Time-To-Build and Dynamics of Capital Structure[1]

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Abstract

Large capital investment projects take time to complete. This time lag is referred to as time-to-build or construction lag. We document the evidence that the time-to-build characteristic of firms' investment projects significantly affect financing decisions. When a firm invests in projects that are subject to longer time-to-build, it chooses lower leverage for periods prior to and immediately after the investments: a firm that initiates a large investment project that takes four years to complete will choose leverage ratio that is 7% lower than a leverage of a firm with similar size project that takes less than one year to complete. We find that firms with investment projects that a subject to longer time-to-build choose a higher proportion of equity financing at the initiation of the investment, but during construction lags firms tend to raise more debt as they approach the completion of the projects. Our findings can provide economically plausible explanations to the "equity dependence" puzzle that "equity issuers are not typically under duress" (Fama and French (2005)). The time-to-build factor can also offer a rational explanation to the “market timing”-like behavior. We argue that the choice to finance investment projects with equity is not driven by the motivation to sell overpriced shares after stock prices rise - as suggested by market timing - but rather by the need to maintain adequate financial flexibility throughout the construction lags during which the projects generate no cash to service debt.

1 Introduction

There is generally an agreement in the capital structure literature on the factors that capture the cross-sectional variation in firms' long-term leverages.[1] In contrast, there are time series regularities in observed leverage choices that are difficult to interpret within conventional theories. In particular, the trade-off theories predict that, after periods when a firm's earning increases and stock price rises and its leverage decreases, at some point the firm should recapitalize and increase its leverage and revert back to its target. If the stock price appreciation is driven by the recognition of a large profitable investment option that requires external financing, the firm can use this investment opportunity to adjust its capital structure upward by raising debt financing.[2] Empirical research shows that firms often employ the exact opposite financing policy: after periods with stock price appreciation, firms often issue external equity, causing leverage to decline even further.[3] Such behavior appears to contradict both the trade-off and pecking order theories leading researchers to resort to behavioral or market timing explanations, according to which there is no target leverage and the managers time the market by trying to sell overpriced equity. There is another seemingly unrelated fact that firms issue debt and/or equity infrequently, but in clusters. Explanations for this fact rely on the presence of different forms of transaction costs of recapitalization (see Fischer, Heinkel, and Zechner (1989), Leary and Roberts (2005)). According to this literature, transaction costs prevent firms from frequent recapitalizations, which leads to wide swings in observed leverage over time.

In this paper, we show empirically that the described time series regularities have the same origin and can be rationally explained without assumptions of market timing or transaction costs.

[1] Important studies that focus on the relation between observed capital structures and various cross-sectional proxies that are likely to be related to firms' target capital structures include Titman and Wessels (1988) and Harris and Raviv (1991).

[2] See Hovakimian, Opler and Titman (2001), Hovakimian, Hovakimian and Tehranian (2004).

[3] See, for example, Masulis and Korwar (1986), Asquith and Mullins (1986), Korajczyk, Lucas and McDonald (1991), Jung, Kim and Stulz (1996), and Hovakimian, Opler and Titman (2001).

Our explanation is based on a combination of the following two observations: 1) firms tend to make capital investments in infrequent but large amounts, such that infrequent periods with large investments account for a significant fraction of firms' total investments,[4] and 2) large capital investments take time to complete. This time lag is referred to as time-to-build (TTB), or construction lag, which is the time between when the firm makes the investment and when the investment starts to generate earnings. We show that firms do make recapitalizations infrequently, and document that active recapitalizations tend to cluster around periods with large capital investments. The recognition of the fact that large investments take time to complete is a key factor as to why firms frequently issue equity (not debt) after periods when their stock price appreciate and leverage decline. We argue that the choice to finance such investment projects with equity is not driven by the motivation to sell overpriced shares – as suggested by market timing – but rather by the need to maintain adequate financial flexibility throughout the construction lags during which the projects generate no cash to service debt.[5]

The idea that the time-to-build characteristic of firms' ongoing investments is a factor in capital structure is novel for empirical literature which focuses on factors that describe firms' existing assets, their history[6] as well as financial market imperfections.[7] When an ongoing investment project is large and takes time to build, the firm will operate with a large fraction of assets-in-progress that do not generate cash to service debt during the construction period. Therefore, as a firm faces the question of how to finance such an investment project, it should be forward-looking and its decision should be weighted not only on the characteristics of existing assets but also on how long it takes

[4]See for example Doms and Dunne (1993), Caballero and Engel (1999), and Nilsen and Schiantarelli (2003).

[5]In a survey of CFOs, Graham and Harvey (2001) report that respondents mention the need to maintain financial flexibility as a "very important" factor in the capital structure choice.

[6]Titman and Kayhan (2004) and Liu (2005) describe the effect of past book-to-market ratios on the observed capital structures.

[7]For example Leary and Roberts (2005) highlight differences in adjustment costs that may explain capital structure patterns. Leland (1998) and Titman and Tsyplakov (2006) show that agency costs play an important role in capital structure dynamics. The role of financial constraints is explored in Lemmon and Zender (2004), Minton and Wruck (2001), and Titman, Tompaidis, and Tsyplakov (2004).

for the project to start generating cash.

To illustrate how this time-to-build lag can influence firms' financing choices, consider the example of Carnival Corporation, the world's largest cruise company. In 1999, after a year of earnings increases and stock price appreciation,[8] the company signed a large contract with two shipyards for the construction of six new cruise ships. The total capital expenditure for the construction was \$2.47 billion, which constituted about 30% of the company's existing assets. By the company's estimation, the deal would be completed by 2003 because the lead time for the design, construction and delivery of a cruise ship was approximately two to three years. According to the schedule, one ship was expected to be in service in 2000, another one in 2001, three in 2002, and one in 2003. To finance the deal, in 1999, the company issued stock valued at \$742 million. In the same year, the company borrowed only about \$7.8 million, but retired \$564 million of long-term debt, driving its book leverage down to 13% from 23%. As the construction of new ships approached their completions, the company increased its leverage to 24%, 25%, 27%, and 30% in 2000, 2001, 2002 and 2003, respectively.

In this example, Carnival's leverage exhibits time-series patterns that would be difficult to explain if the time-to-build characteristic of the construction deal were ignored. First, its leverage swung significantly over the period of four years from as low as 13% to as high as 30%. The wide range of observed leverages may appear to be consistent with an adjustment cost explanation, but adjustment costs alone cannot explain why the company increased its leverage gradually – rather than in a lumpy amount – during the construction period of 2000-2003. Second, the fact that the company issued equity and retired debt in 1999 after its earnings increase contradicts the implications of the trade-off and pecking order theories. Third, Carnival stock appreciated significantly prior to the construction deal, perhaps driven by an increase in earnings and the recognition of the company's valuable investment opportunity. The fact that the company issued equity after a period of stock price gains is consistent with "market timing" argument. However, this

[8] In 1998 Carnival's earnings increased from \$819 million to \$943 million and the stock price appreciated by more than 68%.

is not the only rationale for such financing choices. Carnival's choice of financing the deal primarily with equity is because the company's management was informed that it would take multiple years to build the cruise ships,[9] and that the ships under construction generated no cash to service debt. When the ships were close to completion and started to generate income, the company increased its leverage to reduce its taxable income. Despite the fact that the Carnival case is one specific example, we will show that similar time-series variations in leverages are observed across a wide spectrum of COMPUSTAT firms.

In this paper, we focus on leverage choices during periods when firms have large ongoing investment projects and estimate the time lag needed to complete the investments. In our empirical approach, the estimation of the TTB lag of the capital investments is based on GAAP regulations, according to which incomplete assets (or assets-in-progress) are not allowed to generate depreciation expenses. Only after the investment project is complete, can a firm subtract depreciation, and therefore, the reported depreciation is expected to increase. For each period with large investments, we estimate its TTB as the time lag between the year when the capital expenditure is made and the year when the depreciation rate increases significantly.

We document that firms whose capital investment projects are subject to longer time-to-build choose lower leverage for periods prior to and immediately after the investments. For example, a firm that initiates a large investment project that takes four years to complete chooses a leverage ratio that is 7% lower than that of a firm with a similar size project that takes less than one year to complete. During the construction period, firms with ongoing investment projects that are nearer the estimated completion dates are more leveraged than those whose investments are farther from

[9] Carnival's management acknowledged explicitly in their annual 10-K report that the construction time of the ships is an important concern. The report for year 1999 quotes: "Delays or faults in ship construction may result in delays or cancellations of scheduled cruises, necessitate unscheduled repairs to and dry-docking of the ship and increase the Company's shipbuilding costs and/or expenses. Industrial action, insolvency of shipyards or other events could also delay or indefinitely postpone the delivery of new ships. These events, in turn, could, to the extent they are not covered by contractual provisions or insurance, adversely affect the Company's financial results."

completion.

