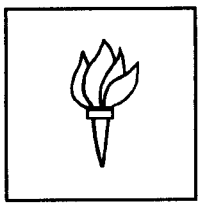


NEW YORK UNIVERSITY
STERN SCHOOL OF BUSINESS
FINANCE DEPARTMENT

Working Paper Series, 1994

Leverage, Investment, and Firm Growth

Larry Lang, Eli Ofek, and René M. Stulz

FD-94-41

Leverage, investment, and firm growth

by

Larry Lang, Eli Ofek and René M. Stulz*

April 1994

Comments welcome

* Respectively, Associate Professor, New York University, Assistant Professor, New York University, and Kurtz Chair in Finance, Ohio State University, and NBER. We are grateful for comments from Harry DeAngelo and Andrei Shleifer and from participants at a seminar at New York University.

Abstract

This paper documents a negative relation between current leverage and future growth. This relation holds within and across industries, when leverage is assumed to depend directly on future growth, and irrespective of which variables are used to forecast growth. It's economic significance exceeds the economic significance of the relation between cash flow and future growth documented in the literature. It holds for low q firms but not for high q firms or for firms in high q industries. Therefore, leverage does not reduce growth for firms known to have good investment opportunities but it is negatively related to growth for firms whose growth opportunities are not recognized by the capital markets and for firms whose growth opportunities are not sufficiently valuable to overcome the effects of their debt overhang.

1. Introduction.

A central issue in finance and macroeconomics is whether leverage affects investment policies. For some, a firm's capital structure is essentially irrelevant. If a firm has good projects, it grows irrespective of how its balance sheet looks because it can always fund good projects. For instance, Miller (1992) argues that we should not "waste our limited worrying capacity on second-order and largely self-correcting problems like financial leveraging."[1] For others, high leverage reduces a firm's ability to finance growth through a liquidity effect: firms with more debt service have fewer discretionary funds available to finance growth, so that they are more likely to have to rely on external funds to finance new projects. However, if external funds are more expensive than internal funds because of agency costs, this greater reliance on external funds means that less growth will be financed. Myers (1978) shows that, in extreme cases, a firm's debt overhang can be large enough that it cannot raise funds to finance positive NPV projects.

There is now substantial evidence that investment is negatively related to cash flow for firms where the wedge between the cost of external and internal funds is large.[2] This evidence, however, does not directly answer the question of how leverage affects growth. Cash flow includes both operating and financing flows, but the existing literature has not assessed whether the two sources of cash flow affect investment differently. Finance theory suggests that debt service should affect investment differently from operating cash flow. An all-equity firm can always issue safe debt, so that cash flow shortfalls should have a negligible effect on investment. In contrast, a highly levered firm faces Myers' (1978) underinvestment problem and may not be able to raise outside funds at all. Consequently, in the presence of information asymmetries and agency costs, an additional dollar of debt service affects investment through its effect on

[1] See Miller (1992), p. 481.

[2] See Bernanke, Gertler and Gilchrist (1993) for a review of this evidence.

discretionary funds, but it also affects investment through its effect on the cost of funds raised externally.

In spite of all the academic and popular debates about the relation between debt and growth, there is almost no empirical evidence on whether there is a significant effect of leverage on investment and future growth.[3] In this paper, we try to improve our understanding of the link between leverage and future growth through an examination of this relation at the firm level. Though the existing literature focuses on investment, we investigate the link between leverage and future growth using several different estimates of short-term and long-term future growth using 20 years of Compustat data. These measures are (1) capital expenditures in excess of depreciation normalized by fixed assets, (2) the rate of growth of capital expenditures, and (3) the rate of increase of employment. The motivation to focus on these different measures is that firms short of discretionary funds can affect their growth in a variety of ways that may not be captured by changes in capital expenditures, such as reducing their employment level to decrease their variable costs. We also look at growth measured over one year as well as growth measured over three years to understand better whether greater leverage has a longer term effect on growth. We also depart from the existing literature by not using a fixed panel. In our panel, firms enter the panel as they meet the data requirements and leave it when they stop meeting them.

We first establish that there is a strong negative relation between leverage and all our growth measures both when we look at firms individually and when we look at firms compared with their industry. Whereas a naive liquidity theory would suggest that leverage decreases investment for all firms, modern leverage theories imply that there should be a stronger effect for

---

[3] A major exception is Whited (1992) who investigates Euler equations for investment and splits her sample between firms with high debt-asset ratios and firms with low debt-asset ratios. She finds that neo-classical Euler equations are rejected for financially unhealthy firms but not for other firms. Another exception is Ofek (1993) who examines the impact of a firm's capital structure on its response to poor performance.

low q firms. As a firm's investment opportunities become better, the underinvestment problem becomes less important for a given level of leverage. Further, the agency costs of managerial discretion are not as important for firms with good investment opportunities. We show that, in our sample, leverage reduces investment and growth only for low q firms. In the remainder of the paper, we investigate the robustness of our results using several alternative approaches and different measures of growth, leverage and investment opportunities.

The paper proceeds as follows. First, we introduce our data. In section 3, we present our results on the correlation between leverage and growth. In section 4, we show that the relation between leverage and growth is driven by the firms in our sample that do not have good investment opportunities. We consider the impact of growth opportunities on leverage in section 5. In section 6, we examine the robustness of our results using alternative samples, measures of growth opportunities, leverage, and growth as well as using alternative estimation approaches. Finally, in section 7, we provide concluding remarks.

Section 2. The data.

We restrict our sample to large industrial firms for several reasons. First, for these firms, the data we need are generally available so that the composition of our sample is not significantly affected by data omissions. This issue is important because, were we to extend our analysis to small firms, a substantial fraction of these firms would not report the data we need most years, so that the population of firms that report this data might be different from the population of firms with incomplete data in subtle ways that might influence our conclusions. Second, if there is a relation between growth and leverage, one would expect it to be weaker for large firms that are established and have already used public securities markets. Showing the existence of a relation for these firms is more convincing than finding a relation in a sample dominated by small firms.

Third, a relation between growth and leverage for small firms has weaker implications for aggregate economic growth than a relation between growth and leverage for large firms.

Because of the above considerations, we restrict our sample each year to firms that have one billion dollars in sales in 1989 dollars. This restriction does not create a sample selection bias because all our analysis focuses on how firms which meet our size criterion in a given year grow in subsequent years. All our data are obtained from Compustat (including the research tapes). The sample includes years 1970 to 1989. We restrict our sample to industrial firms (SIC codes between 2000 and 3999) to avoid concerns with regulation. Firms included in the sample have to have data on sales, number of employees, and capital expenditures both for the base year, year 0, and the subsequent year, year +1. The base year is the year from which growth is measured. The sample contains 640 different firms; of these 640 firms, 142 firms are included each year.

Throughout the paper, we use three growth measures. The first growth measure is real capital expenditures in year +1 minus depreciation divided by the book value of total fixed assets in year 0. This measures net investment. Firms with greater net investment grow more in size. The second measure is the growth rate of real capital expenditures, defined as the ratio of capital expenditures in year +1 adjusted for inflation (using the CPI) and the capital expenditures in year 0 minus one. This measure captures the rate of change of investment. Our final measure is the ratio of the number of employees in year +1 and the number of employees in year 0 minus one. This measure captures the growth rate of employment. For the growth rate measures, we also use measures computed by taking the ratio of year +3 to year 0. The average value of the growth measures for each year is provided in table 1.

All our main results use the same definition of leverage, namely the ratio of the book value of short-term and long-term debt and the book value of total assets. The adjustment

Table 1

Growth, leverage and investment opportunity set measures

The sample period is 1970-1989. Included firms have one billion dollars of sales in 1989 dollars each year in which they enter the sample. All data are obtained from Compustat. Investment is capital expenditures minus depreciation for year +1 divided by the book value of fixed assets at the end of year 0. Employment growth is the percent change in employment. Capital expenditure growth is the percent change in capital expenditures adjusted for inflation. Book leverage is debt divided by total assets (TA). Market leverage is debt divided by book debt plus market value of equity. All growth measures are obtained by comparing a variable at the end of the year in which the firm enters the sample to its value at the end of the following (three) year for one-year (three-year) growth measures. Cash flow is gross of interest payments.

