Adverse Selection, Debt Capacity And Corporate Growth: An Industry Life Cycle Perspective

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ABSTRACT

This paper examines the industry impact on financing corporate growth. According to underinvestment and overinvestment problems, firms are more likely to have less debt capacity in their growth stage of life cycle. However, it is known that new economy firms have higher levels of growth rate, return and risk, and particularly undertake more technical projects. Therefore, I test the hypothesis that debt capacity during the growth stage of life cycle is affected by New Economy. My empirical analysis covers U.S. companies listed on NYSE, AMEX and NASDAQ in the period of 1990-2010. I find that growth firms have significantly smaller debt capacity. Nevertheless, supporting the life cycle theory of financing that emphasizes the adverse selection problem faced by new economy firms, this link tends to be less prominent in the new economy industry. The results complement prior studies that have found significant relationship between firm growth and corporate debt capacity by confirming the important role played by the industry membership (New Economy) in determining the intensity of this relation.

Keywords: Adverse Selection; Debt Capacity; Corporate Growth; Life Cycle Theory of Financing

1. INTRODUCTION

It is often argued that firms use less debt in their capital structure during their growth stage of life cycle (Billet et al., 2007; Rajan & Zingales, 1995; Gaver & Gaver, 1993; Smith & Watts, 1992). This paper tests if the debt financing decision in growth stage is affected by the industry of "new economy." The purpose of this study is to explore the impact of industry membership on the debt financing decision of firms in their growth phase.

As documented by Ittner et al. (2003), new economy firms (NEFs) differ in many respects from traditional ones (old economy firms, OEFs). Actually, NEFs are smaller, pursue riskier strategies, have significantly lower accounting returns, and are undertaking more extensive research and development than OEFs. More importantly, one distinctive feature of these firms is their more opaque and technical projects.

Financing decision varies across firms as a function of the firm life cycle stages. Firms have lower debt-to-equity ratios in the growth stage of life cycle. In this area, Smith and Watts (1992) and Gaver and Gaver (1993) provided initial evidence that growth firms use less debt in their capital structure. Rajan and Zingales (1995) extended these studies by demonstrating that the negative relationship between leverage and the market-to-book ratio, the proxy for growth options, is statistically significant across seven countries, including the United States. Goyal et al. (2002) found that U.S. defense firms increase their use of debt capacity as their growth declines. Billet et al. (2007) concluded that firm growth directly affects the corporate debt in a negative direction.

Although the above studies confirm the inverse association between firm growth and debt capacity, none has examined the industry impact on this relationship. Based on the life cycle theory of financing (Berger & Udell, 1998), I examine empirically if the effect of industry membership (new economy industry vs. old economy industry) tends to attenuate the negative impact of firm growth on debt capacity. I use a leverage equation including growth

options and an interaction term between growth options and New Economy. This interaction makes the effect of growth on leverage conditional on the industry membership of a firm, and thus allows a test of the hypothesis that New Economy affects the negative effect of firm growth on leverage. If New Economy attenuates the negative effect of growth options on leverage, then the interaction between the NEFs measure and the proxy for growth options should have a positive coefficient, while the direct effect for growth options should have the typically observed negative coefficient.

My sample consists of 82,257 firm-year observations representing U.S. companies listed on NYSE, AMEX and NASDAQ in the period of 1990-2010. I then divide my sample into two industries: NEFs and OEFs (Ittner et al., 2003). My results suggest that the incremental effect of New Economy on the negative relationship between corporate financing decision and firm growth is significant. Specifically, this connection is lower for the industry of NEFs. The results provide some support to the life cycle theory of financing suggesting that New Economy start-ups, facing more adverse selection problem during the early stage of the life cycle, benefit from debt providers only at the growth stage of the life cycle. My results are robust to various robustness tests, including different measures of growth options and leverage.

