a concern that in firms where cash flow and investment grow at a rate similar to that of sales, investment-cash flow sensitivities are biased towards one. They further argue that this effect is stronger for firms with higher annual growth rates that tend to be classified as financially constrained.

influence investment expenditures only for firms that are in some way financially constrained. Financial constraints may also be the motivation for asset sales. Asset sales are privately negotiated transactions and may represent a less costly means of raising capital than public issues of debt and equity for those firms facing information problems. Therefore, financially constrainted firms may sell assets to raise cash for alternative investments [Lang, Poulsen, and Stulz (1995)]. In either case, we expect to see a much stronger relation between asset sales and investment for financially constrained firms.

To test this hypothesis we estimate a switching regression model with unknown sample separation to examine cross-sectional differences in investment-asset sales sensitivity. This method avoids the necessity of *a priori* knowledge of whether or not a firm is financially constrained. Rather, the likelihood of a firm demonstrating investment behavior, consistent with financial constraints, is endogenously determined by multiple firm characteristics.

We find that after controlling for investment opportunities and cash flows, cash from asset sales is a significant determinant of corporate investment expenditures. Moreover, the estimates of the switching regression model indicate that the sensitivity of investment to both asset sales and cash flows is related to variables that are likely to be related to financial constraints. In particular, firms that are larger, older, have lower market-to-book ratios, lower levels of financial slack, have bond ratings and are more likely to pay out dividends demonstrate significantly lower sensitivity of investment to asset sales and internal funds.

The paper proceeds as follows. Section 2 defines the variables and describes the sample and data. Section 3 explains the econometric methods and presents the empirical results for investment regressions on the full sample. Section 4 presents the evidence on cross-sectional differences in investment behavior based on the estimation of a switching regression model. Section 5 provides our conclusions.

2. Data and Variables

2.1 Sample and Data

Our sample includes manufacturing firms (SIC codes between 2000 and 3999) listed on the NYSE, AMEX and NASDAQ firms from the COMPUSTAT research file. This data file includes firms that no longer exist, so that there is no survival bias. However, we do restrict our sample in two ways. First, since we examine the relation between asset sales and investment, we consider only firms that have sold fixed assets during the sample period. Second, since we are primarily interested in the effect of financial constraints rather than financial distress, we exclude all financially distressed firm-years from the sample.

Prior studies have shown that distressed and healthy firms sell assets for very different reasons [Ofek (1993), Asquith, Gertner, Scharfstein (1994), Brown, James, and Mooradian (1994)]. In particular, a marginal dollar of cash flow from asset sales is less likely to be invested if a firm is in financial distress. Inclusion of distressed firms in the sample would thus bias the results against finding a relationship between firm investment and internal capital. In addition, classifying distressed firms as constrained may falsely indicate that the sensitivity of investment to internal capital is weaker in firms that are more likely to be constrained [Fazzari, Hubbard, Petersen (2000)]. Our definition of financial distress is based on interest coverage ratios as in Asquith, Gertner, and Scharfstein (1994). A firm is classified as financially distressed in a given year if the firm's earnings before interest, taxes, depreciation, and amortization (EBITDA) is less than 80 percent of its interest expense in one year or if EBITDA is less than the interest expense for two consecutive years.

The sample includes all the firm-years with complete data on the required variables during the period from 1977 to 2000. Because of the need to create both lagged and lead variables, the actual tests are estimated for the period from 1980 to 1999. The final sample used in estimating the regressions consists of an unbalanced panel dataset of 9,751 firm-years and 1,474 firms. The number of observations for each company varies between 1 and 20. The

sample does not have a survival requirement and includes a substantial number of firms that no longer exist.

The sample includes firms from a wide range of size distribution measured by the book value of their total assets and capital. Unlike other studies, we are not imposing a size restriction on asset sale transactions in a given year. All qualifying firm-years are included in the sample irrespective of the size of divestitures in a given year. As a result, the average asset sales transaction is a much smaller percentage of fixed assets compared to those reported in previous studies. For example, Brown, James, and Mooradian (1993) and John and Ofek (1994) report average transaction prices of 14% and 40% of book value of assets, respectively. In our sample, assets are sold in 7,733 out of 9,751 firm-years, and the average transaction size for those observations is 3.2% of capital. Another reason for such a difference between sizes of divestitures is that we measure asset sales only by the amount of cash obtained in exchange for the assets while other studies use the total proceeds that may combine cash and exchanged securities. Since some of our tests are conducted for the 80's and the 90's separately, we also report statistics for the two subperiods separately.

2.2 The Model and the Variables

Our empirical specification can be summarized as follows:

$$Investment_{it} = f(growth\ oppt,\ liquidity,\ assets\ sales,\ control\ variables) + \varepsilon_{it} \quad (1)$$

where i refers to the company, t refers to the time period and investment is measured as the capital expenditures made by a firm during the year. Growth opportunities are proxied by market-to-book ratio, which is calculated as the ratio of the market value of equity plus the book value of total debt to the book value of total assets at the beginning of each period. To measure internally generated liquidity, we include both flow and stock measures. Specifically, we include cash flow, measured as the sum of the income before extraordinary items and depreciation and amortization during the year, and financial slack, measured as the sum of cash and marketable

securities held by a firm at the beginning of each year.