	Mean (t-statistic)	25th percentile	Median	75th percentile	Standard deviation (# of firm-years)
Net investment/fixed assets	0.122 (68.04)	0.041	0.096	0.164	0.148 (6851)
1-year employment growth	0.013 (6.84)	-0.046	0.003	0.054	0.163 (7023)
3-year employment growth	0.036 (9.12)	-0.114	0.003	0.136	0.294 (5645)
1-year capital expenditures growth	0.111 (17.48)	-0.196	0.024	0.284	0.536 (7040)
3-year capital expenditures growth	0.237 (23.59)	-0.264	0.074	0.514	0.754 (5648)
Cash flow/TA	0.106 (152.42)	0.079	0.104	0.133	0.058 (6815)
Tobin's q	0.961 (88.04)	0.509	0.715	1.083	0.908 (6929)
Book leverage	0.243 (164.22)	0.164	0.234	0.307	0.124 (7049)
Market leverage	0.323 (134.28)	0.171	0.291	0.448	.203 (7049)

of capital structure to changes in firms' circumstances is not continuous: firms make large discrete changes in their debt-equity ratio rather than small continuous changes. Focusing on a market value measure of leverage would give too much importance to recent changes in equity values in comparisons of leverage across firms.

If we regress growth measures on a market based leverage measure, we therefore may end regressing growth on the market's expectation of growth as incorporated in the firm's stock price. This would imply a negative relation between leverage and growth. In contrast, the book value measure of leverage does not reflect recent changes in the market's valuation of the firm. Table 1 provides statistics for our leverage measure and figure 1 shows this measure over time. The spread of leverage is non-trivial each year in the sample. Typically, the 25th percentile of leverage is about 40% lower than the median and the 75th percentile is about 20% higher.

To investigate the relation between growth and leverage, we want to control for variables which affect the growth measures we use. To do so, we first control for Tobin's q, since firms with higher q's have more valuable growth opportunities. Tobin's q is the ratio of the sum of the book value of debt and market value of equity to the replacement cost of the firm's assets.[4] Table 1 also provides yearly information on Tobin's q and figure 1 provides a time-series plot of the median q in our sample. Second, we control for cash flow before interest expense divided by total assets. Much recent literature has shown that investment is sensitive to cash flow.[5] Usual cash flow measures are net of interest expense. However, cash flow net of interest expense is negatively related to leverage because firms with higher interest expense have greater leverage (in our sample, the correlation between cash flow net of interest expense and leverage is

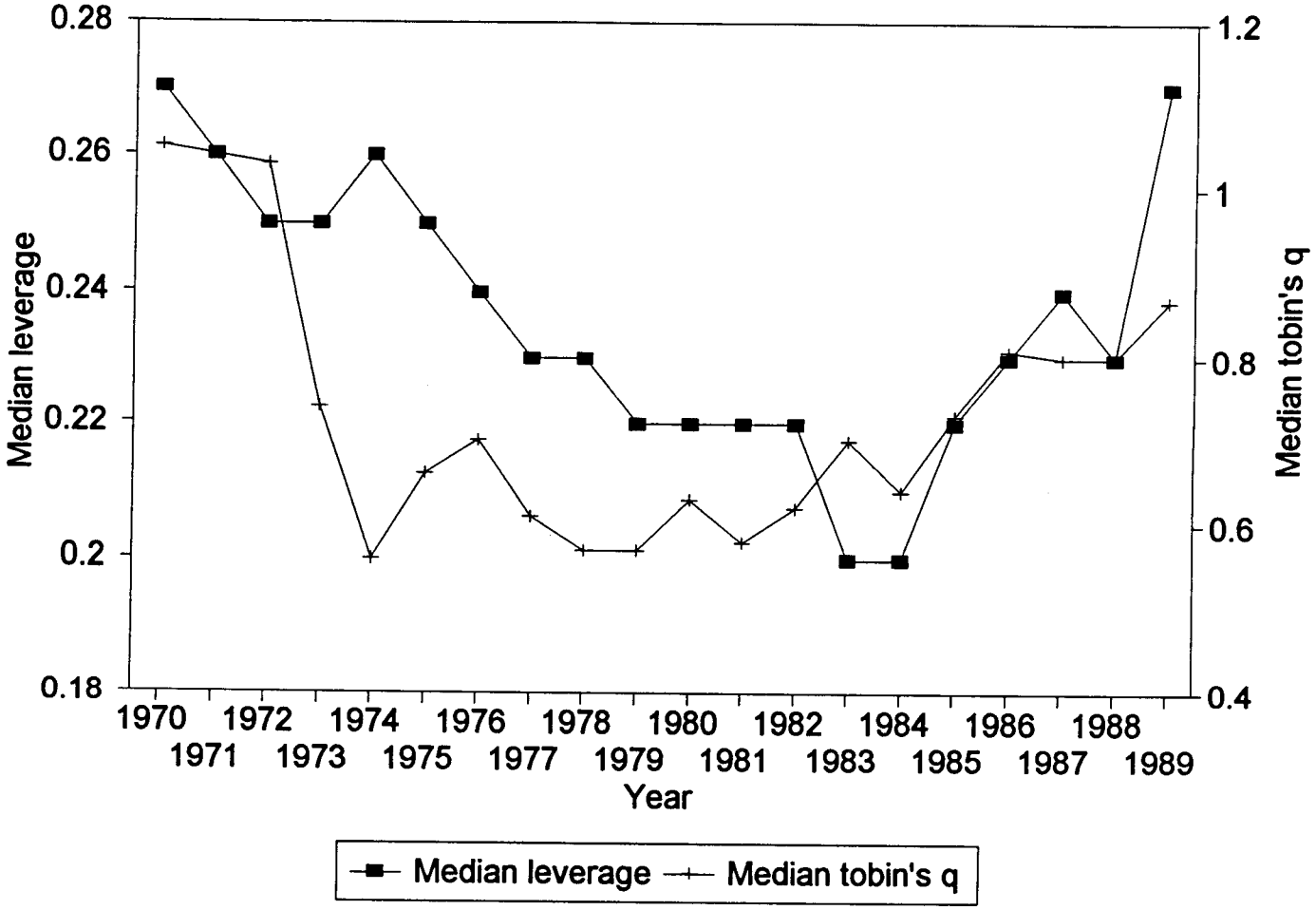
---

[4] Replacement cost is estimated using the Lindenberg and Ross (1981) algorithm with the modifications described in Lang, Walkling and Stulz (1991).

[5] See Fazzari, Hubbard and Petersen (1988) and Hoshi, Kashyap and Scharfstein (1991) for evidence that investment is related to the availability of internal funds.

Figure 1

Median leverage and q, 1970 to 1989.



-0.28). Consequently, cash flow net of interest expense may proxy for a firm's capital structure rather than for the availability of internal funds for investment. To identify the relation between capital structure and growth, it is therefore better to use a cash flow measure gross of interest, since such a measure is less dependent on a firm's capital structure.[6] We also control for sales growth from year -1 to 0 to allow for a multiplier effect.