My contribution to the literature is to establish evidence that New Economy has incremental effect in determining debt policy beyond the life cycle stages. While surveys such as Smith and Watts (1992), Gaver and Gaver (1993), and Billet et al. (2007) support a negative relationship between growth and debt capacity, the effect of New Economy on this association has never received any interest. My empirical results call for new attention to the influence exerted by the new economy industry on the relationship between firm's growth and corporate debt policy. More specifically, technical and intangible projects of NEFs lead debt providers more hesitant and averse. Consequently, it is interesting to investigate the relationship between financing decision and growth in the particular context of NEFs.

The remainder of this paper is structured as follow. Section 2 discusses previous relevant studies and develops my predictions. Section 3 describes research design, sample, data, and presents the empirical models. Section 4 presents the empirical results. Section 5 checks robustness.

2. HYPOTHESIS, DATA AND METHODOLOGY

2.1 Theoretical Foundation and Hypothesis

It is argued that a firm's debt capacity is expected to decline during the growth stage of the life cycle for several reasons, mainly the debt overhang problem (underinvestment) and the wealth transfer effect (overinvestment). The underinvestment problem (Myers, 1977) arises when firms with risky debt ignore some positive net present value (NPV) projects. This occurs because shareholders don't receive the whole projects' payoff since it is shared with the debt-holders. Consequently, firms with valuable growth options are more likely to face the cost of the underinvestment problem. Myers (1977) argues that these firms can mitigate the underinvestment problem by financing their projects with equity instead of issuing debt. Announcing the overinvestment problem, Jensen (1986) argues that the assets in place generate agency costs associated with abundant free cash flow because of the divergent interests of managers and shareholders. In fact, managers have incentive to undertake negative NPV projects to maximise the firm's size in order to increase their control. Low growth firms, facing more agency costs of free cash flow, have more incentives to issue debt. Actually, the proceeds of debt require firm to pay out cash, averting managers from undertaking negative NPV projects.

In view of the above theories, I can notice that a firm declines its debt financing during the growth stage of the life cycle to mitigate the underinvestment and the overinvestment problems. Nevertheless, based on the life cycle theory of financing[1] (Berger & Udell, 1998), this negative relation between growth and debt capacity depend on industry life cycle. This relation tends to be less prominent in the particular industry of new economy for two reasons. First, the adverse selection problem is the key reason explaining why NEFs increase their debt finance during the growth stage of the life cycle. Actually, NEFs suffer from greater information asymmetries with banks,

[1] The life cycle theory of financing, introduced by Berger and Udell (1998), asserts that firms use different types of financing for different stages of growth.

particularly at start-up, that give rise to adverse selection.[2] Adverse selection occurs if debt providers have difficulties in discriminating between bad and good lending propositions. However, investment projects of NEFs are particularly associated with greater information asymmetries than OEFs because the technology is often opaque to outsiders (Mason & Harrison, 1998). Consequently, debt providers such as banks face difficulties in understanding and assessing technical projects, particularly at an earlier stage of their life cycle. Therefore, risk aversion may lead banks to incorrectly reject technical projects with good prospects because of their great opacity. Consequently, NEFs cannot rely on debt at their early stage. Second, the lack of collateral and which characterise most New Economy start-ups have a particularly marked impact on debt providers. Banks conventionally rely on loan guarantees and collateral to alleviate adverse selection problem (Stiglitz & Weiss, 1981). However, based on intellectual rather than physical capital, NEFs' growth options are typically intangible leading debt providers and banks averse and hesitant to accept them as collateral (Hogan & Hutson, 2005).

In summary, the life cycle theory of financing argues that newer NEF's are informationally opaque and have a difficult time attracting external sources of financing, particularly debt (Berger & Udell, 1998). By progressing through its life cycle, a firm from the new economy industry becomes less opaque, and consequently has more access to diverse funding sources. At later stages of life cycle, debt finance become possible options for NEFs as they grow in size and develop, make constant earnings, becomes less opaque, and produce higher incomes and assets that debt producers can use as collateral.