We also find that during infrequent periods with large investment projects (with either short or long TTB), firms engage in more active recapitalization transactions. During these periods, the net debt issuance rate is seven times higher than the rate during the periods without large investments. These results imply that, on a firm level, debt financing of infrequent large investments accounts for more than 50% of the total debt issuances during a firm's lifetime. These findings are consistent with the findings of Leary and Roberts (2005), that external financing transactions are infrequent and tend to be in clusters. However, their argument that financing clusters are caused by transaction costs cannot explain the firms' gradual upward leverage adjustment during the construction periods that follows after the initial investments. Specifically, we find that firms whose projects take three or four years to finish have a tendency to increase their leverages gradually by about 2% every year during a construction period. The observed gradual debt adjustments, rather than issuance in lumpy amounts, contradict the transaction cost argument. Moreover, we believe that the impact of transaction costs on leverage patterns is somewhat exaggerated: it is the need for external financing, not transaction costs, that causes firms' financing decisions to cluster around infrequent periods when they raise capital for large investments.

We also document that leverage decisions during periods when firms initiate large capital investments that take time to complete may be observationally consistent with market timing. We report that such firms do tend to experience higher stock returns in the one- and two-year periods prior to making investments. They raise a larger fraction of external equity to fund their financing deficit when their investment projects are subject to longer TTB. We should stress that TTB is a key factor for this observation. Using the regression model introduced in Shyam-Sunder and Myers (1999) and in Frank and Goyal (2003), we find that only 30% of the external financing needs are covered by equity financing if the firms' project can be completed within one year. But the results change significantly if the investments take longer than one year to complete. In such cases, the firm funds its financing deficit with an increasing amount of external equity as time-to-build increases.

The reliance on equity financing may appear to be in line with the market timing hypothesis. However, the fact that firms with longer TTB projects raise more debt during the construction periods, even though they raise more equity at the initial stages of investments, contradicts the claim that market timing has a persistent effect on firms' leverage choices (Baker and Wurgler (2002)).

Finally, we find that target leverages predicted from a regression that incorporates the TTB variable are significantly closer to actual leverages when compared with leverages predicted from the conventional regression that ignores the effect of TTB. For example, compared to the model that incorporates the TTB factor, conventional models overestimate target leverage of firms whose ongoing investments take three years to build by 5%. Given that the average leverage in the sample is 22%, this 5% gap in leverage overestimation constitutes almost one-fourth of the total observed ratio. This finding suggests that firms are less underleveraged than predicted by models that ignore TTB characteristics of investment projects.

It should be emphasized that the time-to-build factor of the investment projects cannot be subsumed by conventional variables that describe firm characteristics, such as market-to-book ratios, profitability, tangibility of assets, and R&D expenses, etc. This is understandable because these conventional variables, which are constructed from firms' contemporaneous financial statements, or even lagged variables, cannot capture the characteristics of firms' ongoing investments. The novelty of our approach is that we employ a look-ahead method in the construction of the TTB variable. However, it should not be a problem because, in practice, managers do look ahead in their financing decisions as they have information on (or can plan on) how long the firm's investment projects are expected to be under construction. In contrast, a researcher who is trying to predict current leverage using only contemporaneous or lagged data is at an informational disadvantage relative to the managers because contemporaneous data cannot capture the time-to-build characteristics of the firm's investment projects.

There are several related theoretical and empirical papers. Tsyplakov (2007) presents a theoretical model on the effect of projects with TTB lags on the firms' leverage choices, but provides only limited summary statistics for a subsample of firms in the oil and gas extraction industry. In his model, a firm dynamically chooses the timing of its investment, which is subject to TTB, and chooses its source of investment funding that can endogenously adjust its capital structure. Several findings of the theoretical model are supported by the empirical findings in this paper. For example, consistent with model predictions, we find that firms use a larger fraction of external equity when they finance investments subject to longer time-to-build. In the related empirical works by Mayer and Sussman (2004) and Whited (2006), the authors study financing decisions for periods with investment spikes and analyze the timing of investment projects, respectively. Our study differs from these papers in that their studies focus on how financial market imperfections affect firms' capital structure and investment activities but ignore the time-to-build characteristics of investments.

The remainder of this paper is organized as follows. Section 2 describes our data. Section 3 introduces our method that identifies a large investment project and measures the time-to-build associated with the project. Section 4 describes firms' leverage decisions during periods with large investments. Section 5 develops the empirical methodology. Section 6 provides empirical results. Section 7 concludes the paper.

2 Data

Our sample consists of annual data of firms in Compustat from 1986 to 2004. Following standard practice, we exclude financial firms(SIC code 6000-6999), regulated utilities (SIC code 4900-4999), ADR firms and firms that involve major mergers.[10] We restrict the sample to include firms with book value of assets above \$5 million. Firm assets and sales are scaled by the consumer price index and expressed in values of 1986 dollars. To remove outliers, we eliminate observations with market-to-book ratios greater than 10 and leverage (market and book) greater than 1 and less than

[10] We require that a firm has acquisitions(#129)/capital expenditure(#128)$>25\%$ to be considered major mergers. We also use the the Compustat footnote code AB to identify the mergers.

0. In addition, we truncate the variables such as assets and market-to-book asset ratio and remove the most extreme 1% in either tail of the distribution. There are approximately 2,700 firms and 22,198 firm-year observations.

2.1 Measure of time-to-build for large investment projects

In this section, we describe how we identify periods with large investments and how we estimate time-to-build associated with large investments. There are two reasons why we concentrate on periods with large investments. First, due to technological constraints, large investment projects are more likely to take time to complete. Second, the financing of large projects is expected to have a sizable impact on a firm's overall capital structure.

We first identify periods with large investment projects. For each firm, we calculate the median value and the standard deviation of the ratio of capital expenditures over fixed assets $(\frac{CAPX}{FXASTS})=(CAPX\_FXASTS)$ during its sample period,[11] where fixed assets equal the sum of property, plant and equipment, and inventory.[12] We identify a year with a large investment when the capital expenditure ratio exceeds the median capital expenditure ratio by at least one standard deviation, i.e., if $CAPX\_FXASTS_t - median(CAPX\_FXASTS) > 1.0 \times st.dev.(CAPX\_FXASTS)$, where the median and standard deviation ratios are measured on a firm level over the 1986-2004 period.[13] This method identifies 3,181 firm-years with a large investment. Given the sample of 22,198 firm-year observations, on a firm level, large investment occurs once every seven years.

It is not possible to measure directly the exact time-to-build of a given investment project

[11] We scale the capital expenditure by total fixed assets because, in our analysis, we focus on capital expenditures related to investment in property, plant and equipment. Scaling capital expenditure by total asset doesn't change our results significantly.

[12] Previous literature, such as Frank and Goyal (2003), defines fixed assets as the sum of PPE plus inventory. Incomplete assets often are classified seated in inventory. Therefore, excluding inventory from total fixed assets can bias the identification of large investments.

[13] Alternatively, we used filter rules of 1.25, 1.5 and 2 standard deviations from the median investment rate, but found no material change to our results.

because firms do not explicitly report it in their financial statements. However, time-to-build can be estimated indirectly from accounting variables. For each identified large investment, the estimated time-to-build is the time lag between the year of large investment and the estimated completion year of that project. To estimate the completion year of a large investment project, we rely on GAAP regulations, according to which firms are allowed to subtract its depreciation only after the newly built assets are fully complete and productive. First, we measure a firm's depreciation ratio ($\frac{DEP}{FXASTS}$) - the ratio of the firm's depreciation over its fixed assets. Next, we measure the change in depreciation ratio for the subsequent three years following the year with large investments. Specifically , we calculate $\frac{(\frac{DEP}{FXASTS})_t}{(\frac{DEP}{FXASTS})_{t-1}}, \frac{(\frac{DEP}{FXASTS})_{t+1}}{(\frac{DEP}{FXASTS})_t}, \frac{(\frac{DEP}{FXASTS})_{t+2}}{(\frac{DEP}{FXASTS})_{t+1}}, and \frac{(\frac{DEP}{FXASTS})_{t+3}}{(\frac{DEP}{FXASTS})_{t+2}}$.[14] We argue that the year at which the maximum increase in depreciation ratio occurs is the year when the project is complete. For periods without large investment, the TTB measurement takes the value of zero. TTB equal to 1 implies that there is a large investment during that year and the project starts and completes within the same period (i.e., the largest increase in depreciation ratio occurs in the same year as the investment). If the estimated value for TTB is larger than 1, it implies that it takes more than one year to complete a project. We refer to the period between the year t and the estimated completion year as the "construction period."