The amount of cash from asset sales is included as an additional source of liquidity. The asset sales information, taken from the companies' flow of funds statements (Compustat item107), includes the amount of cash obtained from sale of property, plant, and equipment. It understates the total value of sold assets since it measures only cash proceeds from asset sales and does not include the value of divested assets in exchange for equity or debt. Investment is measured by capital expenditures (Compustat item 128), which also includes only the amount of cash spent on investment and not the value of total investment. These measures are more appropriate for the purpose of this study, since we are concerned about constraints associated with raising external cash. All the flow variables and financial slack are scaled by the book value of the beginning-of-period net fixed assets. Finally, in order to control for both effects of leverage in firm investment, we use the coverage ratio, which is calculated as the interest expense divided by EBITDA, in the investment regression and short-term and long-term leverage ratios in cross-sectional regressions.[2] In order to reduce the impact of outliers, the regression variables with extreme observations are winsorized. Descriptive statistics of the variables included in our regressions are presented in Table 1.

Table 2 presents the correlations between the variables. The Table reveals a very strong positive correlation between cash flow and growth opportunities measured by the market-to-book ratios, suggesting that the sensitivity of investment to cash flow may be attributed to information about future profitability that is not captured by the market-to-book ratios. In contrast, the correlation coefficient between asset sale proceeds and the market-to-book ratios is negative and significant, which suggests that firms with greater levels of asset sales may have poorer

[2] Lang, Ofek, and Stulz (1996) argue that investment should be negatively related to leverage because high leverage reduces the current funds available for investment and affects the firm's ability to raise additional funds due to reasons discussed by Myers (1977) and Jensen and Meckling (1976). They provide evidence that for firms with unattractive growth opportunities investment is significantly negatively related to leverage.

investment opportunities.

3. Sensitivity of Investment to Funds from Asset Sales

The first set of tests is based on estimating the model on the full sample. We estimate a least squares regression using first differences for all variables and year dummies in order to control for fixed firm and year effects. We estimate the model on the 20-year sample and for the two ten-year periods of the 80's and the 90's. Both current and lagged values of all independent variables and the lagged value of the dependent variable are included in the model.

The regression results are presented in Table 3. As in previous studies, investment is positively related to both flow and stock measures of internal cash. In all regressions, contemporaneous and lagged cash flow and the beginning-of-period financial slack are significant determinants of investment. Beginning-of-year investment opportunities play a very important role, too, but with a small coefficient as in most previous studies. Consistent with the findings of Lang, Ofek, and Stulz (1996), firms with higher levels of interest expense relative to their income invest significantly less.

The results also show that there is a strong positive relation between the amount of cash from divestitures and corporate investment. A divestiture and use of its proceeds for reinvestment may not happen in the same year. A firm may sell assets and reinvest the proceeds in the following year or it may make an investment planning a divestiture in the following year. In order to consider all these possibilities, we include both positively and negatively lagged asset sales along with current assets sales in the model. The results show that asset sales in the current, previous and the following year have a significant positive effect on investment.

The main result of the first set of regressions is that after controlling for growth opportunities, corporate investment is significantly correlated with both cash flows and funds obtained from divestitures. Our hypothesis is that since asset sales is less likely to be positively related to growth opportunities, the sensitivity of investment to asset sales is likely to be driven

by financing constraints. To explore this hypothesis further we conduct cross-sectional tests.

4. Cross-Sectional Differences in Investment

4.1 Endogenous Switching Regression Model with Unknown Sample Separation

If asset sales are associated with investment expenditures because of financing constraints, then the observed sensitivity of investment to funds raised from asset sales should vary cross-sectionally. In particular, it should be higher when firms are more financially constrained. Most of the prior studies have used the following method for estimating the cross-sectional differences in firms' investment behavior. Firms or firm-years are classified into subgroups based on certain firm characteristics or qualitative information assumed to reflect the degree of financial constraints, and separate investment regressions are estimated for each subgroup.

This method assumes that the points of sample separation are known. In reality, however, the extent of financial constraints faced by a firm is not directly observable. We expect that some firms face greater financial constraints than others, but we cannot perfectly identify these firms ex ante. An exception would be, for example, the case of Japanese firms studied in Hoshi, Kashyap, Scharfstein (1991), where the affiliation of a firm with a *keiretsu* is directly observed. In most other cases, the threshold values of firm characteristics used for sample separation are based on judgment calls. This implies that the results of estimation of investment regressions on different samples may be sensitive to the choice of the criterion and the breakpoints used for sample splits. This may be one of the reasons for the conflicting findings in the existing literature, especially if the relationship between financial constraints and investment-cash flow sensitivity is non-monotonic, as argued by Kaplan and Zingales (1997).