Based on the above discussion, especially on the adverse selection problem and the life cycle theory of financing, New Economy tends to attenuate the negative effect of firm growth on debt capacity.

2.2 Sample and Data

To test the empirical relationship between debt capacity and firm growth with the interaction effect of New Economy, I construct a large sample panel of U.S. firms composed of companies listed on NASDAQ, AMEX and NYSE for the period 1990 to 2010. The financial accounting data are from Bloomberg database of the central bank of Tunisia. Following the tradition in the capital structure literature, utilities (SIC codes 4900-4999) and financial institutions (SIC codes 6000-6099) are excluded to focus on the U.S. industrial corporate sector. Actually, capital structure of financial firms are likely to be significantly different from non-financial firms' ones (Lundstrum, 2009). Utilities firms are excluded to avoid the bias that their leverage decision is regulated (Fama & French, 2002). I also drop firms with negative book value of equity. The final sample size is 82,257 firm-year observations.

I divide the sample into tow industry-based sub-samples: NEFs and OEFs. Following Ittner et al. (2003), I define NEFs as companies competing in the computer, software, internet, telecommunications, or networking fields.[3] OEFs are defined as the traditional firms composed by the rest of the sample.[4]

Estimating financial ratios across this large number of observations certainly produces extreme values. For example, I use a book measure of leverage by dividing total debt to the book value of assets. However, this ratio can largely surpass the value of one, providing principally extreme values.[5] To mitigate the effect of extreme outliers, I winsorize the sample variables and ratios at the top and bottom two percentiles of their respective distributions.

2.3 Measuring Debt Capacity

I compute a book measure of financial leverage (*LEV*) throughout the paper defined as total debt divided by the book value of total assets (book leverage ratio), where total debt is computed as the sum of long-term debt and debt in current liabilities. I follow a recent literature to justify my use of book leverage ratio. Barclay et al. (2006)

[2] Berger and Udell (1998) argue that the adverse selection problem particularly arises in NEFs.
[3] Following the SIC designations, new economy firms are defined as companies with SIC codes of 3570 (Computer and Office Equipment), 3571 (Electronic Computers), 3572 (Computer Storage Devices), 3576 (Computer Communication Equipment), 3577 (Computer Peripheral Equipment), 3661 (Telephone & Telegraph Apparatus), 3674 (Semiconductor and Related Devices), 4812 (Wireless Telecommunication), 4813 (Telecommunication), 5045 (Computers and Software Wholesalers), 5961 (Electronic Mail-Order Houses), 7370 (Computer Programming, Data Processing), 7371 (Computer Programming Service), 7372 (Prepackaged Software), and 7373 (Computer Integrated Systems Design).
[4] Old economy firms are firms with SIC designations less than 4000, and not belonging to the new economy sector.
[5] It is generally expected to get ratio values between zero and one.

provide a conceptual framework showing that book leverage is theoretically preferable in investigating financial leverage. They dispute that the use of market leverage ratio[6] could be particularly problematic in examining the relation between leverage ratio and growth measured by the market-to-book ratio. Actually, market value of equity shows up on both the numerator of the market-to-book ratio and the denominator of the leverage ratio, which could provoke severe endogeneity problems, and leads to biased results. Nevertheless, Welch (2004) prefers market leverage instead of book leverage. Using both book leverage and market leverage in their leverage ratio estimation, Fama and French (2002) get remarkably different results. Given these conflicting arguments, I later provide robustness checks using the market leverage ratio.