The rationale behind our measurement is the following. While the incomplete assets (assets-in-progress) have to appear on the balance sheet, they are not allowed to generate any depreciation expense during the construction period.[15] As a result, before the new investment project is complete, new assets do not generate depreciation, and the firm's depreciation remains relatively constant as the previously built assets depreciate. In the year when the project is completed, the firm will start to take full depreciation for its newly built assets. Given the large size of investment,

[14] We use the window of three years based on an observation by Koeva (2000) that the average time-to-build across industries ranges from one to three years. The only exception is the utilities industry (seven years), which is excluded from our sample set.

[15] New capital expenditures, if they take time to complete, are normally classified as "assets-in-progress" or as inventory, both of which become part of the firm's total assets.

the depreciation ratio is expected to increase significantly when the newly built asset is complete. Therefore, when there exists a large investment project under construction, the year during which the maximum increase in depreciation ratio occurs is considered to be the year of the project completion. To illustrate our measurement, we plot the investment and change of depreciation rate for one of our sample firms. Panel A of Figure 1 illustrates that the firm's large investment occurs in year 2, while Panel B of Figure 1 shows that the maximum increase in depreciation rate happens in year 5. For this example, the estimated time-to-build for this large investment is assigned the value of four years ($TTB = 4$).

3 Time-to-build: Summary Statistics

Panel A of Table I provides summary characteristics for 3,181 firm-years with a large investment. The average size of a firm, measured in sales or book value of assets, during periods with large investments is comparable to that of firms during periods with no identified large investments. The average investment–to-asset ratio for the subsample with large investments ($TTB > 0$) is about twice that for the sample with no large investments ($TTB = 0$). The cross-sectional difference of investment-to-asset ratio among the groups with large investment ($TTB > 0$) is very small. We also calculate the Z score for firms with different TTB. All subsamples have average Z scores larger than 4, implying that on average financial distress is not a concern for firms that undertake large investments.

Panel B of Table I describes the industry distribution for firm-years with large investment and the estimated TTB in the sample. For each one-digit SIC code, we report the number of firm-year observations during which no large investments take place and the number of firm-years with large investments with different TTB. While the firms in the manufacturing industry have more observations with large investments, our sample is not dominated by any particular industry. Observations with the estimated TTB equal to one, two, three, and four are distributed relatively evenly across industries.

4 Nonparametric analysis

In this section, we use nonparametric analysis to describe firms' financing and leverage activities during periods when firms make large capital expenditures and during the construction periods for identified periods with large investments.

4.1 Observed leverage decisions

To illustrate the leverage dynamics for subsamples with different TTB lags, in Figure 2, we construct a graph showing the average market leverage of firms for each year from year $t-1$ to year $t+3$, where year t is the year when firms initiate a large investment. Several features of the graph are worth noting. First, cross-sectional comparison indicates that for the year prior to and at the year of large investment, firms whose investment projects have longer TTB have lower average market leverages. For example, in the year prior to a large investment, i.e., at $t-1$, the market leverage for firms whose investments take an estimated 1 year to complete ($TTB = 1$) is 19.6%, while the leverage for firms whose projects take 4 years ($TTB = 4$) declines to 15.2%. Second, as we will show in figure 3, such time series trends suggest that firms increase their leverages during the construction period and the magnitude of the increase in leverage is greater for firms with longer TTB than for firms with shorter TTB. Leverage ratios increase by about 9% during the construction period if $TTB = 4$, and by 8% if $TTB = 3$. The magnitude of an increase in leverage declines to 6.6% and 2% if the estimated $TTB = 2$ years and 1 year, respectively.

The explanation for the observed leverage patterns is based on the idea that the investment projects that subject to time-to-build lag initially generate no cash to service debt. Therefore firms choose lower debt ratios prior to and at the initiation of large investment to avoid potential difficulties in servicing the debt during the construction periods. When the projects are complete or close to completion, firms will raise more debt to reduce taxable income. Additionally, the leverage of firms with different levels of TTB appears to converge within 3 years after large investment. The cross-sectional difference in leverage ratio among different TTB groups becomes very small (less than 2%). The observed leverage patterns are consistent with the evidence presented in Leary and Roberts (2005) that firms revert back to their "normal" leverage levels within 2 to 4 years after equity issuances, if we consider the leverage of firms who have completed their construction process as "normal." However, our explanation to this leverage behavior does not rely on adjustment costs.

4.2 Financing activity when firms undertake large investment projects

We measure the level of external financing by calculating the sum of debt (gross and net) and equity issuance scaled by lagged book value of assets for firm-years with large investments (at the year of large investment and during the construction periods) and without large investments. As Panels A and B of Table II show, the amount of net external financing during the periods with large investments is 2.4 times greater than that during the periods without large investments. Specifically, firms issue about 13% net external financing at the year of large investments, but only 5.7% during years without large investment. We further decompose the external financing into debt and equity issuance, and report the results in columns 3-6 of Panels A and B. On average, firms raise less than 1% net debt during the years without investments. The amount of net debt raised increases to 7.1% and 4.7% at the year with large investment and during the construction periods, respectively. Such evidence suggests that, on a firm level, periods with large investments account for a significant fraction of firms' net debt issuance. In contrast, firms' equity issuance is only slightly higher during the year with large investment than the year without large investment.

4.3 Recapitalization during the construction periods

In order to further analyze the source of external financing during the construction periods for projects with different TTB lag, we construct a new variable, $Active\_recapitalization_{debt} = \frac{\sum_{t}^{t+TTB} \frac{\Delta D_t}{A_{t-1}}}{TTB}$. The denominator is the estimated time-to-build (in years) of an identified investment. The numerator is the sum of firms' long term gross debt issuance for each year during the construction period scaled by book asset at the year prior to large investment. This variable measures the average debt raised per year during the construction period t. Large values of $Active\_recapitalization_{debt}$ imply that a firm is more active in issuing debt. Using a similar approach, we construct three more variables $Active\_recapitalization_{net\ debt}$, $Active\_recapitalization_{equity}$, and $Active\_recapitalization_{net\ equity}$ that measure firms' average net debt, gross equity and net equity issuance during the construction period, respectively. The results are reported in Panel C of Table II. Active issuance of debt (gross and net) increases in TTB lag. Specifically, the $Active\_recapitalization_{debt}$ for firms with $TTB = 1$ is only about 3.3%, but nearly 8% for firms with $TTB = 4$. The difference between firms with $TTB = 1$ and $TTB = 4$ is significant at 5%. These results show that, on average, firms with investment projects that take longer time-to-build actively issue more debt during each year of the construction period.

In Figure 3, we construct the net debt and net equity issuance rate for firms with investments that have different levels of TTB measured for the periods from year t to year t+3, where year t represents the year when the investment is initiated. It is important to stress that, on a firm level, during the construction periods, firms tend to raise debt sequentially by relatively small amounts rather than in lumpy amounts so that the leverages increase gradually. For example, for firms with projects of $TTB = 4$, the net debt issuance rate is 2.61%, 3.44% and 4.37% during the year 0, year 1, and year 2, respectively, but reduce to a negligible 0.36% when the project is completed at year 3. This pattern is inconsistent with the adjustment cost explanation, according to which firms should issue debt infrequently but in large amounts. Interestingly, firms tend to exhibit a very different pattern in their equity issuance. The net equity issuance is larger at year 0 than at the subsequent years.

5 TTB as a predictor of leverage ratios

A non-parametric analysis and a graphical illustration in the previous section reveals TTB of investment projects is a factor that captures the cross-sectional variation in leverages. In this section, we show that the TTB measure remains an important factor even after accounting for other factors that affect the firms' capital structure decisions. We employ the traditional empirical models used in capital structure studies and regress firms' leverage on a number of factors that are considered to affect their capital structure decisions. We include the estimated TTB in these regressions and examine the effect of TTB on firms' leverages for all periods, as well as during 1) at the year when large investment is made, and 2) prior to large investment. The empirical tests are constructed as follows:

$$Lev_{i,t} = a + \beta X_{i,t-1} + b_1 TTB_{i,t} + \varepsilon_{i,t}, \tag{1}$$

$$Lev_{i,t-1} = a + \beta X_{i,t-2} + b_2 TTB_{i,t} + \varepsilon_{i,t-1}, \tag{2}$$

Lev is firm i's market debt ratio.[16] X is a vector of firm i's characteristics that appear regularly in the previous empirical literature (Titman and Wessels (1988), Rajan and Zingales (1995), and Fama and French (2002)). These characteristics include factors such as non-debt tax shields, risk, financial distress, profitability, tangibility, growth opportunities, industry effect, etc., are reported to be important and are included in our regressions.[17] Subscripts t and $t-1$ represent the year of large investment and the year prior to large investment, respectively. We regress equation (1), and equation (2) with estimation both conditional on large investment ($TTB > 0$) and unconditional on large investment ($TTB = 0$). We use panel regression controlling for firm fixed effects.[18] If firms with longer TTB choose lower leverage prior to and at the time of large investment, we expect $b_1 < 0$ and $b_2 < 0$.