Table 2 shows the correlations among the various variables used in this study. There is a strong negative correlation between book leverage and each growth measure we use. At the same time, though, leverage is negatively correlated with q and q is positively correlated with all growth measures. In addition, leverage is negatively correlated with both cash flow before interest and ROA, which are also positively correlated with all growth measures. Perhaps not surprisingly, the correlations of market value leverage, defined as the ratio of book debt to the sum of book debt and market value of equity, with the growth measures have the same sign but are stronger than the correlations of book leverage with the growth measures. Though these correlations lead to the conclusion that there is a negative relation between growth and leverage, this relation could result from the relation between leverage and q, cash flow and accounting earnings. We therefore have to consider multivariate regressions that allow us to estimate the relation between growth and leverage controlling for these other variables. The high correlation between market leverage (computed as the ratio of the book value of debt and the sum of the book value of debt and the market value of equity) and book leverage indicates that the choice of a leverage measure may not be very important. In section 6, we show that our results hold with the market measure of leverage also.

---

[6] This measure is still affected by a firm's capital structure because a firm's tax payments depend on its capital structure.

Table 2
Correlations

The first line gives the correlation between two variables using the raw data; the second line gives the correlation using industry adjusted variables. NI denotes capital expenditures (Capex) minus depreciation in year +1 divided by fixed assets (FA) at the end of year 0. GI1 is the growth of capital expenditures over one year and GI3 is the growth over three years, adjusted for inflation. GE denotes growth of total employment. Cash flow is gross of interest expense. BLEV is book leverage and MLEV is market leverage. * denotes significance at the 0.01 level.

	NI	GI1	GI3	GE1	GE3	BLEV
NI	1.00 1.00	0.65* 0.66*	0.08* 0.09*	0.37* 0.37*	0.23* 0.24*	-.14* -.10*
GI1	0.65* 0.66*	1.00 1.00	0.40* 0.38*	0.39* 0.37*	0.22* 0.23*	-.11* -.09*
GI3	0.08* 0.09*	0.40* 0.38*	1.00 1.00	0.20* 0.16*	0.39* 0.36*	-.09* -.08*
GE1	0.37* 0.37*	0.39* 0.37*	0.20* 0.16*	1.00 1.00	0.59* 0.57*	-.08* -.07*
GE3	0.23* 0.24*	0.22* 0.23*	0.39* 0.36*	0.59* 0.57*	1.00 1.00	-.11* -.10*
Capex(0)/FA	0.26* 0.22*	-.14* -.13*	-.24* -.23*	0.07* 0.07*	0.05* 0.04*	.01 .035
Tobin's Q	0.13* 0.14*	0.05* 0.06*	0.07* 0.05*	0.14* 0.11*	0.18* 0.13*	-.19* -.18*
Cash flow/ TA	0.23* 0.17*	0.06* 0.04*	0.02* -.00	0.13* 0.12*	0.15* 0.17*	-.10* -.02*
ROA	0.29* 0.21*	0.12* 0.10*	0.04* 0.05*	0.14* 0.12*	0.18* 0.16*	-.35* -.33*
Liquid as-sets/TA	0.18* 0.16*	0.15* 0.14*	0.17* 0.06*	0.11* 0.10*	0.16* 0.14*	-.30* -.22*
Produc-tion/TA	0.05* 0.01	0.03* 0.03	0.02 0.15*	0.03 0.02	0.04* 0.03	-.08* -.08*
Size	0.04* -0.04*	-.04* -.04*	-.06* 0.03	-.05* -.03*	-.09* -.05*	-.02 -.03*
PPE/TA	-0.09* -0.06*	-.05* -.10*	-.07* -.04*	-.03 0.00	-.04* 0.02	0.07* -0.01
Deprecia-tion/TA	-0.02 -0.03*	-.02 -.01	-.01 -.10*	-.03 -.01	-.01 0.02	-.11* -.12*
MLEV	-.21* -.17*	-.13* -.11*	-.12* -.09*	-.16* -.13*	-.21* -.18*	0.75* 0.76*

Section 3. Regressions of growth on leverage and other firm characteristics.

In table 3, we present regressions of the growth measure on a constant, leverage and the control variables discussed above plus indicator variables for each year. Growth can be high for firms in a given year because of the business cycle; if, simultaneously, leverage happens to be low, we might have a negative relation between growth and leverage because leverage proxies for business cycle effects. To avoid this, we estimate the relation between growth and leverage in regressions with indicator variables for each year. We do not reproduce the coefficients for these indicator variables. In all regressions, we use the White adjustment for heteroskedasticity since one would expect the error term for individual firms to be correlated within industries. In section 6, we show that the alternative approach of estimating the regressions year by year leads to similar results when we control for variables that might explain growth in the absence of leverage.

Table 3 shows that there is a strong negative relation between book leverage and growth. One way to evaluate this relation is as follows. The average one year growth in capital expenditures in the sample is 11.1% and the average book leverage is 24%. Our point estimate for the leverage coefficient implies that a firm that has half the average book leverage would have a capital expenditures growth of about 16.8% instead of 11.1%, a difference of the order of 50%. Therefore, the relation is not only statistically significant, it is also economically important. Cash flow has a positive effect on growth for all regressions. The multiplier effect captured by sales growth is significant in all regressions. Capital expenditures are associated with a subsequent increase in employment and a subsequent decrease in capital expenditures growth.

The results in table 3 do not control for industry effects. One approach to control for

Table 3

Regressions of growth measures on leverage

The sample period is 1970-1989. Included firms have 1 billion dollars of sales in 1989 dollars each year in which they enter the sample. All data are obtained from Compustat. Capex is capital expenditures. De stands for depreciation. FA(0) denotes fixed assets in year 0. Growth 1 (3) denotes growth measured over one (three) year, adjusted for inflation. Book leverage is defined as the ratio of total debt to the book value of total assets. q is defined as the ratio of the market value of equity plus the book value of debt to the replacement cost of the assets. All explanatory variables are computed for the base year; flow variables are normalized using total assets (TA) at the end of the previous year. p-value are in parentheses.

Dependent variable (# of obs.)	Capex-De/ FA(0) (6698)	Employee growth 1 (6678)	Employee growth 3 (5390)	Capex growth 1 (6695)	Capex growth 3 (5392)
Intercept	0.025 (0.010)	-0.044 (0.001)	0.047 (0.038)	0.076 (0.072)	0.369 (0.001)
Book leverage/TA	-0.106 (0.001)	-0.059 (0.004)	-0.193 (0.001)	-0.472 (0.001)	-0.615 (0.001)
Cash flow/TA	0.312 (0.001)	0.263 (0.001)	0.725 (0.001)	0.408 0.030	0.673 (0.027)
Capex/ FA(-1)	0.104 (0.001)	0.023 (0.011)	-0.009 (0.750)	-0.373 (0.013)	-1.053 (0.001)
Sales growth	0.017 (0.046)	0.028 (0.007)	0.155 (0.001)	0.280 (0.001)	0.407 (0.001)
Tobin's q	0.016 (0.001)	0.017 (0.001)	0.031 (0.001)	0.017 (0.017)	0.030 (0.015)
R-sq	0.145	0.060	0.095	0.087	0.119

industry effects in the capital structure literature is simply to allow for industry indicator variables.[7] The problem with this approach is that we are specifically concerned with whether firms that grow more in an industry have higher or lower leverage than other firms in the industry. Instead of using industry indicator variables, it makes more sense, therefore, to adjust all our variables except for the year indicator variables by the industry median. We therefore proceed as follows: For each firm, we compute the number of firms with the same 4-digit SIC code. If there are 5 or more firms with the same 4-digit code, we subtract from each firm characteristic the median industry value. If there are less than 5 firms with the same 4-digit code, we compute the number of firms with the same 3-digit code. If this does not produce an industry with at least five firms, we then go to the 2-digit code.