2.4 Explanatory Variables

In line with Rajan and Zingales (1995), I use the market-to-book ratio of assets as a proxy for the firm's growth options. Adam and Goyal (2008) provide evidence that, across numerous measures of growth options, the market-to-book ratio of assets is the best proxy. They show that it has the highest correlation with a firm's actual growth options, reflects the information in other measures, and is least affected by confounding factors.[7] The market-to-book ratio of assets (*MTB*) is a closely related measure to Tobin's *Q*, and it is defined as the market value of assets divided by the book value of assets. The book value of assets presents assets in place, while the market value of assets (replacing book value of common equity with market value of common equity) presents both a firm's assets in place and growth options. Hence, a high market-to-book ratio of assets means that a firm has many growth options compared to its assets in place. Following previous literature (Smith & Watts, 1992; Gaver & Gaver, 1993; Billet et al., 2007) based on underinvestment and overinvestment problems, a negative relationship between market-to-book ratio and leverage ratio is expected.

In order to test my prediction with industry interaction effect, I introduce an indicator variable, *NEF*, equals to 1 if a firm belongs to the new economy industry and 0 otherwise. The coefficient on the interaction between NEFs and market-to-book ratio (*NEF*MTB*) represents the incremental effect of New Economy on the weights allocated to growth options level. Following my hypothesis, this interaction variable is expected to be positively related to leverage ratio.

I also integrate conventional control variables that are usually considered as influencing the firm's leverage ratio. I control for firm size, the nature of assets, profitability, operational risk, and non-debt tax shields. Rajan and Zingales (1995) suggest that firm size is a proxy for the bankruptcy costs. Given their lower bankruptcy probability, larger firms can specially benefit from an increase in debt capacity (Titman & Wessels, 1988). The relationship between leverage ratio and firm size, defined as the natural logarithm of total assets (*LOGTA*), is expected to be positive.

Rajan and Zingales (1995) affirm that tangible assets can be pledged as collateral for loans and can then decrease debt agency costs and consequently increase leverage. Moreover, Harris and Raviv (1990) argue that firms with relatively high levels of tangible assets can be liquidated easily, reducing the cost of inefficient liquidation and consequently increase optimal leverage. I define tangible assets as net property, plant and equipment divided by the book value of total assets (*PPE_TA*), and anticipate a positive relation between leverage ratio and tangible assets.

I include the return on assets as a profitability measure. Following the pecking order theory, Myers (1984) argues that firms prefer internal to external financing and debt to equity if external financing is used, implying that more profitable firms use less debt. The link between return on assets, defined as earnings before extraordinary items divided by total assets (*EBEI_TA*), and leverage ratios is expected to be negative.

A number of empirical studies (Titman & Wessels, 1988; Booth et al., 2001; Johnson, 2003; Billet et al., 2007) use the profit volatility as an explanatory variable for the firm leverage. I follow the argument of Bradley et al. (1984) pointing out that an increase in profit volatility is considered a serious risk for creditors. Profit volatility

[6] Market debt = total debt/market value of total assets, where the market value of assets is estimated as the book value of total assets minus the book value of equity plus the market value of equity, which is defined as shares outstanding multiplied by share closing price at the end of fiscal year *t*.

[7] My results are robust to various sensitivity tests considering alternative proxies for growth options.

should then be negatively related to leverage. I calculate profit volatility by the standard deviation of the first difference in earnings before extraordinary items over the 5 years preceding and including the year in which leverage is computed, scaled by the average value of total assets during this period (*RISK_EBEI*).

DeAngelo and Masulis (1980) provide evidence showing that non-debt tax shields (*NDTS*) are a substitute for the tax benefits of debt capacity. They state that firms with large non-debt tax shields are expected to receive lower tax benefits associated with leverage and hence likely to have less debt in their capital structures. I follow Fama and French (2000) in estimating NDTS by using the ratio of depreciation to total assets. I predict a negative association between NDTS and debt level. Table 1 provides definitions of the variables I use in this study.