We use an endogenous switching regression model with unknown sample separation [see Maddala and Nelson (1994) and Maddala (1986)], which was previously used to estimate cash flow sensitivities in Hu and Schiantarelli (1997). This approach provides estimates of separate

investment regressions without *a priori* classifying firms as constrained or unconstrained. It is based on the assumption that the number of different regimes in which firms operate is known, but the points of structural change are not observable. The advantage of this approach is that the extent that investment behavior differs across groups of firms and the characteristics that make firms more likely to demonstrate higher or lower sensitivity are determined simultaneously.

We assume that there are two different investment regimes. In one regime, investment may be more sensitive to the availability of internal funds than in the other regime. We hypothesize that these differences reflect the extent of financial constraints faced by firms. Depending on the extent of liquidity constraints a firm may operate in one of the two unobservable investment regimes.

The model is composed of the following system of three equations that are estimated simultaneously:

$$I_{1it} = X_{it}\beta_1 + u_{1it} \tag{2}$$

$$I_{2it} = X_{it}\beta_2 + u_{2it} \tag{3}$$

$$y_{it}^{*} = Z_{it}\gamma + \varepsilon_{it}. \tag{4}$$

Equations (2) and (3) are the structural equations that describe the investment behavior of firms in the alternative regimes. Equation (4) is the selection equation that determines a firm's "propensity" of being in one or the other investment regime. The observed investment, $I_{it,}$ undertaken by firm i at time t, , is defined as

$$I_{it} = I_{1it} \;\; iff \;\; y_{it}^{*} < 0$$

$$I_{it} = I_{2it} \;\; iff \;\; y_{it}^{*} \geq 0. \tag{5}$$

In (2) and (3), X_{it} are the determinants of corporate investment and Z_{it} are the determinants of a firms' likelihood of being in the first or the second investment regime at time *t*. β_1, β_2, and γ are vectors of parameters, y_i^* is a latent variable measuring the tendency or the likelihood of being in the first or the second regime, u_1, u_2, and ε are residuals. Firms are not fixed in one regime. As described by (5), a transfer between the regimes occurs if y_i^* reaches a certain unobservable "threshold" value. This is important since a firm's financial status may change over time, leading to a significant change in its investment behavior.

We assume that u_1, u_2, and ε are jointly normally distributed with mean vector 0 and covariance matrix $\Sigma = \begin{pmatrix} \sigma_{11} & \sigma_{12} & \sigma_{1\varepsilon} \\ \sigma_{12} & \sigma_{22} & \sigma_{2\varepsilon} \\ \sigma_{1\varepsilon} & \sigma_{2\varepsilon} & 1 \end{pmatrix}$. This assumption permits a nonzero correlation between the shocks to investment and the shocks to firms' characteristics and endogenous switching between the two investment behaviors. Note, that var(ε) is normalized to 1 because, in (4), we can estimate only $\gamma/\sigma_\varepsilon$, but not γ and σ_ε, individually. Since σ_{12} does not appear in (7), it is not estimable.

The switching regression approach allows us to control for multiple indicators that jointly determine the group in which a firm is likely to belong without the need for splitting the sample into many smaller parts or including many interaction terms. The number of indicators used to split the samples or create interaction terms is usually limited to one or two. However, single factor classifications may not successfully separate firms with different sensitivity of investment to internal financing. The severity of financial constraints often varies among firms of the same subgroup because of other factors that are not controlled for. Multiple factor classifications, on the other hand, increase the number of subsamples reducing the size of each group used for estimation or increase the number of interactive terms in single regressions and produce imprecise estimates. The estimation of the selection equation also allows us to assess the statistical significance of the factors assumed to proxy for the degree of liquidity constraints faced

by a firm. Besides, the selection regression, which directly includes the firm characteristics, incorporates more information into the estimation of the separate investment regimes than the creation of dummy variables or sample splits.

The model is estimated by the method of Maximum Likelihood. Although we do not observe the tendency of a firm being in one or the other investment regime, we know that if $\varepsilon_{it} < - Z_{it}\gamma$, the firm's investment is determined by (2), and if $y_{it}^{*} > 0$ or, equivalently, $\varepsilon_{it} > - Z_{it}\gamma$, the firm's investment is determined by (3). The likelihood function for each observation is given by

$$l_{it} = \Pr\left(\varepsilon_{it} < -Z\gamma \middle| u_{1it} = I_{1it} - X_{it}\beta_1\right) \Pr\left(u_{1it} = I_{1it} - X_{it}\beta_1\right) +$$

$$+ \Pr\left(\varepsilon_{it} > -Z\gamma \middle| u_{2it} = I_{2it} - X_{it}\beta_2\right) \Pr\left(u_{2it} = I_{2it} - X_{it}\beta_2\right). \quad (6)$$

and the log-likelihood function subject to maximization is given by

$$\ln L = \sum_{i=1}^{N} \ln\left\{ \Phi\left(\frac{-Z_{it}\gamma - \frac{\sigma_{1\varepsilon}}{\sigma_{11}} u_{1it}}{\sqrt{1 - \frac{\sigma_{1\varepsilon}^{2}}{\sigma_{11}}}} \right) \phi\left(u_{1it}, \sigma_{11}\right) + \left[1 - \Phi\left(\frac{-Z_{it}\gamma - \frac{\sigma_{2\varepsilon}}{\sigma_{22}} u_{2it}}{\sqrt{1 - \frac{\sigma_{2\varepsilon}^{2}}{\sigma_{22}}}} \right) \phi\left(u_{2it}, \sigma_{22}\right) \right] \right\}. \quad (7)$$

In (7), $\phi(.)$ is the normal density distribution and $\Phi(.)$ is the normal cumulative distribution.