Table 4 provides the regression estimates obtained after adjusting all variables for industry effects. Here again we find a strong relation between leverage and growth. The interpretation of the results obtained here is that firms that have greater leverage than the industry median grow less than the industry median. This result holds even though we control for cash flow, capital expenditures, sales growth and q. The control variables have the effect one would expect: industry-adjusted growth is positively related to industry-adjusted cash flow, sales growth and q. It is useful to note that q is typically five times book leverage and 10 times cash flow divided by total assets. Therefore, for investment, a firm with twice the median leverage has to have a q equal to twice the median q or a cash flow equal to twice the median cash flow to have investment equal to the median. These results mean that the cash flow, leverage and q coefficients have roughly the same economic significance in the investment equation. For the other growth measures, the economic significance of cash flow is greater than the economic significance of leverage for the employment growth measures but not for the capital expenditures

[7] See, for instance, Bradley, Jarrell and Kim (1984).

Table 4

Industry-adjusted regressions of growth measures on leverage

The sample period is 1970-1989. Included firms have 1 billion dollars of sales in 1989 dollars for the year in which they enter included. All data are obtained from Compustat. Investment is capital expenditures (Capex) at year 0 minus depreciation divided by fixed assets (FA) at the end of year 0. Growth 1 (3) denotes growth measured over one (three) year, adjusted for inflation. Book leverage is the ratio of total debt to the book value of total assets. q is the ratio of the market value of equity plus the book value of debt to the replacement cost of the assets. All explanatory variables are computed for the base year; flow variables are normalized using total assets (TA) at the end of the previous year. p-values are in parentheses.

Dependent variable (# of obs.)	Capex-de/ FA(0) (6698)	Employee growth 1 (6678)	Employee growth 3 (5390)	Capex growth 1 (6695)	Capex growth 3 (5392)
Intercept	0.008 (0.048)	0.004 (0.468)	0.029 (0.038)	0.064 (0.002)	0.117 (0.001)
Book leverage	-0.088 (0.001)	-0.051 (0.019)	-0.140 (0.001)	-0.423 (0.001)	-0.382 (0.001)
Cash flow/TA	0.270 (0.001)	0.264 (0.001)	0.818 (0.001)	0.358 (0.053)	0.840 (0.011)
Capex(0)/FA	0.093 (0.001)	0.020 (0.051)	-0.071 (0.005)	-0.328 (0.021)	-1.036 (0.001)
Sales growth	0.011 (0.271)	0.026 (0.012)	0.191 (0.001)	0.230 (0.001)	0.341 (0.001)
Tobin's q	0.018 (0.001)	0.017 (0.001)	0.029 (0.001)	0.026 (0.003)	0.041 (0.007)
R-sq	0.076	0.026	0.045	0.039	0.067

growth measures. For capital expenditures growth, the economic significance of leverage is greater than the economic significance of q; the opposite is the case for the employment growth equations. Another way to look at the economic significance of the coefficient estimates for leverage is that a firm with leverage equal to twice the industry median will have investment lower than the median by about 17%, one-year employment growth lower by almost 100%, three-year employment growth lower by almost 100%, one-year capital expenditures growth lower by about 80%, and three-year capital expenditures growth lower by 40% when the industry medians for these variables are also the sample medians.

One important way to assess the economic importance of the relation between leverage and growth directly is to investigate whether the relation between growth and debt service is stronger than the relation between growth and cash flow. The earlier literature focuses on cash flow net of debt service, so that it assumes that the effect on growth of a dollar more of debt service is the same as the effect on growth of a dollar less of cash flow from operations. We have argued here is that there should be a multiplier effect of leverage, which is that a dollar of debt service both reduces liquidity and increases the cost of outside funds. Table 5 provides direct evidence on this issue. For all regressions, except the one with three-year capital expenditures growth as the dependent variable, the coefficient on debt service is significantly larger in absolute value than the coefficient on cash flow. Interestingly, for the investment equation, the coefficient on debt service is more than twice the coefficient on cash flow in absolute value, suggesting that there is a substantial multiplier effect to leverage compared with cash flow. It follows from this that regressions that take into account leverage only through its effect on cash flow net of interest payments seriously underestimate the relation between leverage and firm growth.

In the remainder of the paper, we mostly present industry-adjusted results, so that unless we say otherwise the regressions we present are industry-adjusted. We estimated regressions

Table 5

Industry-adjusted regressions of growth measures on debt service

The sample period is 1970-1989. Included firms have one billion dollars of sales in 1989 dollars for the year in which they enter included. All data are obtained from Compustat. Investment is capital expenditures (Capex) at year 0 minus depreciation divided by fixed assets (FA) at the end of year 0. Growth 1 (3) denotes growth measured over one (three) year, adjusted for inflation. Debt service is defined as interest paid divided by total assets. q is the ratio of the market value of equity plus the book value of debt to the replacement cost of the assets. All explanatory variables are computed for the base year; flow variables are normalized using total assets (TA) at the end of the previous year. p-values are in parentheses. The last row provides p-values for the test that the coefficient on debt service is equal to minus one times the coefficient on cash flow.

Dependent variable (# of obs.)	Capex-de/ FA(0) (6698)	Employee growth 1 (6678)	Employee growth 3 (5390)	Capex growth 1 (6695)	Capex growth 3 (5392)
Intercept	0.008 (0.041)	0.004 (0.420)	0.030 (0.033)	0.065 (0.002)	0.117 (0.001)
Debt service	-0.562 (0.001)	-0.668 (0.001)	-1.989 (0.001)	-2.081 (0.001)	-1.677 (0.070)
Cash flow/TA	0.276 (0.001)	0.259 (0.001)	0.798 (0.001)	0.393 (0.031)	0.870 (0.009)
Capex(0)/FA	0.091 (0.001)	0.018 (0.083)	-0.079 (0.002)	-0.336 (0.020)	-1.050 (0.001)
Sales growth	0.009 (0.309)	0.028 (0.009)	0.196 (0.001)	0.221 (0.001)	0.334 (0.001)
Tobin's q	0.019 (0.001)	0.017 (0.001)	0.028 (0.001)	0.032 (0.001)	0.047 (0.002)
R-square	0.074	0.027	0.049	0.034	0.065
p-value for test of equality	0.098	0.032	0.004	0.004	0.431

without industry adjustments and they support the conclusions drawn from the industry-ajdusted results.

Section 4. Growth opportunities and leverage.

Finance theory implies that leverage should have less of an effect for firms with valuable investment opportunities recognized by the capital markets, i.e., high q firms. In contrast, for firms doing poorly because of a lack of recognized investment opportunities, poor managerial performance, or other reasons, leverage should have a negative effect on growth. The cost of capital of these firms increases with their leverage because, contrary to firms with very valuable investment opportunities, it is not clear that funds raised externally will be used profitably. In this section, we investigate this hypothesis. The alternative hypothesis is what we call the naive liquidity effect, namely that leverage reduces investment and growth irrespective of investment opportunities.

Table 6 provides evidence on the relation between growth and leverage when growth opportunities are allowed to affect the impact of leverage on growth. From the regressions shown there, the growth of high q firms is unrelated to their leverage. In contrast, the growth of low q firms is strongly negatively related to leverage. This implies that the difficulties of borrowing against growth opportunities are not a serious growth impediment when these opportunities are well recognized by outside investors. Therefore, the mechanism by which leverage reduces growth is through the inability of highly levered firms with poor or unrecognized investment opportunities to have funds available for growth. This can occur in two ways. These firms may have low cash flow net of interest and therefore have no funds left for investment after paying interest. In addition, though, firms with a given amount of cash flow and high leverage may not be able to obtain outside funds to finance investment at an acceptable cost because external

markets doubt their ability to use funds productively given their low q.

The regressions in table 6 raise two issues. First, if high q firms choose to have low leverage, we could find that leverage does not matter for high q firms simply because there is little variation in leverage among these firms. Second, if leverage matters, it can reduce q since q takes into account only the investment opportunities that firms can exploit and leverage affects negatively the ability of firms to take advantage of investment opportunities. Therefore, it could be that there are firms with good investment opportunities and low q's because the market knows that leverage will prevent these firms from taking advantage of their investment opportunities.