Table 1: Description of Key Variables

Leverage Ratio (LEV)
Total debt/book value of total assets, where total debt is computed as sum of long-term debt and debt in current liabilities
Explanatory Variables
Market-to-book ratio of assets (MTB)
Market value of assets/book value of assets
New economy firms (NEF)
Equals1 if the firm belongs to the new economy industry; and 0 otherwise
Firm size (LOGTA)
Natural logarithm of total assets
Asset tangibility (PPE_TA)
Net property, plant, and equipment/total assets
Profitability (EBEI_TA)
Earnings before extraordinary items/total assets
Earnings volatility (RISK_EBEI)
Standard deviation of the first difference in earnings before extraordinary items over the five years preceding and including the year in which leverage is computed/by the average value of total assets during this period
Non-debt tax shields (NDTS)
Depreciation/total assets

2.5 Empirical Specification

I investigate the impact of New Economy on the relationship between firm growth and corporate debt policy. More specifically, I examine whether the negative impact of growth options on debt level is lower in NEFs. I specify a leverage equation where T-statistics are calculated using White standard errors clustered by firm and by year, which account for heteroscedasticity and serial correlation (Petersen, 2009; Thompson, 2011). I follow the argument of Smith and Watts (1992) to develop my hypothesis and assume that growth options are exogenously determinated. Therefore, we examine the association between leverage and growth options without consider the causality effect.

My leverage equation contain the independent variables discussed above including a proxy for growth options, a measure of New Economy, and an interaction between the New Economy measure and the proxy for growth options. With this design, the partial derivative of leverage ratio with respect to growth options contains two terms, the coefficient on the growth options measure and the coefficient on the interaction term measure of New Economy. The first term measures the typical effect of growth options on leverage, and should be negative. The second term measures the reduction of the negative effect of growth options on leverage of a firm belonging to the industry of new economy, and should be positive. All measures of independent variables discussed above except earnings volatility measure are from the year before the year in which leverage is measured (lagged exogenous variables).

3. EMPIRICAL RESULTS

3.1 Univariate Analysis

Table 2 reports descriptive statistics for variables I use in my empirical analysis. These statistics are referred to the full sample of the study, covering the period of 1990-2010. On average, 18.97% of U.S. companies' assets are financed through debt. The mean (median) of market-to-book ratio is 2.32 (1.60). These values are greater

than one which means that, on average, firms have valuable investment options, and hence potentially face underinvestment and overinvestment problems. The mean size of the firms is about 4.86, i.e., 72.443 millions of dollars. Followed by the market-to-book ratio, the firm size has the highest average deviation around the mean (2.34), indicating the importance of firm assets in determining its financial policy. Tangible asset have a mean value of 28.53%, representing about the quarter party of total assets. The profitability measure (EBEI_TA) has a mean value of -0.64%. The earnings volatility has an average of 0.56%. The average of NDTS is about 4.59%.

Table 2: Summary Statistics, 1990-2010

Variable	N	Mean	Median	Std. Dev
LEV	82257	0.1897	0.1478	0.18764
MTB	60910	2.3190	1.5988	1.9835
LOGTA	65961	4.8582	4.6570	2.3406
PPE_TA	65851	0.2853	0.2106	0.2432
EBET_TA	64264	-0.0642	0.0232	0.2565
RISK_EBEI	43941	0.0056	0.0003	0.0149
NDTS	65422	0.0459	0.0390	0.0334

The summary statistics are for a sample of 82,257 firm-year observations from 1990 to 2010. Variables are defined in Table 1. N = number of observations.

Now, I evaluate the descriptive statistics of the debt variables depending on the firms' growth level. Therefore, I divide my full sample into two groups: firms in growth life cycle stage and firms in no growth life cycle stage. I rank all firms annually based on their market-to-book ratio of assets which is my measure of the growth options. The firms in growth life cycle stage are those with market-to-book ratio above the annual sample quartile; and the firms in no growth life cycle stage are those with market-to-book ratio below the annual sample quartile. Moreover, in order to test the significance of the difference between the two debt variables means, I run a Student's t-test. The last column of Table 3 exposes the Student test results about the difference in debt capacity between firms in growth and firms in no growth stage of life cycle.