The Maximum Likelihood estimates of β_1, β_2, γ, σ's can be obtained using numerical maximization techniques. It is possible to test for the existence of two different investment regimes by performing a likelihood ratio test with the log-likelihood values for OLS and the switching model. If β_1 is equal to β_2, and $\sigma_{1\varepsilon}$ is equal to $\sigma_{2\varepsilon}$ then u_1 is equal to u_2 and the likelihood function reduces to a standard normal density. We conduct this test later.

4.2 Criteria of Sample Separation

4.2.1 Size

One of the most widely used proxy variables for the level of financial constraints is firm size [Devereux and Schiantarelli (1990), Oliner and Rudebusch (1992)]. Smaller firms are likely to be financially constrained for a number of reasons. First, empirical evidence shows that transaction costs of new issues decrease with the issue size. This makes external funds relatively more expensive for small firms. Second, small firms get less analyst coverage and may thus have less access to external sources of capital because of adverse selection problems [Myers and Majluf (1984)]. Third, large firms can raise debt more easily because they are more diversified and less prone to bankruptcy. Thus, higher sensitivity of investment to internal capital in small firms will support the hypothesis that financial constraints lead to underinvestment.

Previous empirical tests of a financial constraint size effect report mixed results [Schiantarelli (1996)]. When size is applied to large datasets with a wide range of firm sizes, the results seem to support the hypothesis that small firms face much higher costs of raising external funds than do large firms. However, results for smaller samples of relatively large firms show either higher sensitivity of investment to changes in cash flow for larger firms or no significant differences between size groups. One possible explanation for such evidence is that different sampling criteria may create a bias towards selecting only those small firms that have been successful and less liquidity constrained.

Our sample may suffer from a similar selection bias. First, we are using only quoted firms. Second, we are eliminating distressed firm-years. The number of distressed firm-years and observations with missing values is likely to be higher among smaller firms. Thus our sampling criteria may exclude more small firms than large firms. However, we do include firms that are no longer in existence. We also impose a less strict restriction on the minimum required number of years of record. This is likely to mitigate to some extent the selection bias against small firms.

We measure size as the natural logarithm of the book value of assets at the beginning of each period adjusted for inflation.

4.2.2 Age

Similar to size, firm age may proxy for the wedge between the costs of external and internal capital [Devereux and Schiantarelli (1990), Oliner and Rudebusch (1992)]. Younger and growing firms are more likely to be financially constrained. Age is proxied by the natural logarithm of the number of years a firm has been listed on NYSE, AMEX or OTC.

4.2.3 Leverage

As argued by Lang, Ofek, and Stulz (1996), leverage may negatively affect firm investment in a number of ways. First, it may reduce the amount of cash available for investment. Second, due to reasons discussed by Myers (1977) or Jensen and Meckling (1976), highly levered firms may face higher hurdles in accessing external sources of capital. To control for both effects separately we include two measures of leverage in the selection equation--the ratio of short-term debt over the book value of assets and the ratio of long-term debt over the book value of assets.

4.2.4 Financial Slack

Financial slack may be associated with financial constraints for two reasons. Some have argued that firms with ample cash reserves are not liquidity constrained since their investment is not limited by a lack of finance [Kaplan and Zingales (1997), Kashyap, Lamont, and Stein (1994)]. Others, however, suggest that high levels of financial slack indicate that these firms are more financially constrained [Calomiris, Himmelberg, and Wachtel (1996), Fazzari, Hubbard, and Petersen (1996), Kim, Mauer, and Sherman (1998)], since constrained firms have more incentive to hold large cash balances. For example, Calomiris, Himmelberg, and Wachtel (1996) find that firms with low or no credit quality ratings tend to hold larger stocks of liquid assets and demonstrate higher sensitivity of investment to cash flow.

4.2.5 Market-to-Book Ratio

Firms with high growth opportunities have greater need for external financing, and, therefore, may be more liquidity constrained. At the same time, a high market-to-book ratio may indicate that the firm's growth opportunities are recognized by the market, which implies that, other things equal, firms with higher market-to-book ratios will have easier access to external funds.

4.2.6 Dummy Variables for Dividend Payout and Bond Rating

We also include a dummy variable, which is equal to one if a firm paid out dividends in the year prior to the investment and zero, otherwise, and a dummy variable which is equal to one if a firm has bond rating by the Standard & Poors. Firms that pay out dividends are expected to be less liquidity constrained and firms that have bond rating are expected to have easier access to external capital markets.