Our results are not explained by a lack of variation in leverage for high q firms. Not surprisingly, both the mean and median of leverage are lower for high q firms. The interquartile range for high q firms is 0.157 around a median of 0.199 whereas the interquartile range for low q firms is 0.132 around a median of 0.244. However, the ranges for high q firms and for low q firms are similar and more than one quarter of the high q firms have leverage in excess of the median leverage of low q firms. Consequently, variation in leverage is substantial for both high q and low q firms and our results show that this variation does not explain cross-sectional variation in growth for high q firms but does explain this cross-sectional variation for low q firms.

Because of the concern that q incorporates the effects of leverage on the firm's ability to take advantage of its growth opportunities, we also re-estimated the equations in table 6 using an industry-level q to compute the indicator variable. Therefore, for each firm, the high q interactive dummy takes value one if that firm belongs to an industry with a median q greater than one and zero otherwise. These regressions are reported in table 7. In all regressions except the regression for the three-year growth of capital expenditures, we find that leverage has less impact on firms in high q industries. In particular, for the investment regression, we find that leverage has a coefficient of -0.105 and that leverage times the high q indicator variable has a coefficient of

Table 6

Investment opportunities and the relation between growth and leverage

The sample period is 1970-1989. Included firms have one billion dollars of sales in 1989 dollars for each year in which they enter the sampled. All data are obtained from Compustat. Capex is capital expenditures. De stands for depreciation. FA(0) is the book value of fixed assets at the end of the base year. Growth 1 (3) denotes growth measured over one (three) year, adjusted for inflation. Book leverage is defined as the ratio of total debt to the book value of total assets. q is the ratio of the market value of equity plus the book value of debt to the replacement cost of the assets. All explanatory variables are computed for the base year; flow variables are normalized using total assets (TA) at the end of the previous year. p-values are in parentheses.

Dependent variable (# of obs.)	Capex-de/ FA(0) (6698)	Employee growth 1 (6678)	Employee growth 3 (5390)	Capex growth 1 (6695)	Capex growth 3 (5392)
Intercept	0.009 (0.032)	0.005 (0.379)	0.031 (0.028)	0.066 (0.001)	0.121 (0.000)
Book leverage	-0.118 (0.000)	-0.089 (0.000)	-0.217 (0.000)	-0.515 (0.000)	-0.556 (0.000)
Book leverage, q > 1	0.103 (0.010)	0.135 (0.009)	0.278 (0.003)	0.319 (0.015)	0.633 (0.004)
Cash flow/TA	0.267 (0.000)	0.260 (0.000)	0.795 (0.000)	0.349 (0.056)	0.786 (0.018)
Capex(0)/ FA	0.093 (0.000)	0.020 (0.055)	-0.071 (0.005)	-0.327 (0.022)	-1.037 (0.000)
Sales growth	0.009 (0.367)	0.024 (0.016)	0.188 (0.000)	0.225 (0.000)	0.334 (0.000)
Tobin's q	0.019 (0.000)	0.020 (0.000)	0.033 (0.000)	0.031 (0.001)	0.052 (0.002)
R-sq	0.078	0.027	0.047	0.040	0.069

Table 7

Industry investment opportunities and the relation between growth and leverage

The sample period is 1970-1989. Included firms have one billion dollars of sales in 1989 dollars for each year in which they enter the sampled. All data are obtained from Compustat. Capex is capital expenditures. De stands for depreciation. FA(0) is the book value of fixed assets at the end of the base year. Growth 1 (3) denotes growth measured over one (three) year, adjusting for inflation. Book leverage is the ratio of total debt to the book value of total assets. q is the ratio of the market value of equity plus the book value of debt to the replacement cost of the assets. ql is the median industry q. All explanatory variables are computed for the base year; flow variables are normalized using total assets (TA) at the end of the previous year. p-values are in parentheses.

Dependent variable (# of obs.)	Capex-de/ FA(0) (6698)	Employee growth 1 (6678)	Employee growth 3 (5390)	Capex growth 1 (6695)	Capex growth 3 (5392)
Intercept	0.008 (0.282)	0.004 (0.669)	0.030 (0.065)	0.065 (0.027)	0.118 (0.004)
Book leverage	-0.105 (0.001)	-0.078 (0.001)	-0.167 (0.001)	-0.483 (0.001)	-0.429 (0.001)
Book leverage, industry ql > 1	0.068 (0.051)	0.113 (0.006)	0.117 (0.177)	0.246 (0.061)	0.207 (0.344)
Cash flow/TA	0.269 (0.001)	0.261 (0.001)	0.811 (0.001)	0.354 (0.004)	0.828 (0.001)
Capex(0)/ FA	0.093 (0.001)	0.020 (0.007)	-0.070 (0.001)	-0.326 (0.001)	-1.036 (0.001)
Sales growth	0.009 (0.281)	0.024 (0.016)	0.191 (0.001)	0.225 (0.001)	0.340 (0.001)
Tobin's q	0.019 (0.001)	0.020 (0.001)	0.031 (0.001)	0.031 (0.001)	0.045 (0.001)
R-sq	0.077	0.027	0.045	0.040	0.067

0.068, so that the total effect of leverage for high industry firms is -0.037. Therefore, leverage is less important for firms in industries with good growth opportunities.

Section 5. Correlation or causality?

There is a fundamental difficulty in interpreting results showing a negative relation between growth and leverage. Firms choose leverage and if high leverage prevents them from taking advantage of growth opportunities, one would expect firms with advantageous growth opportunities to have lower leverage. If all firms behave this way, there would be a negative relation between growth and leverage, but it would not be the case that greater leverage causes less growth and investment.

The regressions provided in section 4 limit the importance of the inference problem. If the only reason for observing a negative relation between growth and leverage is that firms with the best investment opportunities choose low leverage, one would expect to observe such a negative relation for high q firms as well as for low q firms since there is a lot of variation in leverage and q for firms with q greater than one. Therefore, if our regression results are obtained because growth opportunities are negatively related to leverage, it must be that this negative relation exists only for firms with poor investment opportunities, which is the opposite from what finance capital structure theories would predict.

To explore the inference problem further, though, it is useful to start with a brief discussion of how investment opportunities and leverage are related in modern theories of capital structure choice. First, in the literature that focuses on agency conflicts between bondholders and shareholders, Myers (1977) argues that highly levered firms may choose to not take advantage of investment opportunities because raising funds to finance these opportunities would benefit the debtholders and not the shareholders. Therefore, when a firm chooses its capital structure, it is

more concerned about the underinvestment problem if it has valuable growth options. If there is an advantage to debt-financing because of taxes, firms with valuable growth options, which on average should grow more than other firms, will have less leverage. This theory implies, however, that among firms with similar growth opportunities, firms with more leverage will grow less.

Second, it is often argued that there is greater information asymmetry for growth opportunities than for fixed assets. This means that firms that have to borrow against growth opportunities will find outside finance expensive. Therefore, one would expect highly levered firms using our book measure of leverage to grow less for given cash flow because it is more expensive for these firms to finance growth. To the extent that it is hard to borrow against investment opportunities, one would expect these firms to have lower market leverage, but not necessarily book leverage. This is because firms with good growth opportunities might borrow more against existing assets and still have lower market leverage than firms with no growth opportunities. Therefore, information asymmetries imply a direct effect of book leverage on growth but have unclear implications for the effect of expected growth on book leverage.