Columns 1 and 2 of Table III present the panel (fixed effects) estimates of equation (1). The first

[16] Recent research tends to use market debt ratio to measure leverage. (Hovakimian, Opler and Titman (2001), Fama and French (2002), Leary and Roberts (2006)).

[17] The detailed list of control variables X is discussed in Table III. An exhaustive list of factors is beyond the scope of this paper. Readers can refer to the survey paper by Harris and Raviv (1991) and the empirical study by Titman and Wessels (1988) for a detailed list of relavant factors.

[18] Lemmon, Roberts and Zender (2006) show that firm unobserved fixed effects can explain the majority of variation in firms' capital structure.

column provides the unconditional estimates for all observations and the second column provides the results of estimation conditional on large investment ($TTB > 0$). To save space, we skip reporting the results for other control variables, most of which are statistically significant and carry the same sign as documented by the previous studies. The key variable for our analysis is TTB. The estimated coefficient for TTB is negative and statistically significant. The coefficient for unconditional estimation of TTB is -0.006. Economically this means that the leverage during the year of large investment that has $TTB = 4$ is about 2.4% less than that of firms with no large investment, after controlling for the effects of the other factors. The estimated coefficient for TTB conditional on the occurrence of a large investment is bigger than that of unconditional estimation. Given a large investment at hand, each additional year in the time-to-build reduces the firms' leverage by 1.6% when measured at the year of investment suggesting that the firm with the project that has four years of time-to-build is 4.8% less leveraged than a firm with one year of time-to-build. This result is generally consistent with what is shown in Figure 2, where the market leverage of firms with $TTB = 4$ after the investment is initiated is about 16%, while that of firms with $TTB = 1$ is more than 20%.

Columns 3 and 4 of Table II report the results of regression (2) . The estimated coefficients for the TTB variable suggest that firms' leverages one year prior to large investments are negatively related to the estimated time-to-build. The coefficients of TTB for both unconditional and conditional regression are -0.016 and -0.02, respectively, both of which are larger than the estimates in regression (1) . This result is consistent with the prediction of the dynamic model in Tsyplakov (2007) that the target ratios are lower for periods prior to large investment and the target leverages should monotonically decrease as the investment' TTB increases. The results in this section confirm that the impact of TTB on firm's leverage decisions is economically significant and that the TTB variable is not subsumed by other control variables.

5.1 Leverage decisions during the construction periods

In the previous sections we argue that as a firm's project nears its completion, the likelihood of liquidity problem diminishes and the firm should consequently raise debt. Holding other factors constant, a firm at a later stage of the construction period should be more leveraged than at an earlier stage. To test this prediction, we construct two new variables $RTTB$ and $ETTB$ that measures the remaining periods before the estimated completion of the project and the elapsed periods since the project is initiated, respectively. Obviously, for a given project, $RTTB+ETTB = TTB$.[19] We run the following regression that examines the cross sectional difference in leverage ratios during the construction periods :

$$Lev_{i,t^*} = a + \beta X_{i,t^*-1} + b_3 RTTB_{i,t^*} + b_4 ETTB + \varepsilon_{i,t^*}, \; t^* \in [t, t+TTB]^{20} \tag{3}$$

where the subscript t^* represents the years during the construction period of a large investment. If a firm closer to the project completion is more leveraged than a firm that is farther away from the completion of a project, then we expect the coefficient $b_3 < 0$ and $b_4 > 0$.

Column 6 of Table III reports the estimation results. Consistent with our prediction, $b_3 = -0.009$ and $b_4 = 0.007$ and both coefficients are statistically significant at 5% level. During the construction period, a one year decrease in remaining TTB leads to about 0.9% increase in firms' leverages and a one year increase in elapsed TTB increases the leverage by 0.7%.

[19] For example, considering a firm with a large investment project that takes 3 years to build ($TTB = 4$), by definition, the $RTTB$ and $ETTB$ of this firm at year 0 are 4 and 0, respectively, at year 0, and 3 and 1 at year 1.

[20] We also estimate a regression without controling for the effect of $ETTB$. The resulta are reported in column 5 of Table III

6 How important is the TTB variable in predicting leverage ratios?

In order to measure the economic importance of the TTB variable we compare the predictive power of an empirical model that incorporates TTB as an explanatory variable with a traditional model that ignores that variable. In Figure 4, we depict two predicted leverages for firms with different estimated TTB at the year when firms make large investments and the year prior to it. In this figure, *Leveage* 1 is the leverage predicted from the regression model that includes TTB as an independent variable (i.e. the model presented in column 1 and 3 of Table III), and *Leveage* 2 is the leverage predicted from, otherwise identical regression, except that TTB is excluded. To illustrate the predictive power of two models, we plot firms' realized market leverages prior to and at the year of investment in the same graph. One important observation is that firms with projects that have longer TTB tend to be less leveraged prior to and at the year of investment. This pattern is captured by the *Leveage* 1 predicted by the regression which incorporates the TTB variable, but is not captured by *Leveage* 2 that ignore TTB. Interestingly, the predicted values of *Leveage* 2 are relatively flat across periods. The difference between the observed leverage ratios and predicted *Leverage*2 is especially wide for periods when investment projects have longer TTB. For example, the model that ignores the TTB suggests that firms whose investment projects have $TTB = 4$ are underleveraged relative to predicted leverage (*Leverage* 2) by nearly 7% and 4% at the year of investment and prior to it, respectively. In contrast, the leverage ratios (*Leverage* 1) predicted by the model that takes into account the TTB are significantly closer in magnitude to the observed leverage ratios. For example, firms with $TTB = 4$, the deviation from the predicted leverages is only about 2% and 0.04% at the year and prior to the year of investment, respectively.

One observation regarding firms' capital structures generally mentioned in the literature is that firms appear to be conservative in their debt policy and are underleveraged relative to their predicted optimal leverage ratios. Our results show that the leverage deficit is not that significant if we control for the TTB characteristics of firms' ongoing investments.

7 Does the TTB variable capture additional variation in traditional capital structure tests?

7.1 TTB and market timing-like financing behavior

Empirical research finds that firms have a tendency of timing the equity issuance when their stock prices increase. For example, Baker and Wurgler (2002) argue that such a market timing has a persistent effect on firms' financing decisions. The authors point out that there is a negative relationship between firms' market valuations measured by past MB ratios and observed leverages. They interpret this negative relationship as an the evidence supporting the timing hypothesis that managers try to sell overpriced equity shares. There are several studies that question the conclusion in Baker and Wurgler (2002) by showing that high MB ratios proxy for growth opportunities rather than for equity overvaluation. However, these studies do not show directly why firms issue equity after stock price appreciation. We will show that the financing behavior of firms that initiate large capital investments that are subject to time-to-build do appear to be consistent with "market timing". However, we argue the choice to finance the projects largely with equity is driven by the TTB nature of the investments rather than for timing the equity markets.

Table IV reports the performance measures for firms-years with no large capital investments ($TTB = 0$), and for firm-years with large investments ($TTB > 0$). The Panel A reveals that firms that undertake large investments generally perform better, measured in both market and operating performance, than firms without large investments. Both the one- and two-year cumulative stock returns are significantly higher for years prior to when firms initiate large investments. Similarly, the operating performance, measured as the average ratio of EBIT (earning before interests and taxes) over assets, is significantly higher for firm-years with large investment than that without large investment. Also, the need for external financing (defined as the net debt issuance plus net equity issuance) is higher during firm-years with large investments.

In Panel B we split the subsample of firm-years according to the estimated TTB and repeat the univariate analysis. Prior stock returns and the accounting performances improve with the for firm-years with longer TTB. The firms' net equity issuance increases nearly monotonically as the investments' TTB lengthens. These last two facts imply that firms that raise higher proportion of external equity financing tend to enjoy greater prior stock returns. If the TTB nature of the investments were disregarded, such a pattern would be routinely interpreted as market-timing. Note, that such leverage patterns are more pronounced for firms with investments that require longer TTB. We argue that the choice to finance such investment projects with equity is not driven by the motivation to sell overpriced shares– as suggested by market timing– but rather by the need to maintain adequate financial flexibility throughout the construction lags during which the projects generate no cash to service the debt. Moreover, if market timing was a rationale behind equity issuances firms whose investments are of longer TTB, then the observed capital structures would reflect cumulative result of past timing behavior. To the contrary, the equity issuance of firms with longer TTB do not have a persistent effect on capital structures. Because firms, especially those with longer TTB, issue more debt and reverse back to their long-run "normal" leverage levels during the construction periods.