4.3 Results of Estimation of the Switching Model

The switching regression model with unknown separation is estimated by the method of Maximum Likelihood using numerical maximization techniques. In order to account for firm-specific fixed effects, the investment regressions are estimated in first differences, and year dummies are included in the investment regression to control for fixed year effects. We estimate the model for the entire 20-year period and its two 10-year subperiods of 1980-89 and 1990-99.

Table 4 reports the results of the estimation of the switching regression model for the 20-year sample. The estimates of the two investment regressions, presented in Panel A, demonstrate that the firms' investment behavior is significantly different in the two regimes. This difference is especially apparent for asset sales. In both regimes, investment is positively and significantly related to cash flow and the stock of cash. Although there are statistically significant differences in these coefficient estimates, they are roughly of the same magnitude. In contrast, the coefficient of the contemporaneous asset sales variable is about eight times larger in the constrained regime, and the leads and lags of this variable is significant only in the constrained regime. In addition,

the coverage ratio has a significantly stronger negative effect on investment for firms operating in the second investment regime, where investment is more sensitive to internal liquidity and asset sales. The coefficients of growth opportunities are not significantly different between the two regimes.

The estimates of the selection equation, presented in Panel B, reveal that six of the selection characteristics play an important role in determining the likelihood of a firm being in a particular investment regime. The estimates indicate that firms that are larger, older, have lower levels of financial slack, lower market-to-book ratio, are more likely to pay dividends and have bond rating are likely to operate in investment regime 1. The estimates in the investment equation are consistent with regime 1 being the unconstrained regime, which is consistent with our intuition about the characteristics of firms that are likely to be constrained.

The estimates of the same model for the 1980-89 and 1990-99 decades are reported in Tables 5 and 6, respectively. Overall, the findings are consistent with those reported in Table 4. As shown in Panel A of Tables 5 and 6, firms operating in the first investment regime demonstrate lower sensitivity to all the three measures of liquidity. However, the differences in sensitivities are much more dramatic for asset sales. Unlike the previous results, growth opportunities are more important for firms that operate in the first investment regime in the decade of 1980-89 and become less important for the same kind of firms in the decade of 1990-99. Panels B present the results of the selection equation. As before, firms that are larger, older, have lower market-to-book ratio, lower financial slack, and are more likely to pay dividends are more likely to operate in the first investment regime where investment is less sensitive to internal funds and asset sales. Long-term leverage is significantly negative in the results for the 80's indicating that firms with lower leverage are less dependent on internally generated cash. It becomes positive and marginally significant in the 90's.

The existence of two distinct investment regimes can be tested with a likelihood ratio test. The problem with a switching model is that under the restriction that the coefficients of the

two investment regimes are equal, the parameters of the selection equation are not identified which complicates the calculation of degrees of freedom. It is also possible that the asymptotic likelihood ratio statistic does not have a χ^2 distribution. We rely on the results of the Monte Carlo tests conducted by Goldfeld and Quandt (1976), suggesting that the χ^2 distribution can be used to conduct a likelihood ratio test by defining the degrees of freedom as the sum of the number of constraints and the number of unidentified parameters. The calculations for our model yield 57 degrees of freedom. Given the critical value for the χ^2 distribution at the 1 percent level with 57 degrees of freedom, we can easily reject the possibility of similar investment behavior by all firms at any conventional level of significance for both estimated specifications. Two distinct investment regimes describe the data significantly better than one regime.

6. Conclusion

This paper examines the relation between proceeds from voluntary asset sales and firm investment using an extension of the q model of investment. The evidence suggests that funds from voluntary divestitures provide an important financing source for financially constrained firms. Specifically, firms invest more when they generate cash from asset sales and the extent to which they do this tends to be related to firm characteristics that are likely to be associated with financial constraints.

The findings in this paper provide strong evidence that cross-sectional differences in financing constraints have significant effects on corporate investment expenditures. This evidence is consistent with a substantial literature on financial constraints that focuses on the sensitivities of investment expenditures to cash flows. The existing literature, however, has been criticized because cash flows are likely to measure investment opportunities as well as corporate liquidity. Our tests, therefore, provide an important contribution to this debate because it is unlikely that asset sales would be strongly related to investment opportunities.

Although our analysis suggests that financing constraints at least partially explain why firms invest more when they sell assets, we do not explain the causal relation between these two variables. One possibility is that financially constrained firms take on existing positive NPV projects that they would have otherwise passed up when they receive the proceeds from an unrelated asset sale. Another possibility is that financially constrained firms choose to finance new investment opportunities by selling assets. Both explanations require financial constraints, however, the direction of causation between asset sales and investment is very different. Although it is likely that in reality both explanations are important, this should probably be considered in future research.

Future research should probably also consider other explanations for the relation between investment expenditures and asset sales. Perhaps, this relationship arises because firms are constrained in ways that have nothing to do with capital. For example, firms may have only limited amounts of managerial time and are thus forced to eliminate a line of business before they can add a more promising line of business. While this explanation is plausible, one would have to argue that the firm characteristics that appear to be associated with financing constraints are really measuring managerial constraints. This is unlikely, but probably should be considered in future work.