Finally, a firm's capital structure can help control agency conflicts between shareholders and managers. If management pursues growth objectives, debt limits management's ability to do so by forcing it to pay out funds. The resulting debt overhang limits management's ability to raise funds and so will the existence of information asymmetries that make it difficult for management to communicate to potential investors the quality of investment opportunities. This is because, if management pursues growth objectives, it will always try to convince outsiders that it has valuable investment opportunities. Therefore, with this approach, one would expect shareholders to want firms with poor growth opportunities to have high leverage to prevent these firms from growing at the expense of shareholder wealth; in contrast, firms with good investment opportunities will have low leverage so that they do not end in a situation where they cannot

finance growth.[8]

Because of the theoretical literature, our approach suffers from two potential problems. First, leverage could have a significant coefficient because it could proxy for variables forecasting firm growth that are omitted from our regressions. Second, though we treated growth as endogenous and leverage as exogenous, it is possible that both are endogenous because firms choose leverage and growth simultaneously. For instance, a firm might decide to have low leverage because it wants to be able to take advantage of its growth opportunities. We now address these two issues.

If firms with high growth choose to be financed more by equity, leverage depends on future growth. In sections 3 and 4, we estimated the relation between leverage and growth using OLS. This approach is correct if we can treat leverage as an exogenous variable, but may be inappropriate otherwise. To explore whether there is a negative relation between growth and leverage when leverage is endogenous, we now show results for an alternative approach where future growth influences current leverage.

The approach we use is as follows. All variables except the growth measures and leverage are treated as exogenous. However, management chooses at the same time growth and leverage. There are variables that affect growth only, variables that affect leverage only, and variables that affect both growth and leverage. Given leverage and the variables that affect growth, there is an optimal amount of growth. Given growth and the variables that affect leverage, there is an optimal amount of leverage.

The choice of variables for the growth and leverage equations is as follows. Variables that affect growth but not leverage are the growth of sales, cash flow divided by total assets, and capital expenditures normalized by fixed assets. One would expect growth to be positively related

[8] See Stulz (1990) for a derivation of these implications.

to the first two variables; the effect of the third variable is unclear, since it depends on whether there is mean-reversion in growth. We assume that property, plant and equipment divided by total assets affects leverage but not growth, since it captures the ability to raise funds against fixed assets. We also include depreciation divided by total assets since the tax benefits for debt fall as this variable increases. We include earnings before interest, taxes and depreciation divided by total assets since profitability is generally negatively related to leverage. The log of total assets is assumed to affect leverage as a proxy for idiosyncratic risk: one would expect larger firms to have more leverage because they are less risky (though in table 2 the correlation between size and leverage is insignificant). Q is assumed to affect growth positively and leverage negatively, which corresponds to the correlations documented in table 2. The negative effect of q on leverage comes about because debt is more costly for firms with good investment opportunities. We eliminate industry factors by subtracting the industry median from all variables.

Table 8 provides estimates of the two equation system using two-stage least squares. It is immediately apparent that leverage still has a significant negative effect in all growth equations but one, the three-year capital expenditures growth equation. In all growth equations, growth is negatively related to leverage and the magnitude of the leverage effect is larger than the one estimated earlier except in one case (the three-year growth in capital expenditures). The other variables in the growth equations also have coefficients similar to those estimated earlier. The evidence from the leverage equations is more ambiguous. Though leverage is negatively related to q, the evidence on the relation between the growth measures and leverage is mixed, being positive for three measures and negative for two. This evidence suggests that the reverse causality argument cannot explain our evidence, but the positive relation between leverage and growth for three measures of growth does not have a clear explanation and suggests that these regressions should be viewed with caution. The other variables in the leverage equations have

Table 8

Two-stage least square estimates of the relation between growth and leverage

We estimate jointly the equation for book leverage and the equation for growth using two-stage least squares. The sample period is 1970-1989. Included firms have 1 billion dollars of sales in 1989 dollars for the year in which they enter included. All data are obtained from Compustat. Capex is capital expenditures. De stands for depreciation. FA(0) is the book value of fixed assets in year 0. Growth 1 (3) denotes growth measured over one (three) year, adjusted for inflation. Book leverage is the ratio of total debt to the book value of total assets. q is the ratio of the market value of equity plus the book value of debt to the replacement cost of the assets. All explanatory variables are computed for the base year; flow variables are normalized using total assets (TA) at the end of the previous year. p-values are in parentheses.

Panel A. Leverage regressions.

Dependent variable (#observat-ions)	Book leverage (6698)	Book leverage (6695)	Book leverage (5389)	Book leverage (6694)	Book leverage (5391)
Growth measure	Capex-de/ FA(0)	Employee growth 1	Employee growth 3	Capex growth 1	Capex growth 3
Intercept	-0.000 (0.840)	-0.012 (0.071)	-0.009 (0.027)	0.015 (0.001)	0.013 (0.001)
Growth measure	0.588 (0.001)	2.241 (0.001)	0.722 (0.001)	-0.059 (0.001)	-0.037 (0.001)
EBITD/TA	-0.610 (0.001)	-0.902 (0.001)	-0.861 (0.001)	-0.269 (0.001)	-0.403 (0.001)
PPE/TA	0.091 (0.001)	0.081 (0.083)	0.045 (0.157)	0.036 (0.014)	0.044 (0.003)
Deprecia-tion/TA	0.195 (0.112)	-0.159 (0.603)	-0.051 (0.811)	-0.418 (0.001)	-0.273 (0.004)
Tobin's q	-0.014 (0.001)	-0.036 (0.001)	-0.020 (0.001)	-0.014 (0.001)	-0.007 (0.001)
Log of TA	-0.004 (0.038)	0.012 (0.052)	0.006 (0.136)	-0.006 (0.001)	-0.009 (0.001)
R-square	0.065	0.009	0.032	0.081	0.125

Panel B. Growth regressions.					
Dependent variable	Capex-de/ FA(0)	Employee growth 1	Employee growth 3	Capex growth 1	Capex growth 3
Intercept	0.017 (0.001)	0.011 (0.001)	0.025 (0.001)	0.085 (0.001)	0.138 (0.001)
Book lever-age	-0.273 (0.001)	-0.172 (0.011)	-0.179 (0.045)	-0.976 (0.001)	-0.247 (0.272)
Cash flow/TA	0.230 (0.001)	0.245 (0.001)	0.812 (0.001)	0.262 (0.041)	0.861 (0.001)
Capex(0)/ FA(-1)	0.096 (0.001)	0.021 (0.007)	-0.071 (0.001)	-0.317 (0.001)	-1.037 (0.001)
Sales growth	0.020 (0.027)	0.031 (0.003)	0.192 (0.001)	0.256 (0.001)	0.331 (0.001)
Tobin's q	0.012 (0.001)	0.014 (0.001)	0.027 (0.001)	0.009 (0.387)	0.045 (0.006)

the expected sign, except for the size variable that is significantly negative in some cases and depreciation that is insignificant in some cases. Contrary to the evidence for the growth equations, though, the coefficients in the leverage equations, especially those on the growth variables, seem to be sensitive to the variables we control for. Since the evidence is not supportive of the endogeneity argument for most of the regressions presented here and since the coefficients on growth variables in the leverage regressions do not seem robust, we focus on OLS regressions in the rest of the paper.

The two-stage least squares estimates address the issue of the simultaneous determination of growth and leverage, but not the issue of omitted variables. One way to address this issue is as follows. Suppose that there are unspecified omitted variables which can help forecast growth. One would expect these variables to be correlated with the change in leverage from -1 to 0 rather than with leverage in period -1. This is because the firm characteristics we use are for

the period from -1 to 0 or for date 0 and hence should be more informative than leverage at date -1. Hence, if we regress growth on firm characteristics, leverage at date -1 and the change in leverage from -1 to 0, one should get a lower bound on the effect of leverage on growth by focusing on the coefficient on lagged leverage. In table 9, we provide regressions where the leverage variable at date 0 is divided into a leverage variable at date -1 and a change in leverage from date -1 to date 0. We find that the level of leverage at date -1 is negatively related to growth, but the coefficient is insignificant for one-year employment growth and three-year capital expenditures growth. The coefficient on the change in leverage is significant and negative in all cases. Note though that the interpretation of this coefficient is ambiguous. The change in leverage may be correlated with variables that forecast firm growth, but it is also possible that the change in leverage itself leads to lower growth because it corresponds to greater leverage. Hence, focusing on the coefficient on lagged leverage provides a conservative view of our results.

