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## Firm debt structure and firm size

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DEPARTMENT OF ECONOMICS WORKING PAPER SERIES

## **Firm Debt Structure and Firm Size**

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Working Paper No: 2009-09

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## **Firm Debt Structure and Firm Size**

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### **Abstract**

The recent macro monetary policy debate over the existence of bank lending channels focuses on short-term bank borrowing versus short-term non-bank borrowing by firms. The approach is macro using aggregate manufacturing corporation data from the QFR of the US Census Bureau. In the present paper, the approach is micro using Compustat corporation data. In the macro approach, the price-substitution effect between bank and non-bank lending is studied to test the existence of a bank lending channel. Pricing (interest rates) data are not available in the micro data. However, the scale effect (Slutsky equation) on term debt structure can be studied. Using regression analysis, covering the period 1995 to 2007 with an unbalanced panel sample of 30,789 observations, the log of the ratio of accounts payable in trade to the long-term debt is regressed on revenue, assets, net income, retained earnings, and dummy variables for industry classifications and monetary conditions. The revenue-size effect was positively related to the debt ratio, assets were negatively related, and retained earnings were positively related. Industry effects and monetary conditions effects varied. The conclusion is that firms can insulate themselves from the effects of monetary policy by relying on trade credit and retained earnings.

**Keywords:** Firms, Debt-Structure, Monetary Policy

**JEL Classification:** C33; E44; E52

## Introduction

Rather than begin this paper in the usual way by saying what I will do, I begin by saying what the paper is not about. It is not directly about the debate over the macro monetary policy impact or lack thereof on the various demand-side loanable funds channels or sources (bank short-term loans, non-bank short-term loans, and other sources of loans not covered by the first two). The volume of literature covering this impact is large. A selective subset includes Gertler and Gilchrist (1994), Onliner and Rudebusch (1995 and 1996), Bernanke (1993 and 2007), Bernanke and Blinder (1992), and Kashyap, Stein, and Wilcox (1993 and 1996). The debate distinguishes between the various sources of loans, with the emphasis on short-term bank and non-bank loans to manufacturing firms. Up to the present time, the controversy still exists as to whether or not policy actions by the FED (and/or US Treasury Department) can affect the demand side of short-term loans by banks and non-banks. One reason for the controversy is due to the nature of the data used. More will be given on this point later. So, while I do not address this sources controversy directly, indirectly it is related due to the perspective taken. It should be noted in passing that in a broader context, the supply or cost side of monetary transmission effects has not been ignored (see, for example, Barth III and Ramey, 2001), but the focus here is on the demand side.

My paper is a micro economic approach to the term structure or composition of the firm's borrowings (debt structure). It addresses the demand side of the various loan channels addressed by the literature cited. Due to the type of data available, the focus is on the term-structure of the firm's debt. In this respect it is partly related to the controversy. My paper differs, however, in two fundamental respects. I motivate my

micro analysis by first developing a simple, *a priori* theory of how firms determine the term structure of their debt. Kashyap, Stein, and Wilcox (1993) and others have a simple theory on the optimal source structure or composition of firm debt.

The second difference has to do with the type of data. The macro analysis uses time series data essentially at the aggregate manufacturing company level (for example, see Oliner and Rudebusch, 1996). Only data from manufacturing corporations are used. The data are from the US Census Bureau's Quarterly Financial Report (QFB) for manufacturing, mining, and trade corporations. The data are from sample surveys and in-house estimates and provide information on both the term structure of debt and the various financial sources of the debt (essentially, banks and non-banks). However, due to the way the data are gathered and assembled, they are not perfectly equivalent with firm micro data.

In particular, the firm micro data does not give information on the financial sources of the firm's debts. Also, to its advantage, the macro time-series approach has available various indicators of loan finance rates (such as the interest rate, or federal funds rate) not available with the micro data. As a substitute, dummy variables will be used to identify tight and loose monetary policy conditions. In summary, with the micro approach, the data is unbalanced panel data (time series and cross section), it does not contain firm-level finance rates, it does not identify the sources of the borrowing, and it has a limited number of term-debt instruments. While the micro approach cannot easily get at the price (finance rates) or substitution effect across different sources of borrowing, it is well suited to get at the scale (or firm size) effect on the firm's term-debt structure.

As is well known in micro economics, when the interest rate (for example) on long-term debt (bonds) changes, there is a change in relative finance rates with respect to other forms of firm debt. Such a change produces both a substitution effect and a special scale effect (hence, the Slutsky equation). Due to the lack of suitable finance rate data, I can only analyze the scale effect. In other words, whatever macro policy change directly or indirectly causes the firm's product demand to change, the micro data only allows me to analyze the scale effect (firm size) on the composition (in terms of term structure) of the firm's debt. The debt composition or term structure may change, but it will be linked to the change in firm size (rather than including a relative change in the price of debt).