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Table 1

Descriptive statistics for 1,474 financially healthy US manufacturing firms that sold fixed assets for cash proceeds at least once over the period 1980-99. Investment is measured as capital expenditures. Cash flow is the sum of income before extraordinary items and depreciation and amortization. Asset sales is equal to the cash proceeds received from sale of fixed capital. Growth opportunities (M/B) is equal to the sum of the book value of total debt and market value of equity divided by the book value of total assets. Financial slack is the sum of cash and short-term investments. Investment, cash flow, asset sales, and financial slack are deflated by the book value of the beginning-of-period net fixed assets (K). Total assets and net capital are measured in million dollars. Total assets, net capital, and leverage ratios are measured at the beginning of each year. The number of observations for all variables is 9,751 for 1980-99, 4,919 for 1980-89, and 4,832 for 1990-99.

Variable	Time period: 1980-99		Time period: 1980-89		Time period: 1990-99	
	Mean	Median	Mean	Median	Mean	Median
TA	1316.68	156.12	1100.46	135.81	1536.79	178.38
K	483.27	44.75	496.28	39.34	470.02	50.53
M/B	1.52	1.26	1.34	1.14	1.70	1.39
Investment / K	0.28	0.22	0.28	0.23	0.28	0.21
Asset sales / K	0.02	0.01	0.03	0.01	0.02	0.01
Cash flow / K	0.51	0.38	0.47	0.37	0.55	0.40
Financial slack / K	0.51	0.17	0.48	0.17	0.55	0.17
Total debt / TA	0.21	0.20	0.21	0.20	0.21	0.19
Short-term debt / TA	0.05	0.03	0.05	0.03	0.05	0.02
Long-term debt / TA	0.16	0.15	0.16	0.15	0.16	0.14
Interest expense/ EBITDA	0.16	0.11	0.17	0.13	0.14	0.10

Table 2

Correlation coefficients between the variables used in investment regressions for a sample of 1,474 US manufacturing firms. Investment is equal to capital expenditures. Cash flow is the sum of income before extraordinary items and depreciation and amortization. Asset sales is equal to the cash proceeds received from sale of fixed capital. Growth opportunities is equal to the sum of the book value of total debt and market value of equity divided by the book value of total assets. Financial slack is the sum of cash and short-term investments. Investment, cash flow, asset sales, and financial slack are deflated by the book value of the beginning-of-period net fixed assets. There are 9,751 observations for each variable.

Variable	Investment/K_0	Cash flow/K_0	Asset sales/K_0	Financial slack/K_{-1}	Interest expense / EBITDA $_{-1}$
Investment/K_0	1.000				
Cash flow/K_0	0.417*	1.000			
Asset sales/K_0	0.112*	0.013	1.000		
Financial slack/K_{-1}	0.274*	0.647*	-0.008	1.000	
Interest expense / EBITDA $_{-1}$	-0.197*	-0.311*	0.091*	-0.234*	1.000
Growth opportunities $_{-1}$	0.290*	0.402*	-0.044*	0.223*	-0.328*

* Significant at the 1% level

Table 3

Investment regressions for 1,478 financially healthy US manufacturing firms that sold fixed assets for cash proceeds at least once over the period 1980-99. The dependent variable is investment measured as capital expenditures. Cash flow is the sum of income before extraordinary items and depreciation and amortization. Asset sales is equal to the cash proceeds received from sale of fixed capital. Growth opportunities is equal to the sum of the book value of total debt and market value of equity divided by the book value of total assets. Financial slack is the sum of cash and short-term investments. Investment, cash flow, asset sales, and financial slack are deflated by the book value of the beginning-of-period net fixed assets. The regressions are estimated using first differences for all the variables and year dummies in order to control for fixed firm- and year effects.

	Time period: 1980-99		Time period: 1980-89		Time period: 1990-99	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Investment $_{-1}$	-0.403***	-44.71	-0.422***	-33.97	-0.381***	-29.11
Cash flow$_{0}$	0.164***	23.55	0.270***	20.99	0.120***	14.39
Cash flow$_{-1}$	0.145***	19.23	0.211***	15.87	0.109***	11.78
Asset sales$_{+1}$	0.177***	4.33	0.102**	2.03	0.298***	4.35
Asset sales$_{0}$	0.388***	7.30	0.309***	4.80	0.497***	5.40
Asset sales$_{-1}$	0.172***	4.69	0.186***	4.22	0.124*	1.92
Growth opp.$_{-1}$	0.045***	10.45	0.028***	3.72	0.055***	10.35
Growth opp.$_{-2}$	-0.004	-0.93	-0.003	-0.44	-0.003	-0.58
Financial slack$_{-1}$	0.079***	17.41	0.055***	8.36	0.096***	15.39
Financial slack$_{-2}$	0.064***	14.68	0.058***	9.19	0.062***	10.56
Interest/EBITDA$_{-1}$	-0.209***	-10.85	-0.193***	-7.40	-0.212***	-7.44
Interest/EBITDA$_{-2}$	-0.166***	-8.97	-0.178***	-7.06	-0.154***	-5.73
Adjusted R^2	0.32		0.35		0.32	
Number of obs.	9,751		4,919		4,832	

***, **, * Significant at the 1%, 5%, and 10% level, respectively.

Table 4

A switching regressions model of corporate investing. The sample has 9,751 observations for 1,478 financially healthy US manufacturing firms that sold fixed assets for cash proceeds at least once over the period 1980-99.