Section 6. Alternative specifications.

In this section, we investigate the robustness of the relation between growth and leverage. Concerns about robustness arise for three main reasons. First, we use twenty years of data. It might be that this relation is not stable over time or that the implicit selection bias in Compustat because of the data added during the 1970s plays a role in our results. We show that if we restrict our sample period to the 1980s, our results hold. Second, we use an unbalanced panel, which differs from the existing literature. It is important to verify that our results hold using the more conventional approach, though this approach creates a substantial selection bias. Third, all the previous results are based on book leverage. We argued that this measure is well-suited for our tests, but it makes sense to investigate whether our results hold with alternative measures of leverage. Fourth, because of the omitted variable problem, it is important to check whether

Table 9

Investment opportunities and lagged leverage

The sample period is 1970-1989. Included firms have one billion dollars of sales in 1989 dollars for the year in which they enter included. All data are obtained from Compustat. Investment is capital expenditures (Capex) minus depreciation divided by fixed assets (FA). Growth 1 (3) denotes growth measured over one (three) year, adjusted for inflation. Book leverage is the ratio of total debt to the book value of total assets (TA). q is the ratio of the market value of equity plus the book value of debt to the replacement cost of the assets. All explanatory variables are computed for the base year; flow variables are normalized using total assets (TA) at the end of the previous year. p-values are in parentheses.

Dependent variable (# of obs.)	Investment (6612)	Employee growth 1 (6592)	Employee growth 3 (5324)	Capex growth 1 (6609)	Capex growth 3 (5326)
Intercept	0.010 (0.013)	0.005 (0.328)	0.034 (0.016)	0.074 (0.001)	0.130 (0.001)
Book leverage(-1)	-0.063 (0.001)	-0.019 (0.401)	-0.089 (0.038)	-0.191 (0.003)	-0.084 (0.416)
Change in bok leverage	-0.139 (0.001)	-0.113 (0.014)	-0.445 (0.001)	-1.184 (0.001)	-1.973 (0.001)
Cash flow/TA(-1)	0.269 (0.001)	0.255 (0.001)	0.785 (0.001)	0.270 (0.180)	0.607 (0.061)
Capex(0)/ FA(-1)	0.095 (0.001)	0.023 (0.016)	-0.042 (0.111)	-0.295 (0.021)	-0.882 (0.001)
Sales growth	0.009 (0.385)	0.023 (0.021)	0.181 (0.001)	0.211 (0.001)	0.298 (0.001)
Tobin's q	0.019 (0.001)	0.018 (0.001)	0.030 (0.001)	0.035 (0.001)	0.048 (0.003)
R-sq	0.077	0.026	0.049	0.052	0.086

alternative choices of firm characteristics change our results. Fifth, we used White's procedure to take into account serial correlation and heteroskedasticity. It makes sense to investigate whether an alternative approach to handle this issue leads to similar results.

In table 10, we first provide in Panel A results for different samples. To save space, we reproduce estimates for only two growth measures. First, we show results for a balanced panel of 142 firms, which are the firms continuously in the sample. To facilitate comparisons with the existing literature, we use data which are not industry adjusted and allow for fixed effects. For this balanced panel, the effect of leverage is substantially larger than in section 3. Therefore, one cannot argue that the unbalanced panel is responsible for our results. Second, we show results using only firms in the 1980s. There is a significant effect for the 1980s and it does not seem to differ much from the one documented for the whole sample. Finally, we show results for the firms with ROA in excess of the sample median to address the concern that our results reflect the effects of poor financial performance rather than leverage. Again, our results hold up for these subsamples.

In panel B, we first provide estimates of the effect of leverage which use alternative measures of leverage. First, we use market leverage. The coefficients on leverage do not differ when market leverage is used instead of book leverage. Further, the coefficients on the other variables do not seem to depend on which measure of leverage is used. Second, we use book equity divided by debt plus equity. One would expect growth to be positively related to equity divided by total capital and this is indeed the case. Therefore, in conjunction with table 5 which uses debt service to total assets as a measure of leverage, table 10 shows that our results are not sensitive to how leverage is measured.

In panel C of table 10, we investigate whether our estimates on leverage depend on the control variables used in the regressions. First, we re-estimate the regressions using market to

Table 10

Alternative specifications of independent variables

The sample period is 1970-1989. Included firms have one billion dollars of sales in 1989 dollars for each year in which they enter the sampled. All data are obtained from Compustat. Capex is capital expenditures. De stands for depreciation. FA(0) is the book value of fixed assets at the end of the base year. Growth 1 denotes growth measured over one year, adjusted for inflation. Book leverage is the ratio of total debt to the book value of total assets. Market leverage is debt divided by the sum of debt plus the market value of equity. TA denotes total assets at the end of the base year. p-values are in parentheses.

	Capex-de/FA	1-year growth	Capex-de/FA	1-year growth	Capex-de/FA	1-year growth
Panel A. Alternative samples.						
	Balanced panel of 142 firms		1980's sample		Firms with ROA greater than industry median	
Intercept	0.077 (0.001)	0.994 (0.001)	0.013 (0.059)	0.105 (0.001)	-0.001 (0.951)	0.064 (0.271)
Book leverage	-0.265 (0.001)	-1.610 (0.001)	-0.083 (0.001)	-0.415 (0.008)	-0.067 (0.008)	-0.389 (0.006)
Cash flow/TA	0.204 (0.001)	0.844 (0.036)	0.185 (0.014)	0.418 (0.308)	0.368 (0.001)	1.240 (0.002)
Capex(0)/FA	0.200 (0.001)	-2.714 (0.001)	0.088 (0.001)	-0.830 (0.001)	0.077 (0.001)	-0.803 (0.001)
Sales growth	0.015 (0.401)	0.286 (0.016)	0.004 (0.749)	0.387 (0.002)	0.004 (0.785)	0.399 (0.001)
Tobin's q	0.008 (0.003)	-0.022 (0.219)	0.039 (0.001)	0.110 (0.001)	0.016 (0.001)	0.033 (0.021)
R-square	0.254	0.111	0.033	0.065	0.083	0.075
# obs.	2777	2382	3432	2244	3147	2566
Panel. B. Alternative leverage measures.						
Intercept	0.010 (0.011)	0.071 (0.001)	0.008 (0.259)	.064 (0.028)		
Market leverage	-0.096 (0.001)	-0.316 (0.001)				
Book equity/Capital			0.036 (0.001)	0.220 (0.001)		
Cash flow (0)/TA(-1)	0.223 (0.001)	0.244 (0.178)	0.273 (0.001)	0.335 (0.011)		