Panel A of Table 3 shows that leverage measure is, on average, significantly higher for the sample of growth stage of life cycle, explaining that firms prefer debt financing in order to mitigate asymmetric information problems. To evaluate more the difference in the level of debt between firms in growth and no growth stage of life cycle, I divide my full sample into blocs: NEFs and OEFs. Then, I rank the firms of the two groups annually based on their market-to-book ratio of assets. Table 3 compares debt capacity between groups of NEFs (Panel B) and OEFs (Panel C) according to their life cycle stages. Following the Student test results, the prediction that leverage are lower during the growth stage of life cycle persists even when considering New Economy, supporting the Smith and Watts' (1992) contracting hypothesis that firms with high growth options have lower debt-to-equity ratios.

Table 3: Comparison of Debt Capacity between Firms in the Growth and No Growth Stage of Life Cycle over the Period 1990-2010

	Panel A: All Firms	Panel B: New Economy Firms	Panel C: Old Economy Firms
Firms in the Growth Stage of Life Cycle			
N	15109	3211	11897
Mean	0.1078	0.0752	0.1221
Median	0.1562	0.1343	0.00237
Std. Dev	0.00127	0.00237	0.00149
Firms in the No Growth Stage of Life Cycle			
N	32968	8188	24762
Mean	0.2087	0.1587	0.2226
Median	0.1980	0.1882	0.1990
Std. Dev	0.00109	0.00208	0.00126
Student t	**-55.23*** **	**- 22.95*** **	**- 47.95*** **

3.2 Correlation Analysis

Table 4 reports the matrix of Pearson correlation coefficients among variables for the full sample used for examining debt capacity. While correlations across most of variables are low, the correlation between size and

earnings volatility tend to be relatively high. To check the collinearity between these variables, I perform a VIF (Variance inflation factor) test. The VIF values are very low relative to the threshold value of 10, indicating that exogenous variables included in the models are not significantly correlated each other. Consequently, I can pursue my analysis without any serious multicolinearity problems. The reported correlations display some preliminary relationships among the variables before moving to the regressions results. Leverage measure in Table 4 is negatively correlated with market-to-book ratio. This finding is consistent with the theory, arguing that potential underinvestment and free cash-flow problems negatively affect debt levels (Myers, 1977; Jensen, 1986).

Table 4: Pearson Correlations and VIF between Quantitative Variables of Debt Capacity over the Period 1990-2010

Variables	MTB	LOGTA	PPE_TA	EBEI_TA	RISK_EBEI	NDTS	VIF
MTB	1.00000						1.3677

LOGTA	0.2310	1.00000					1.4236
	<.0001						
PPE_TA	-0.1903	0.1852	1.00000				1.3926
	<.0001	<.0001					
EBEI_TA	-0.3075	0.3988	0.1198	1.00000			1.4004
	<.0001	<.0001	<.0001				
RISK_EBEI	0.2780	-0.4707	-0.0937	-0.3638	1.00000		1.4113
	<.0001	<.0001	<.0001	<.0001			
NDTS	-0.1094	0.0796	0.3926	-0.1402	-0.0417	1.00000	1.3589
	<.0001	<.0001	<.0001	<.0001	<.0001		

Variables are defined in Table 1. VIF: variance inflation factor.

3.3 Multivariate Analysis

Table 5 reveals the results about the regression of leverage ratio on growth levels, their interaction with the New Economy indicator, and control variables. As expected, the market-to-book ratio coefficient is negative and statistically significant at the 0.01 level. A coefficient of -0.02 implies that a double increase in the market-to-book ratio would be associated with a decline of two percent in leverage ratio. Other things being equal, when the level of a firm's growth increases without varying the value of assets in place, the optimal total debt would decrease. This finding is consistent with the Myers's (1977) prediction that growth firms use less debt, and consistent with findings in Smith and Watts (1992) and Rajan and Zingales (1995). Under the contracting arguments, firms with more growth options tend to have less debt in their capital structure to avoid underinvestment and overinvestment problems, which rise with leverage.