7.2 Financing deficit regression and TTB

In this section we formally test the role of TTB played in firms' financing choices at the time of large investment. We address this issue by estimating a financing deficit regression in Shyam-Sunder and Myers (1999) and Frank and Goyal (2003). Our purpose is not to test pecking order theory, but to check whether, in these regressions, the choice of financing depends on the TTB of the investment project. We replicate the regression run in Shyam-Sunder and Myers (1999) and Frank and Goyal (2003)) for subgroups with different levels of TTB:

$$\Delta D_{it} = a + bDEF_{it} + \varepsilon_{it}, \tag{4}$$

where DEF_{it} is financial deficit, which is the amount of net external financing raised by firm i during year t.[21] Following Frank and Goyal (2003), we define $DEF_{it} = DIV_{it} + I_{it} + \Delta W_{it} - C_{it} = \Delta D_{it} + \Delta E$, where

DIV_{it} is the cash dividend paid in year t;

I_{it} is net investment in year t;

ΔW_{it} is the change in net working capital in year t;

C_{it} is cash flow after interest and taxes in year t;

ΔD_{it} is net debt issued in year t;

ΔE_{it} is net equity issued in year t.

We group the sample of firm-years into groups according to the level of TTB. Our goal is to examine the cross-sectional differences between firms' financing behavior among different subgroups and compare the estimated coefficients $b_{TTB=1}$, $b_{TTB=2}$, $b_{TTB=3}$, and $b_{TTB=4}$ for these subgroups. We expect that firms use a lower fraction of debt and a higher fraction of equity when they finance large investments that are subject to longer TTB. Therefore, we expect that the estimated coefficients for different subgroups should satisfy $b_{TTB=1} > b_{TTB=2} > b_{TTB=3} > b_{TTB=4}$.

Table V provides results supporting these predictions. Panel A of Table IV reports results for the regression that uses the net debt issued as the dependent variable. The estimated coefficient for financing deficit variable for the sample with no large investment ($TTB = 0$) is 0.22. The value of the estimated coefficient for financial deficit is close in magnitude to the estimates reported in Frank and Goyal (2003)[22] concluding that debt covers only a small fraction of financing deficit. The

[21] According to Shyam-Sunder and Myers (1999),the pecking order theory suggests that $a = 0$ and $b = 1$. However, Chirinko and Singha (2000) point out that this model generates misleading inferences about the pecking order theory because the model tests the joint hypothesis of ordering (the financial hierarchy) and the proportion of financing choice. However, this is not a concern for our paper, since the goal of the paper is not about distinguishing between pecking order and trade-off hypothesis.

[22] The estimated coefficient is slightly lower than in Frank and Goyal's (2003) because our data includes the periods of the 1990s, which, as pointed out by Frank and Goyal (2003), have smaller coefficient of financing deficit (0.15) than for the other periods.

results change significantly when we run the same regression for the subsamples that consist of firms with large investments subject to TTB. The coefficients of financing deficit are 0.77, 0.63, 0.49 and 0.19 for subsamples with $TTB = 1, 2$, 3 and 4, respectively. The estimates are all statistically significant.As an alternative test, we also estimate the same financing deficit regression using net equity raised as the dependent variable. As financing deficit is just the sum of net debt and net equity issuance, we predict a similar result but in reverse order. The results are reported in Panel B of Table V. The estimated coefficient for the sample with $TTB = 0$ is 0.75. This observation is consistent with the conclusion in Frank and Goyal's (2003) that debt explains a relatively small fraction of a firm's financing deficit and also in line with the statement made in Fama and French (2005) that "equity issues are on average large and not typically done by firms under duress." More interestingly, when firms make large capital investments that take longer time-to-build, they tend to use a higher fraction of external equity to fund external financing needs. The coefficients for financing deficit are 0.22, 0.36, 0.51, 0.80 for groups with $TTB =$ 1, 2, 3 and 4, respectively.

The observed effect of TTB of ongoing investment projects on firms' financing choices can be rationalized by the following argument: If the investment project is large but can be completed within a year, then the project is expected to generate incremental cash flows without a time lag. In such a case, the firm can optimally choose relatively high leverage at the time of investment and will finance the project with a higher fraction of debt since the incremental cash flows from the new projects can be used to make interest payments. In contrast, when a project is subject to longer time-to-build, it does not immediately generate cash flow to service the debt. Therefore, in order to maintain financial flexibility, a firm will choose lower leverage and finance such a project with a lower fraction of debt and a higher fraction of equity.

7.3 Partial adjustment toward target leverage during the construction period

There is no consensus in the literature regarding the speed at which firms adjust toward their capital structure targets.[23] We expect that firms' leverage adjustment rates during the periods with large ongoing investment projects should exceed those during periods without large investments. The reason is the following: When a firm invests in a large project, it has to raise external debt, equity or both. In such cases, the firm will have a better opportunity to issue debt and equity in the proportions such that it will adjust the firm's capital structure towards targets.[24] We use a conventional partial adjustment model to test this prediction:

$$Lev_{i,t^*} - Lev_{i,t^*-1} = \lambda(Lev^*_{i,t^*} - Lev_{i,t^*-1}) + \varepsilon_{i,t^*}, t^* \in [t, t+T] \tag{5}$$

where Lev^*_{i,t^*} is the target leverage predicted from equation (3), t^* represents the year when large investments are initiated and T is the estimated TTB. Column 1 in panel A of Table VI reports the estimates of adjustment speed for the group without large investment. The estimated adjustment rate is about 49% per year, which is faster than the 34% reported in Flannary and Rangan (2006), but close in magnitude to their sample estimates for 1980s and 1990s. In our regressions for the subsample of $TTT > 0$, the estimated coefficient is about 0.67 confirming that firms do adjust their capital structure towards target at a higher annual rate during the construction period.

Finally, to measure the magnitude of firms' capital adjustment over the whole length of the construction period. We estimate a new modified partial adjustment regression

$$Lev_{i,t+T} - Lev_{i,t-1} = \lambda(Lev^*_{i,t+T} - Lev_{i,t-1}) + \varepsilon_t \tag{6}$$

Every variable remains the same as equation (5), except that we replace the annual leverage change in equation (5) with the leverage change during the whole construction period. We run this regres-

[23] Fama and French (2002) note that firms' debt ratios adjust slowly "at snails speed" toward their target. However, Flannery and Rangan (2006) find that adjustment speed is much faster and the typical firm closes about one-third of the gap between its actual and its target leverage ratio each year.

[24] See Hovakimian, Hovakimian and Tehranian (2004).

sion separately for groups with different estimated TTB. The coefficient λ captures the magnitude that firms move toward their optimal leverage over the entire construction period. The results are reported in Panel B of Table VI. The estimated λ is 0.63, 0.98,0.99 and 0.96 for firm-years with $TTB = 1$, $TTB = 2$ *or* 3 and $TTB = 4$, respectively.

These results reiterate our previous findings presented in Figure 2 and 3 that firms adjust their leverages more actively during the construction periods relative to other periods. As we mentioned earlier our explanation to this result is along the same lines as the argument in Hovakimian, Opler, and Titman (2001) who document that managers tend to move toward optimal debt levels faster when they raise new capital or retire existing capital. Since during periods with large investments firms are actively involved in issuances of debt and/or equity capital, it is not surprising that firms exhibit faster adjustment towards targets around those periods.

8 Conclusion

This paper provides the argument that capital structure decisions are driven not only by the characteristics of firm's existing assets, but also by characteristics of the firms" ongoing capital investment projects. Empirically we concentrate on time-to-build characteristics of investment projects that are in progress. We report the evidence that large investment projects that take time to complete have a unique impact on the firms' financing decisions, which help explain a series of stylized facts regarding the time-series characteristics of leverage decisions.

We show that because large investments take time to complete, firms should issue equity (not debt) to finance such projects. The choice to finance such investment projects with equity is not driven by the motivation to sell overpriced shares – as suggested by market timing – but rather by the need to maintain adequate financial flexibility throughout the construction lags during which the projects generate no cash to service debt. We also document that active recapitalizations tend to cluster around periods with large capital investments. Existing literature attributes this observation to the presence of transaction cost. We show that it is the need for external financing, not transaction costs, that causes firms' financing decisions to cluster around infrequent periods when they raise capital for large investments.

The idea of assessing the characteristics of firms' ongoing investment opportunities as a determinants of capital structure can be extended along many venues. For example, researchers can concentrate on capital investments that can change the risk profile of a firm. In particular, if a firm that produces finished products makes a large capital investments in a supplier, then such an investment will reduce a firm's exposure to supplier price risk, which, in turn, should have an impact on the firm's capital structure choice.

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Table I Number of observations by industry and firm characteristics by estimated TTB.