Panel A: Investment regressions

The dependent variable is investment measured as capital expenditures. Cash flow is the sum of income before extraordinary items and depreciation and amortization. Asset sales is equal to the cash proceeds received from sale of fixed capital. Growth opportunities is equal to the sum of the book value of total debt and market value of equity divided by the book value of total assets. Financial slack is the sum of cash and short-term investments. Investment, cash flow, asset sales, and financial slack are deflated by the book value of the beginning-of-period net fixed assets. The regressions are estimated using first differences for all the variables and year dummies in order to control for fixed firm- and year effects. The *p*-values for coefficient differences in the two regimes are based on the Wald test.

	Investment Regime 1		Investment Regime 2		*p*-values for coefficient differences
	Coefficient	t-stat	Coefficient	t-stat	
Investment /K_{-1}	-0.104***	-19.51	-0.589***	-38.05	0.000
Cash flow / K_{0}	0.134***	29.71	0.167***	22.58	0.000
Cash flow / K_{-1}	0.041***	9.96	0.222***	15.88	0.000
Asset sales / K_{+1}	0.032	1.47	0.372***	4.66	0.000
Asset sales / K_{0}	0.091***	3.24	0.768***	6.84	0.000
Asset sales / K_{-1}	0.036*	1.79	0.349***	4.17	0.007
Growth op.$_{-1}$	0.040***	12.99	0.044***	5.14	0.206
Growth op.$_{-2}$	0.003	1.08	-0.013	-1.46	0.064
Financial Slack/K_{-1}	0.038***	14.52	0.094***	13.14	0.040
Financial Slack/K_{-2}	0.026***	9.98	0.079***	11.47	0.035
Interest/EBITDA$_{-1}$	-0.130***	-13.45	-0.368***	-5.84	0.000
Interest/EBITDA$_{-2}$	-0.070***	-7.41	-0.276***	-4.87	0.000

***, **, * Significant at the 1%, 5%, and 10% level, respectively.

Table 4 (continued)

Panel B: The selection equation

The dependent variable is coded 1 for the first investment regime and 0 for the second investment regime. A positive coefficient means that firms with a high value of the selection variable are more likely to be in the first regime. The book value of assets is estimated in 1980 US dollars. Age is the number of years a firm has been listed on NYSE, AMEX or OTC. Financial slack includes cash and short-term investments and is deflated by the beginning-of-period net fixed assets. Growth opportunities is equal to the sum of the book value of total debt and market value of equity divided by the book value of total assets.

	Coefficient	t-statistic
Intercept	-1.032***	-8.59
Log (book value of assets) $_{-1}$	0.255***	14.14
Log (age) $_{-1}$	0.299***	9.09
Dummy for dividend payout $_{-1}$	0.249***	5.10
Short-term debt/total assets $_{-1}$	-0.019	-0.06
Long-term debt/total assets $_{-1}$	-0.162	-0.94
Growth opportunities $_{-1}$	-0.298***	-10.07
Dummy for bond rating $_{-1}$	0.211**	2.44
Financial Slack $_{-1}$	-0.109***	-5.08
p- value of the model	0.000	

***, **, * Significant at the 1%, 5%, and 10% level, respectively.

Table 5

A switching regressions model of corporate investing. The sample has 4,919 observations for 1,023 financially healthy US manufacturing firms that sold fixed assets for cash proceeds at least once over the period 1980-89.

Panel A: Investment regressions

The dependent variable is investment measured as capital expenditures. Cash flow is the sum of income before extraordinary items and depreciation and amortization. Asset sales is equal to the cash proceeds received from sale of fixed capital. Growth opportunities is equal to the sum of the book value of total debt and market value of equity divided by the book value of total assets. Financial slack is the sum of cash and short-term investments. Investment, cash flow, asset sales, and financial slack are deflated by the book value of the beginning-of-period net fixed assets. The regressions are estimated using first differences for all the variables and year dummies in order to control for fixed firm- and year effects. The *p*-values for coefficient differences in the two regimes are based on the Wald test.

	Investment Regime 1		Investment Regime 2		*p*-values for coefficient differences
	Coefficient	t-stat	Coefficient	t-stat	
Investment /K_{-1}	-0.159***	-19.52	-0.559***	-27.87	0.000
Cash flow / K_{0}	0.173***	22.44	0.316***	14.71	0.000
Cash flow / K_{-1}	0.104***	12.55	0.270***	11.46	0.000
Asset sales / K_{+1}	0.0002	0.01	0.269***	2.84	0.008
Asset sales / K_{0}	0.063*	1.75	0.652***	4.81	0.000
Asset sales / K_{-1}	0.072***	2.83	0.338***	3.18	0.018
Growth op.$_{-1}$	0.049***	8.29	0.019	1.22	0.092
Growth op.$_{-2}$	0.012**	2.26	-0.018	-1.11	0.085
Financial Slack/K_{-1}	0.034***	7.77	0.060***	5.57	0.030
Financial Slack/K_{-2}	0.015***	4.11	0.087***	6.70	0.000
Interest/EBITDA$_{-1}$	-0.128***	-8.73	-0.313***	-3.24	0.063
Interest/EBITDA$_{-2}$	-0.092***	-6.72	-0.233***	-3.36	0.051