Table 5: The Impact of Industry Life Cycle on the Association between Debt Capacity and Firm Growth

Independent Variables	Expected Sign	Coefficient	Student t
MTB	-	-0.0166	-30.75***
NEF		-0.0533	-20.16***
MTB*NEF	+	0.0032	5.08***
LOGTA	+	0.0190	47.83***
PPE_TA	+	0.1517	33.54***
EBET_TA	-	-0.0540	-13.97***
RISK_EBEI	-	0.1531	2.38**
NDTS	-	0.0280	0.90
Intercept		0.0873	30.08
N		42434	
Adjusted R^2		0.1659	

The table presents panel estimates of leverage equation relating leverage ratio and explanatory variables. Variables are defined in Table 1. N = number of observations. *** indicates statistical significance level of 1 percent; ** indicates statistical significance level of 5 percent.

Nevertheless, the interaction term between market-to-book and New Economy measure has a significantly positive coefficient of 0.0032 (t = 5.08). This result supports my prediction and is also consistent with the life cycle theory of financing that New Economy attenuates the negative effect of growth level on leverage.

To evaluate the economic significance of New Economy decrease effect (new economy) on the market-to-book ratio-leverage relation, I use the coefficient estimates to compute the effect on (mean) leverage of a one-standard deviation increase in the market-to-book ratio. For my global sample, the coefficient of the market-to-book ratio leverage ratio is -0.0166. For the NEFs, the partial derivate is -0.0166 plus 0.0032, i.e., -0.0134. In other words, a one-standard deviation in the market-to-book ratio of assets generally reduces leverage by approximately 9% of its mean, but reduces leverage by only approximately 7% of its mean for NEFs. Clearly, the negative effect of growth level on leverage is lower in NEFs than in OEFs. This finding is consistent with our prediction and the life cycle theory of financing (Berger & Udell, 1998) arguing that the negative relation between firm growth and debt capacity depend on industry life cycle. This relation tends to be less important in the new economy industry because of the adverse selection problem that faces NEFs, particularly at an earlier stage of their life cycle. However, by progressing through its life cycle, a firm from new economy industry becomes informationally less opaque and have more tangible loan guarantees and collaterals, and consequently has more access to diverse funding sources. NEFs have more debt in their capital structure during the growth stage of life cycle leads to attenuate the negative impact of growth options on leverage.

The coefficients on the other variables in the leverage equation are generally consistent with previous capital structure studies. In concordance with the debt capacity prediction (Titman & Wessels, 1988), the coefficients on firm size are positive and statistically significant at the 0.01 level. As predicted, fixed asset ratio has always significantly positive coefficients. The coefficients on profitability are negative and significant at the 0.01 level, supporting the pecking order theory. Earnings volatility is negatively associated with leverage ratios. This result appears to be in concordance with capital structure studies supporting a negative relationship between debt and firm risk (Johnson, 2003; Billet et al., 2007). Finally, NDTS has statistically insignificant coefficient.

3.4 Robustness Tests

To check the robustness of the results reported in the previous section, I rerun my regression with different specifications. Table 7 summarises sensitive analyse results.

3.4.1 Alternative Measures of Leverage

To investigate whether my results are sensitive to the measure of leverage, I conduct my base regression employing two alternative measures of leverage ratio, defined in Table 6: a market debt ratio and a long term debt ratio. Replacing the dependant variable in leverage equation with these different definitions of total debt, Table 7 reveals that coefficients on MTB*NEF for the alternative measures of leverage are statically significant at the 0.01 level, indicating that my findings in summarized table are robust.