The sample consists of Compustat data from 1986 to 2004. Financial (SICs 6000-6999) and utilities (SICs 4900-4999) and ADR firms are excluded. M/B is market-to-book ratio, which is defined as (market value of equity + book value of debt)/total assets. Market value of equity is obtained as the sum of the market value of equity (price-close $\times$ shares outstanding) + debt in current liabilities + long-term debt + preferred-liquidation value - deferred taxes and investment tax credit. Investment ratio is the ratio of capital expenditure over fixed assets. Assets and sales are reported in millions. Zscore is calculated as 3.3 $\times$ pretax income sales + 1.4 $\times$ retained earnings + 1.2 $\times$ (current assets -current liabilities)/assets.

Panel A Firm characteristics across periods with different TTB.

TTB	# of obs	M/B	Investment ratio	Assets	Sales	Zscore
0(No large inv)	18714	1.710	0.181	187.54	174.880	4.380
1	585	1.711	0.332	191.75	178.350	4.530
2	1089	1.897	0.361	165.29	156.650	5.960
3	1007	2.046	0.341	188.49	187.920	6.610
4	803	2.060	0.332	179.88	180.520	6.950

Panel B Number of observations by industry

Sic	Industry title	No large inv	TTB=1	TTB=2	TTB=3	TTB=4
1	Mining and Construction	1482	48	91	66	48
2	Manufacturing (Food-Petroleum)	3565	100	221	207	160
3	Manufacturing (Plastics-Electronics)	6836	243	403	408	305
4	Transportation and Communication	1150	33	55	53	51
5	Wholesale and Retail Trade	2355	73	168	126	115
7	Services (Hotels-Recreation)	2292	64	101	100	90
8	Services (Health-Private Household)	803	15	40	37	26

Table II The cross-sectional differences in external financing between firms with and without large investments.

The sample is Compustat firms from 1986 to 2004. Financing, regulated utility, and ADR firms are excluded. Gross debt is measured by long term debt issued. Net debt is the total debt changes during a period. Gross equity is the total equity sales. Net equity is the equity sales minus equity purchases. Total external financing is the sum of debt issued and equity issued. All variables are scaled by the pre-issue book asset value. "All" represents the total sample observations. "Year of large investment" refers to the firm-year observations of large investments. "Year of no large investment" is all firm-year observations without large investments. "Construction period" refers to the firm-year observations during the construction period of a large investment. "Non-construction period" is all observations outside the construction periods. Panels A and B include the average external financing, debt issued, and equity issued calculated by taking the mean for different groups. Panel C reports the $Active\_recapitalization$ for firms with different TTB levels,where $Active\_recapitalization_{debt} = \frac{\sum_t^{t+TTB} \frac{\Delta D_t}{A_{t-1}}}{TTB}$. T-statistics reported reflect the statistical difference between the year of large investment and no large investment (panel A), between construction period and non-construction period (panel B), and between TTB=1 and TTB=4 (panel C).

Panel A.

	Total external financing		Debt issued		Equity issued	
	Gross	Net	Gross	Net	Gross	Net
All	0.187	0.068	0.111	0.017	0.077	0.056
Year of large investment	0.256	0.134	0.157	0.071	0.099	0.063
Year of no large investment	0.177	0.057	0.104	0.008	0.073	0.050
t	6.21	10.42	6.55	14.81	2.99	2.67

Panel B.

	Total external financing		Debt issued		Equity issued	
	Gross	Net	Gross	Net	Gross	Net
All	0.187	0.068	0.111	0.017	0.077	0.056
Construction period	0.217	0.102	0.130	0.047	0.087	0.056
Non-construction period	0.176	0.053	0.103	0.004	0.072	0.051
t	4.44	8.69	4.99	13.5	1.62	1.32

Panel C

	Debt issued		Equity issued	
	Gross	Net	Gross	Net
No large inv	0.095	-0.015	0.0840	0.060
TTB=1	0.115	0.033	0.1040	0.058
TTB=2	0.177	0.061	0.0990	0.076
TTB=3	0.210	0.084	0.0890	0.056
TTB=4	0.204	0.077	0.0890	0.067
t	-3.34	-2.32	0.16	-0.77

Table III Leverage dynamics

The sample consists of Compustat data from 1986 to 2004. Financial (SICs 6000-6999) and utilities (SICs 4900-4999) and ADR firms are excluded. Columns 1 and 2 are the results for equation (1): $Lev_{i,t} = a + \beta X_{i,t-1} + b_1 TTB_{i,t} + \varepsilon_{i,t}$. Columns 3 and 4 are the results for equation (2): $Lev_{i,t-1} = a + \beta X_{i,t-2} + b_2 TTB_{i,t} + \varepsilon_{i,t-1}$. Column 5 and 6 are the results for equation (3): $Lev_{i,t^*} = a + \beta X_{i,t^*-1} + b_3 RTTB_{i,t^*} + b_4 ETTB + \varepsilon_{i,t^*}$, $t^* \in [t, t+TTB]$, where the independent variable $RTTB$ represents the remaining time-to-build and $ETTB$ is the elapsed time-to-build since the project is initiated. In both equation (1) and equation (2), t refers to the year when a large investement is initiated. In equation (3), t^* refers to the year during the construction period of a large investment. Dependent variable in all three equations are market leverage, which is defined as the ratio of total debt (debt in current liabilities + long-term debt) to market value of assets (market value of equity + book value of debt). Dep_ta is depreciation over book assets. Div_dum is a dummy that equals one if cash dividend paid is greater than zero and zero otherwise. Ebit_ta is earning before interest and tax over book assets. Lnsales is log of sales. Rnd_ta is research and development expenses over book assets. Rnd_dum is dummy that takes one if a firm does not report its R&D expenses and takes zero otherwise. MB is market-to-book ratio defined as in table I. Fa_ta is fixed assets over book assets. Ind_median is the industry median debt ratio using the industry definition of three digit SIC code. T-statistics calculated using robust standard errors is reported in parentheses.

	For period t (eq 1)		For period t-1(eq 2)		From t to t+TTB (eq 3)	
	All obs	Large inv.	All obs	Large inv.	Lev during const. prd	
TTB	-0.006	-0.015	-0.02	-0.016		
	(-5.74)	(-6.16)	(-17.25)	(-5.65)		
RTTB					-0.011	-0.009
					(-6.11)	(-3.32)
ETTB						0.007
						(2.38)

Table III (continued)

	For period t (eq 1)		For period t-1(eq 2)		From t to t+TTB (eq 3)	
	All obs	Large inv.	All obs	Large inv.	Lev during const. prd	
Dep_ta	-0.207	-0.21	-0.21	-0.378	-0.196	-0.15
	(-7.73)	(-2.47)	(-6.56)	(-3.47)	(-2.83)	(-1.43)
Div_dum	-0.031	-0.046	-0.036	-0.038	-0.036	-0.039
	(-7.92)	(-5.9)	(-8.17)	(-4.3)	(-5.83)	(-0.460)
Ebit_ta	-0.144	-.207	-0.16	-0.151	-0.155	-0.237
	(-18.28)	(-9.17)	(-18.34)	(-6.17)	(-10.54)	(-10.54)
Lnsales	0.024	0.02	0.027	0.016	0.019	0.040
	(19.64)	(7.8)	(19.35)	(5.23)	(9.23)	(9.23)
Rnd_ta	-0.154	-0.141	-0.189	-0.145	-0.15	-0.233
	(-10.55)	(-3.28)	(-11.29)	(-3.71)	(-5.66)	(-5.66)
Rnd_dum	0.026	0.032	0.032	0.036	0.03	0.007
	(6.04)	(3.88)	(6.51)	(4.07)	(4.41)	(4.41)
MB	-0.009	-0.01	-0.007	-0.013	-0.008	-0.003
	(-14.07)	(-7.72)	(-12.63)	(-7.05)	(-8.3)	(-2.41)
Fa_ta	0.121	0.158	0.123	0.101	0.139	0.148
	(15.38)	(9.09)	(13.86)	(5.11)	(10.48)	(6.7)
Ind_median	0.411	0.424	0.4	0.381	0.408	0.329
	(34.49)	(14.77)	(30.65)	(11.97)	(19.59)	(12.22)
Constant	-0.295	-0.215	-0.331	-0.118	-0.208	-0.208
	(-13.94)	(-4.74)	(-13.78)	(-2.25)	(-5.75)	(-5.75)
N	18461	2696	16412	2165	5398	5398
R square	0.11	0.12	0.1248	0.07	0.12	0.12

Table IV Firm characteristics by TTB

The sample consists of Compustat data from 1986 to 2004. Financial (SICs 6000-6999) and utilities (SICs 4900-4999) and ADR firms are excluded. Mean value of key characteristics are shown. Two-year stock return is defined as the stock return from July of year t-2 to June of year t, where t is the year of large investment. One-year stock return is the stock return from July of year t-1 to June of year t. Ebit/assets are the ratio of earning before interests and taxes over total assets. Financing deficit is the sum of dividends, investment, and change in working capital(change in operating working capital+change in cash+change in short term debt) minus the cash flow after interest and taxes over total asset. Net debt issuance is long term debt issued minus long term debt retired over total assets. Net equity issuance is the equity sales minus equity purchase over total assets. T-statistics reported reflect the statistical difference between the year of large investment and no large investment (panel A), and between TTB=1 and TTB=4 (panel B).