***, **, * Significant at the 1%, 5%, and 10% level, respectively.

Table 5 (continued)

Panel B: The selection equation

The dependent variable is coded 1 for the first investment regime and 0 for the second investment regime. A positive coefficient means that firms with a high value of the selection variable are more likely to be in the first regime. The book value of assets is estimated in 1980 US dollars. Age is the number of years a firm has been listed on NYSE, AMEX or OTC. Financial slack includes cash and short-term investments and is deflated by the beginning-of-period net fixed assets. Growth opportunities is equal to the sum of the book value of total debt and market value of equity divided by the book value of total assets.

	Coefficient	t-statistic
Intercept	-0.958***	-4.71
Log (book value of assets) $_{-1}$	0.305***	11.51
Log (age) $_{-1}$	0.299***	5.34
Dummy for dividend payout $_{-1}$	0.318***	3.05
Short-term debt/total assets $_{-1}$	-0.425	-0.94
Long-term debt/total assets $_{-1}$	-1.096***	-3.65
Growth opportunities $_{-1}$	-0.432***	-6.48
Dummy for bond rating $_{-1}$	0.156	1.10
Financial Slack $_{-1}$	-0.047*	-1.88
p- value of the model	0.000	

***, **, * Significant at the 1%, 5%, and 10% level, respectively.

Table 6

A switching regressions model of corporate investing. The sample has 4,832 observations for 941 financially healthy US manufacturing firms that sold fixed assets for cash proceeds over the period 1990-99.

Panel A: Investment regressions

The dependent variable is investment measured as capital expenditures. Cash flow is the sum of income before extraordinary items and depreciation and amortization. Asset sales is equal to the cash proceeds received from sale of fixed capital. Growth opportunities is equal to the sum of the book value of total debt and market value of equity divided by the book value of total assets. Financial slack is the sum of cash and short-term investments. Investment, cash flow, asset sales, and financial slack are deflated by the book value of the beginning-of-period net fixed assets. The regressions are estimated using first differences for all the variables and year dummies in order to control for fixed firm- and year effects. The *p*-values for coefficient differences in the two regimes are based on the Wald test.

	Investment Regime 1		Investment Regime 2		*p*-values for coefficient differences
	Coefficient	t-stat	Coefficient	t-stat	
Investment /K_{-1}	-0.082***	-11.67	-0.580***	-24.03	0.000
Cash flow / K_{0}	0.108***	21.49	0.119***	12.85	0.310
Cash flow / K_{-1}	0.029***	5.68	0.164***	9.36	0.000
Asset sales / K_{+1}	0.039	1.14	0.660***	3.71	0.001
Asset sales / K_{0}	0.060	1.31	1.034***	4.45	0.000
Asset sales / K_{-1}	-0.054*	-1.78	0.317**	2.17	0.015
Growth op.$_{-1}$	0.037***	10.65	0.062***	5.73	0.032
Growth op.$_{-2}$	-0.001	-0.37	-0.006	-0.55	0.689
Financial Slack/K_{-1}	0.040***	11.14	0.116***	11.73	0.000
Financial Slack/K_{-2}	0.024***	6.84	0.079***	9.10	0.000
Interest/EBITDA$_{-1}$	-0.111***	-8.58	-0.439***	-5.02	0.000
Interest/EBITDA$_{-2}$	-0.060***	-4.55	-0.274***	-2.88	0.029

***, **, * Significant at the 1%, 5%, and 10% level, respectively.

Table 6 (continued)

Panel B: The selection equation

The dependent variable is coded 1 for the first investment regime and 0 for the second investment regime. A positive coefficient means that firms with a high value of the selection variable are more likely to be in the first regime. The book value of assets is estimated in 1980 US dollars. Age is the number of years of a firm has been listed on NYSE, AMEX or OTC. Financial slack includes cash and short-term investments and is deflated by the beginning-of-period net fixed assets. Growth opportunities is equal to the sum of the book value of total debt and market value of equity divided by the book value of total assets.

	Coefficient	t-statistic
Intercept	-0.815***	-5.10
Log (book value of assets) $_{-1}$	0.184***	7.20
Log (age) $_{-1}$	0.263***	6.55
Dummy for dividend payout $_{-1}$	0.284***	4.37
Short-term debt/total assets $_{-1}$	0.546	1.15
Long-term debt/total assets $_{-1}$	0.399*	1.72
Growth opportunities $_{-1}$	-0.229***	-6.57
Dummy for bond rating $_{-1}$	0.313***	2.89
Financial Slack $_{-1}$	-0.153***	-4.61
p- value of the model	0.000	

***, **, * Significant at the 1%, 5%, and 10% level, respectively.