Dependent variable	Capex-de/FA	1-year growth	Capex-de/FA	1-year growth	Capex-de/FA	1-year growth
Capex(0)/ FA(-1)	0.092 (0.000)	-0.332 (0.022)	0.096 (0.001)	-0.333 (0.001)		
Sales growth	0.014 (0.125)	0.234 (0.001)	0.007 (0.412)	0.237 (0.001)		
Tobin's q	0.013 (0.001)	0.014 (0.094)	0.018 (0.001)	0.028 (0.002)		
R-square # obs.	0.084 6698	0.041 6695	0.075 6673	0.037 6669		
Panel C. Alternative control variables.						
Intercept	0.008 (0.046)	0.065 (0.002)	0.012 (0.005)	0.073 (0.001)	0.006 (0.118)	0.057 (0.006)
Book leverage	-0.093 (0.001)	-0.405 (0.001)	-0.110 (0.001)	-0.428 (0.001)	-0.056 (0.001)	-0.298 (0.001)
Cash flow/TA	0.249 (0.001)	0.355 (0.058)	0.363 (0.001)	0.408 (0.116)	0.304 (0.001)	0.472 (0.019)
Capex/TA	0.093 (0.001)	-0.330 (0.020)	0.093 (0.001)	-0.324 (0.025)	0.094 (0.001)	-0.342 (0.020)
Sales growth	0.014 (0.136)	0.230 (0.001)	0.007 (0.502)	0.230 (0.001)	0.006 (0.550)	0.224 (0.001)
Tobin's q					0.012 (0.001)	0.004 (0.632)
Market to book	0.023 (0.001)	0.024 (0.026)				
P/E ratio			-0.000 (0.136)	-0.001 (0.059)		
Liquid assets/TA					0.290 (0.001)	1.108 (0.001)
Production-/TA					0.005 (0.089)	0.030 (0.034)
R-square # obs.	0.075 6779	0.038 6775	0.068 6268	0.038 6263	0.092 6273	0.056 6669

book instead of Tobin's q. This variable seems to have the same relation with growth as q and substituting market to book for q has no effect on the coefficient on leverage. We then replace Tobin's q by the price-earnings ratio. We find a significant negative effect of the P/E in one regression and an insignificant negative effect in another regression. Both of these coefficients are puzzling, but irrespective of the coefficient on P/E, though, we find the same relation between leverage and growth. Finally, we add liquid assets and production, both normalized by total assets. We find that liquid assets and growth are positively related and that the coefficient is significant; in contrast, production divided by total assets does not have a significant coefficient. Yet, including these two additional variables has no significant effect on the leverage coefficients. These additional regressions therefore suggest that our results on the relation between growth and leverage are not sensitive to the control variables used in the regressions. Finally, in regressions not reproduced here, we estimated the relation between sales growth and leverage and obtained results consistent with those presented in this paper.

In table 11, we provide the results for an altogether different estimation strategy. With that strategy, we estimate the relation between growth and leverage one year at a time. This approach allows the relation to differ across years. We summarize the results of this approach in table 11 for regressions which include both leverage and leverage multiplied with an indicator variable that takes value one if q is greater than one. It should be clear from these results that the negative relation between growth and leverage for low q firms is extremely stable over time.

Section 7. Concluding remarks.

In this paper, we show that there is a significant negative relation between leverage and growth controlling for a number of determinants of growth. We find that the effect of debt service on growth is more important than the effect of operating cash flows on growth. Although it is

Table 11
Summary results for yearly regressions

The regressions of table 6 are estimated for each year separately. The mean and median coefficients for the leverage variables are reported with the cross-sectional p-values reported in parentheses. The sample period is 1970-1989. Included firms have one billion dollars of sales in 1989 dollars for each year in which they enter the sample. All data are obtained from Compustat. Capex is capital expenditures. De stands for depreciation. FA(0) is the book value of fixed assets at the end of the base year. Growth 1 (3) denotes growth measured over one (three) year, adjusted for inflation. Book leverage BL is the ratio of total debt to the book value of total assets. q is the ratio of the market value of equity plus the book value of debt to the replacement cost of the assets. BLHQ is book leverage times an indicator variables that takes value one for firms with q greater than one.

Dependent variables (# regressions)	Capex-de/ FA(0) (20)	Employee growth 1 (20)	Employee growth 3 (17)	Capex growth 1 (20)	Capex growth 3 (17)
Mean BL coefficient (p-value)	-0.118 (0.000)	-0.080 (0.003)	-0.203 (0.001)	-0.594 (0.001)	-0.632 (0.001)
Median BL (p-value) (% positive)	-0.113 (0.000) 5%	-0.097 (0.006) 25%	-0.197 (0.001) 12%	-0.572 (0.001) 0%	-0.776 (0.001) 6%
Mean BLHQ coefficient (p-value)	0.099 (0.047)	0.118 (0.003)	0.320 (0.001)	0.380 (0.014)	0.776 (0.001)
Med. BLHQ (p-value) % positive	0.087 (0.070) 65%	0.149 (0.006) 86%	0.337 (0.001) 88%	0.244 (0.009) 75%	0.821 (0.001) 82%

tempting to argue that leverage does not really matter for growth and that our results only show that low growth firms choose high leverage, we provide evidence that is inconsistent with such an explanation. In particular, we find that:

1. The negative relation between growth and leverage holds within industries. This results is important because it provides a benchmark for our effect if growth opportunities are measured poorly. If growth opportunities are similar within industries, industry-adjusted results compare firms with similar growth opportunities. Hence, if we found no relation between growth and leverage using industry-adjusted data, one would have to argue that growth opportunities mismeasurement across industries explains our results.
2. Estimating the relation between growth and leverage in a system of two equations where the other equation explains leverage does not affect our results. It follows from this that our results do not appear to be due to self-selection where firms with good growth opportunities choose low leverage.
3. Allowing for changes in leverage to forecast growth does not seem to affect our results. Even if all of the recent change in leverage can be explained by the firm's reaction to changes in growth opportunities, past leverage is still negatively related to growth.
4. The negative relation between growth and leverage is robust holds when we use alternative measures of leverage and growth opportunities and when we allow for other variables to influence growth. It also holds if we estimate it year by year.

Perhaps more importantly, we find that the relation between q and growth holds only for low q firms. If leverage only proxies for growth opportunities in our regressions, there is no reason

why leverage should only matter for low q firms. In contrast, if leverage increases the costs of external funds for firms that do not have good investment opportunities recognized by capital markets, then we should be finding that it matters mostly for low q firms.

The result that leverage is negatively associated with growth only for low q firms suggests that the negative effect of leverage on growth affects only those firms that have good investment opportunities the market does not know about and those firms that do not have good investment opportunities but might want to grow nevertheless. If the sample of low q firms is mostly composed of firms that have marginal growth opportunities and poor performance, the fact that leverage acts like a brake on growth for these firms might be beneficial for the shareholders of these firms and provide support for capital structure theories, such as Jensen (1986) and Stulz (1990), which emphasize the disciplinary role of debt.

References

Bernanke, B., M. Gertler, and S. Gilchrist, 1993, The financial accelerator and the flight to quality, unpublished working paper, Princeton University.

Bradley, M., G. Jarrell, and E.H. Kim, 1984, On the existence of an optimal capital structure: Theory and evidence, Journal of Finance 39, 857-878.

Fazzari, S., R. Glenn Hubbard, and B. Petersen, 1988, Finance constraints and corporate investment, Brookings Papers on Economic Activity 1, 141-195.

Harris, M., and A. Raviv, 1991, The theory of capital structure, The Journal of Finance 46, 297-357.

Hoshi, T., A. Kashyap, and D. Scharfstein, 1991, Corporate structure, liquidity, and investment: Evidence from Japanese panel data, Quarterly Journal of Economics 106, 33-60.

Jensen, M.C., 1986, Agency costs of free cash flow, corporate finance and takeovers, American Economic Review 76, 323-339.

Lang, L., R.M. Stulz, and R. Walkling, 1989, Managerial performance, Tobin's q and the gains from successful tender offers, Journal of Financial Economics 24, 1370154.

Lindenberg, E.B., and S.A. Ross, 1981, Tobin's q ratio and industrial organization, Journal of Business 54, 1-32.

Myers, S., 1977, Determinants of corporate borrowing, Journal of Financial Economics 5, 147-175.

Ofek, E., 1993, Capital structure and firm response to poor performance: An empirical analysis, Journal of Financial Economics 34, 3-31.

Smith, C.W., and R. Watts, 1992, The investment opportunity set and corporate financing, dividend and compensation policies, Journal of Financial Economics 32, 263-292.

Stulz, R.M, 1990, Managerial discretion and optimal financing policies, Journal of Financial

Economics 26, 3-27.

Whited, T., 1992, Debt, liquidity constraints, and corporate investment: Evidence from panel data, Journal of Finance 47, 1425-1461.