Panel A

	without large inv.	with large investment.	t
TTB	TTB=0	TTB>0	
Two-year stock return	0.340	0.636	(-7.51)
One-year stock return	0.21	0.28	(-2.62)
Two-year mean ebit/assets	0.047	0.830	(-9.02)
Financing deficit	0.048	0.087	(-14.01)
Net debt issuance	0.016	0.031	(-11.94)
Net eeqity issuance	0.032	0.056	(-7.5)

Panel B

TTB	1	2	3	4	t
Two-year stock return	0.422	0.653	0.709	0.708	(-3.01)
One-year stock return	0.09	0.24	0.36	0.34	(-4.46)
Two-year mean ebit/assets	0.042	0.081	0.099	0.098	(-4.23)
Financing deficit	0.062	0.098	0.094	0.081	(-2.58)
Net debt issuance	0.038	0.049	0.034	0.023	(2.01)
Net eqity issuance	0.024	0.048	0.059	0.058	(-3.51)

Table V Financing deficit regression for groups with different TTB.

The regression is for equation (4): $\Delta D_{it} = a + bDEF_{it} + \varepsilon_{it}$. The sample period is 1986-2004. Financing deficit (DEF) is the sum of dividends, investment, and change in working capital(change in operating working capital+change in cash+change in short term debt), minus the cash flow after interest and taxes. The dependent variable is net debt and net equity for panels A and B, respectively. Net debt issued is the total debt change within a period. Gross debt issued is the long term debt issued. Net equity issued is equity sales minus equity purchases. Gross equity issued is total equity sales. All variables are scaled by the book asset value. T-statistics is reported in parentheses and calculated using robust standard error. T-statistics is reported in parentheses.

Panel A	without large inv.	with large investment.			
TTB	0	1	2	3	4
Net debt issuance	0.22	0.77	0.63	0.49	0.19
	(91.00)	(10.46)	(5.71)	(5.2)	(2.05)
Constant	-0.01	-0.02	-0.01	-0.01	0.02
	(-8.87)	(-4.03)	(-0.73)	(-0.9)	(2.08)
R	0.31	0.47	0.34	0.22	0.23

Panel B	without large inv.	with large investment.			
TTB	0	1	2	3	4
Net equity issuance	0.76	0.22	0.36	0.51	0.80
	(107.68)	(3.06)	(3.42)	(5.46)	(8.98)
Constant	0.01	0.02	0.01	0.01	-0.02
	(8.87)	(3.94)	(0.73)	(0.9)	(-2.08)
R	0.7	0.54	0.56	0.71	0.66

Table VI Leverage adjustment during the construction period of large investments.

The table presents results for firms' partial adjustment toward target leverage during the construction period, which represents the period between when the project is initiated and when the project is completed. The regression is estimated controlling for firm fixed effects. Panel A reports the results of equation (5):$Lev_{i,t^*} - Lev_{i,t^*-1} = \lambda(Lev^*_{i,t^*} - Lev_{i,t^*-1}) + \varepsilon_{i,t^*}, t^* \in [t, t+T]$, where Lev^*_{i,t^*} is the target leverage predicted from equation (3), t^* represents the year during the construction period and T is the estimated TTB. Panel B reports the results of equation (6): $Lev_{i,t+T} - Lev_{i,t-1} = \lambda(Lev^*_{i,t+T} - Lev_{i,t-1}) + \varepsilon_t$,where $Lev^*_{i,t+T}$ and $Lev_{i,t+T}$ are, respectively, firms' target (predicted from 3) and actual market leverage ratio (defined in Table III) when the project is completed. T-statistics are reported in parentheses.

Panel A	No large investment	With large investment
	$TTB = 0$	$TTB > 0$
λ	0.48	0.6760
	(77.54)	(28.54)

Panel B	$TTB = 1$	$TTB = 2$	$TTB = 3$	$TTB = 4$
λ	0.63	0.98	0.99	0.96
	(6.6)	(26.44)	(39.16)	(40.26)

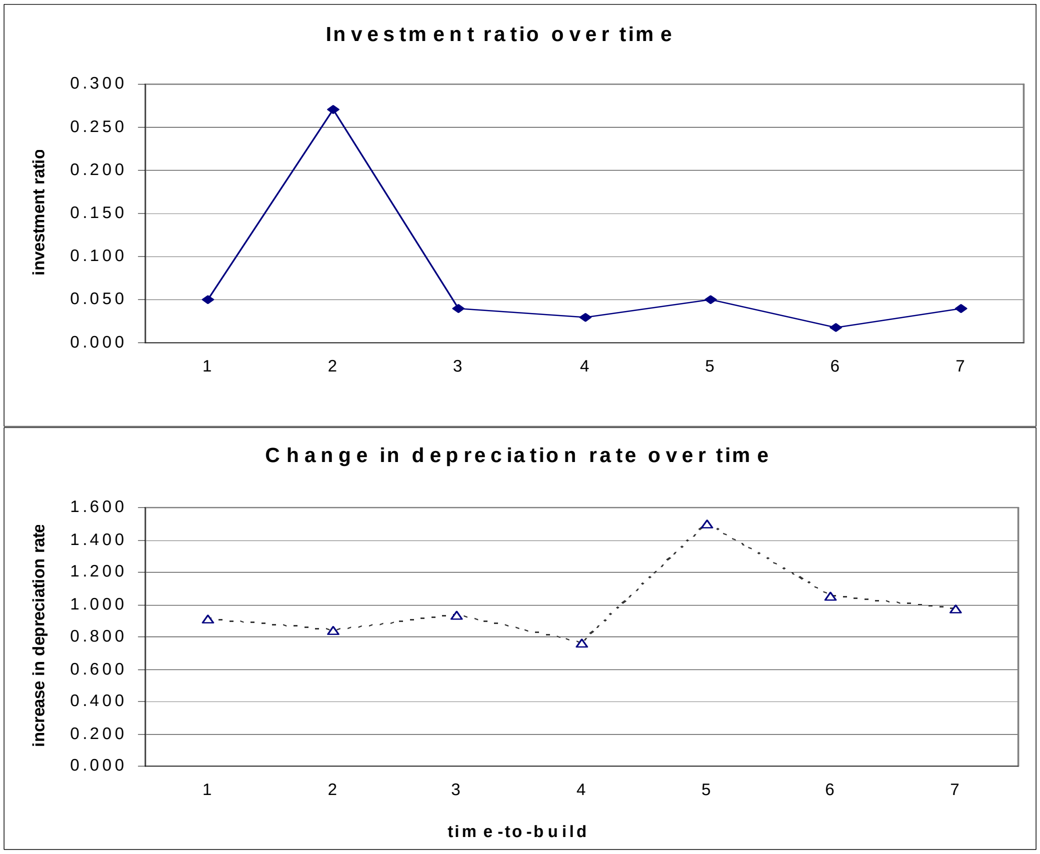

Figure 1:

Figure 1 Illustration of time-to-build using the data of one firm from the sample.Investment ratio is the ratio of capital expenditure over fixed assets plus inventory. Depreciation rate is the ratio of depreciation over fixed assets.