Table 6: Description of Alternative Variables

Alternative Measures of Leverage

- *M_LEV* = Total debt/market value of total assets, where the market value of assets is estimated as the book value of total assets minus the book value of equity plus the market value of equity, which is defined as shares outstanding multiplied by share closing price at the end of fiscal year *t*
- $LT\_DEBT_{i,t+1}$ = Long term debt in year *t*+1/total assets

Alternative Measures of Growth Options

- $MBE_{i,t}$ = Market-to-book ratio of equity in year *t*, defined as the market value of equity divided by the book value of equity. The market value of equity is defined as shares outstanding multiplied by share closing price at the end of fiscal year *t*. Similarly to the MTB ratio, a high ratio of MBE indicates the magnitude of growth options relatively to assets in place.
- $E\_P_{i,t}$ = Earnings to price ratio in year *t*, calculated by dividing the earnings per share before extraordinary items by the market closing price of the stock at the end of fiscal year *t*. A relatively high E_P ratio indicates that a large proportion of equity value is attributable to assets in place relative to growth options (Chung and Charoenwong, 1991).

3.4.2 Alternative Measures of Growth Options

The market-to-book ratio of assets is the most commonly used proxy for a firm's growth options (Adam & Goyal, 2008). We check the robustness of our results with alternative measures of growth options (MBE and E/P),

defined in Table 6. Table 7 shows the estimation results with alternative proxies of growth options. The prediction of my study remains consistent; the leverage estimation results are robust to the growth options measures variation.

Table 7: Robustness Tests

	Alternative Measures of Leverage Ratio		Alternative Measures of Growth Options	
Independant Variables	**M_LEV**	**LT_DEBT**	**MBE**	**E_P**
MTB	-0.0281***	-0.0106 ***	0.0010**	0.7218***
NEF	-0.0532***	-0.0440***	-0.0425***	-0.0720***
MTB*NEF	0.0065***	0.00437***	0.0002***	0.6640***
SIZE	0.0106***	0.0207***	0.0112***	0.0180***
TNG	0.1358***	0.1380***	0.1473***	0.1270***
ROA	-0.0393***	-0.0363***	-0.0223***	-1.0557***
RISK	-0.0512	0.0682	-0.3472***	0.2147**
NDTS	-0.1700***	-0.0289	-0.0657***	-0.1294*
Intercept	0.1230	0.0226	0.0760	0.0957
N	42235	42472	42229	26814
Adjusted R^2	0.2059	0.1899	0.1501	0.2486

Variables are defined in Table 1 and Table 6 (Alternative Measures). N = number of observations. *** indicates statistical significance level of 1 percent; ** indicates statistical significance level of 5 percent; * indicates statistical significance level of 10 percent.

4. CONCLUSION

This article investigates empirically how the life cycle industry affects the relation between leverage and growth level. I address the impact of the life cycle industry on the negative relationship between growth options and debt ratios. This study is motivated by NEFs' distinctive characteristics that have higher levels of growth rate, return and risk, and particularly undertake more technical projects. Previous literature provides evidence on the prominent role of growth options on leverage. Nevertheless, empirical literature is not concerned by the effect of New Economy on the negative relationship between growth options and leverage ratios. I investigate the interaction effect of New Economy with growth options on debt level of U.S. firms.

I find strong support for the life cycle theory of financing that New Economy attenuates the negative effect of growth options on leverage. Actually, the life cycle theory of financing argues that, at its early life cycle, a NEF is informationally opaque and has a difficult time to attract debt financing (Berger & Udell, 1998) because of the adverse selection problem. By progressing through its life cycle, a firm from the new economy industry becomes less opaque, and consequently has more access to diverse funding sources. At later stages of life cycle, and consequently during the growth stage, debt capacity become possible options for NEFs as they grow in size and develop, make constant earnings, becomes less opaque, and produce higher incomes and assets that debt producers can use as collateral.

The framework employed in this article is sufficiently general to allow analysis of how different industries affect the relation between leverage and firm growth. It should be possible to study the effect of other distinctive industries on the negative relation between debt and firm growth using the framework employed in this article.

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