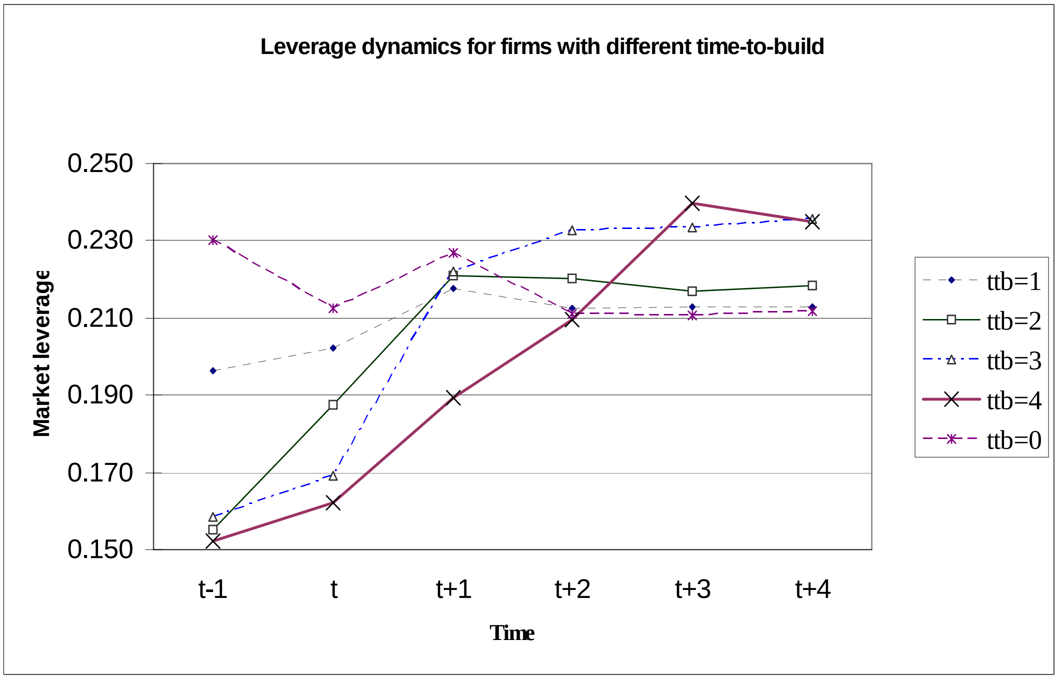

Figure 2:

Figure 2 Average market leverage for firms with different TTB during the construction period.

The sample consists of Compustat data from 1986 to 2004. Financial (SICs 6000-6999) and utilities (SICs 4900-4999) and ADR firms are excluded. The average market leverage is calculated and plotted for observations with different values of TTB from the year t-1 to the year t+4, where year t represents the year of large investment. Market leverage is defined in the same way as in table III.

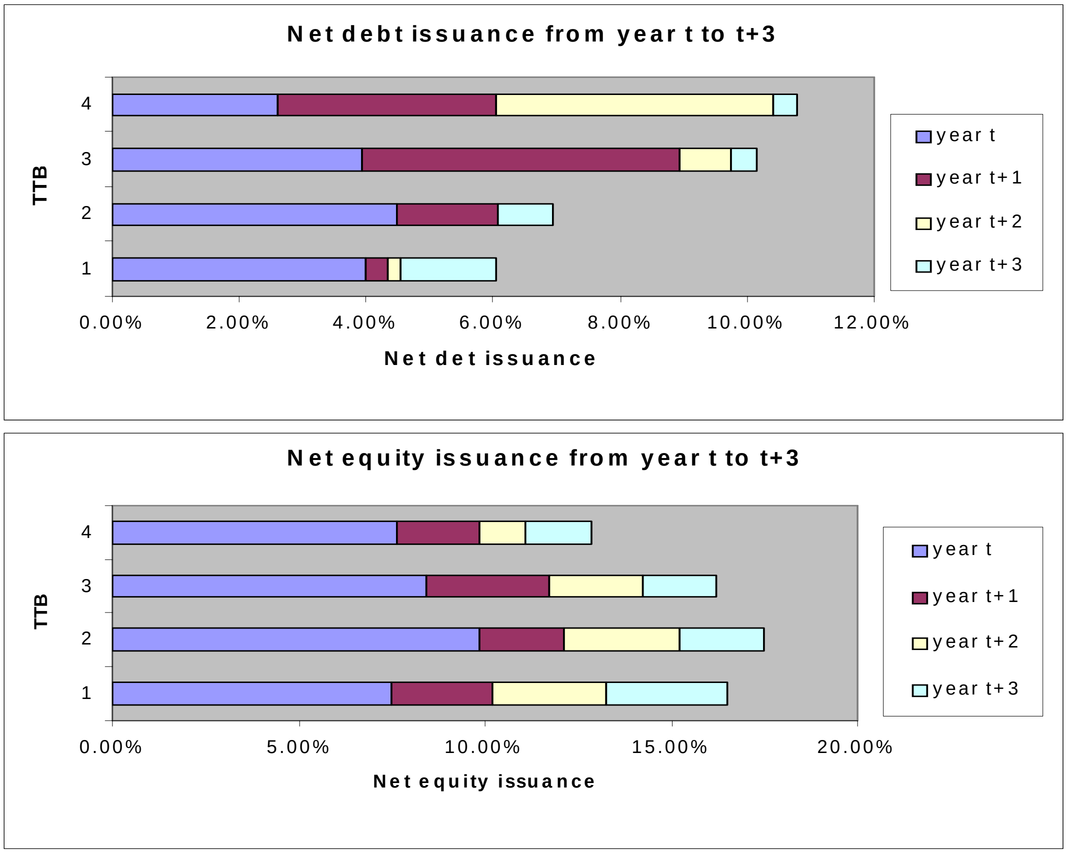

Figure 3:

Figure 3 Net debt and equity issuance for firms with different levels of TTB from year t to year t+3.

The sample consists of Compustat data from 1986 to 2004. Financial (SICs 6000-6999) and utilities (SICs 4900-4999) and ADR firms are excluded. Net debt is the ratio of long term debt issuance minus long term debt retirement over total assets. Net equity is the ratio of equity sales minus equity purchase over total assets. Year t is the year when an investment is initiated. The average value is taken for firms with different TTB levels.

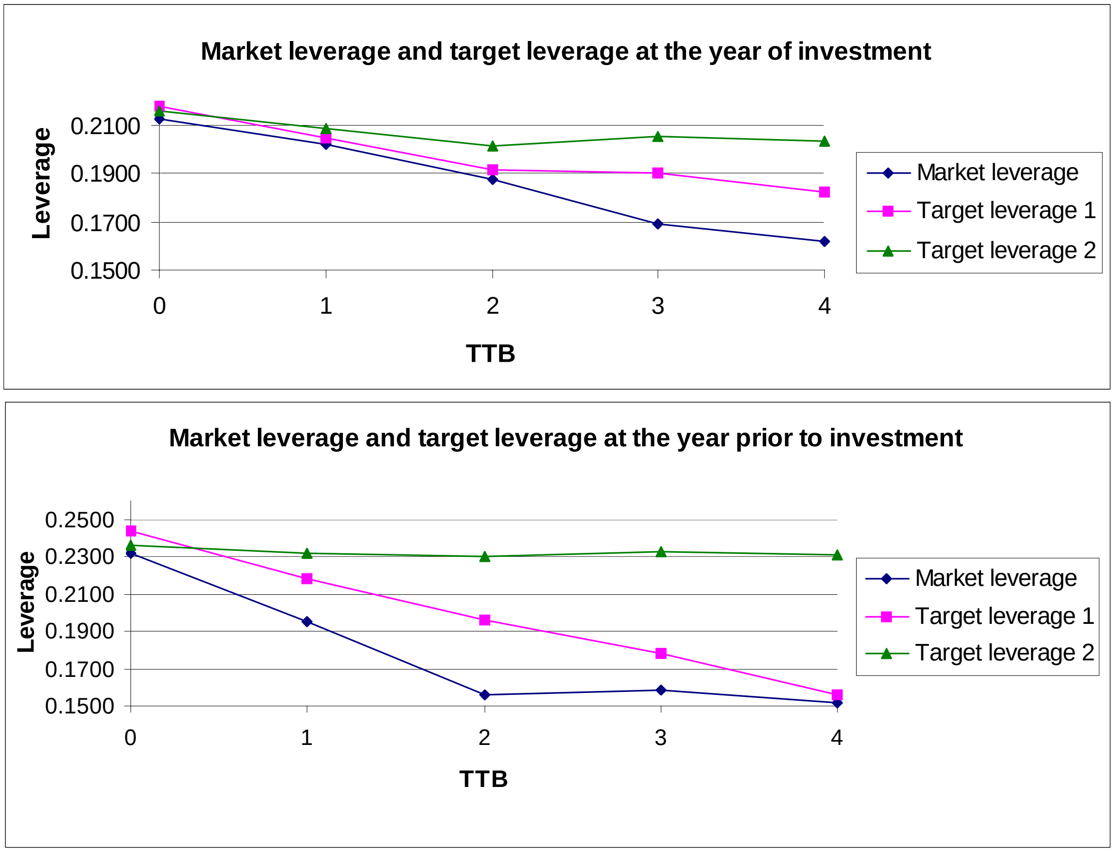

Figure 4:

Figure 4. Market and target leverage of firms with different TTB.

The sample consists of Compustat data from 1986 to 2004. Financial (SICs 6000-6999) and utilities (SICs 4900-4999) and ADR firms are excluded. Target leverage 1 is predicted from equation (3), which includes both $ETTB$ and $RTTB$, as well as conventional variables that capture firm characteristics. Target leverage 2 is predicted from the same regression that does not include $ETTB$ and $RTTB$.