The central concept behind the scale analysis is the debt transformation function (developed later) which relates firm size (real physical capital or a proxy thereof ) to various types of debt instruments and the firm's level of output. In effect, the transformation function which shows how real capital is financed serves much like a utility function where types of debts and level of output are the choice variables.

In what follows, the next section develops a simple theory of the firm's debt structure. The following section operationalizes the theory. The third section presents the econometric results. The final section contains a summary and some conclusions.

#### The Debt-Structure Theory of the Firm

The model representing the theory is simple and uses a single-period, static approach. Since only the term-structure of debt is considered, the model to remain simple must rely on some heuristic assumptions. Since the model is a single-period model, the distinction between the short run and the long run can be confusing. I follow Hicks' (1946) example that the long-run interest rate is the average of the short-run

interest rates in a multiple sequence of short-term loans. In other words, the contract for a long-term loan can be compared to a contract made up of a sequence of short-term loans. In this way, both types of loans relate to the same time period.

In regards to the debt transformation function, then, real physical capital  $K$  is financed by short-term loans  $B$  and long-term loans  $NB$ . In formal terms, the term structure could be ignored and the  $B$  and  $NB$  could relate to the sources of finance. Retained earnings and reserves for depreciation as sources of finance are ignored. I assume that  $B$  and  $NB$  are differentiated financial inputs (or contracts), so they are treated as substitutes by the firm. Each has its own price  $P_1 = (1 + r_1)$  for  $B$  and  $P_2 = (1 + r_2)$  for  $NB$ , determined exogenously in its respective market for loanable funds (monetary policy is implicitly given). Being a single-period model, the debt prices reflect both the principal and the respective interest rates. Due to the firm's willingness to pay a premium to secure one long-term contract as opposed to a sequence of short-term contracts, I assume that  $P_1 < P_2$ . The firm uses both  $B$  and  $NB$  to finance  $K$ .

The debt transformation function is defined by  $K = K(B, NB, \dots)$ , where the  $\dots$  represent possible monetary policy parameters. The marginal rate of substitution between  $B$  and  $NB$  along the iso- $K$  is falling. In effect,  $K(\cdot)$  serves as the firm's preference function for its term debt structure. It implicitly reflects the firm's risk attitude and other business and policy conditions.

The firm maximizes its profit given by

$$(1) \quad \Pi = P \cdot Q(K(B, NB)) - P_1 \cdot B - P_2 \cdot NB,$$

where  $Q(K)$  is a simplified production function in terms of one variable,  $K$ .

The first-order conditions are given by

$$(2) \quad P^*[(\partial Q/\partial K)(\partial K/\partial B) - P_1 = 0$$

$$P^*[(\partial Q/\partial K)(\partial K/\partial NB) - P_2 = 0,$$

where the firm's debt demands are  $B = B(P_1, P_2)$  and  $NB = NB(P_1, P_2)$ . The output price  $P$  is given and fixed. Implicitly, output  $Q$  and  $K$  are determined by the debt demands.

The graphic solution is shown in Figure 1, below. The equilibrium solution is given by point "a" on the iso- $K$  curve given by  $K^*$  which is tangent to the equilibrium budget line  $C^* = P_1^*B + P_2^*NB$ .

For a comparative-static analysis, let monetary policy change such that  $P_1$  falls and the price-ratio  $P_2/P_1$  rises. The typical compensated Slutsky substitution effect is given by the move from point "a" to point "b". The term debt structure will change, resulting in a higher  $B/NB$  ratio (short-term debt to long-term debt). The scale effect goes from point "b" to point "c" on a higher iso- $K$  curve (and implicitly a higher output,  $Q$ ). The move from "a" to "b" and "a" to "c" involve the controversy discussed earlier. The move from "b" to "c" is addressed by the present paper. It could result in a change in the debt-structure ratio. Such a change is the scale-effect discussed earlier and is the basis of the operational model given in the next section.

### Operational Model

As indicated above, the focus of this paper is on the scale effect and its impact on the term structure (short term versus long term) of debts. Following Kashyap, Stein, and Wilcox (1993, 1996), I use the MIX concept where the  $MIX = STD/LTD$ . Based on equations (1) and (2), the reduced-form debt transformation function will include the firm's output (the surrogate is revenue) and is given by

$$(3) \quad K_{ijt} = K(LTD_{ijt}, STD_{ijt}, REV_{ijt}),$$

where  $K$  is total assets,  $LTD$  is long-term debt,  $STD$  is short-term debt (accounts payable in trade with vendors and notes payable are surrogates), and  $REV$  is revenue as a proxy for real output.<sup>1</sup> All variables are measured in nominal values. After some rearrangement of (3), the basic MIX regression equation is given by

$$(4) \quad \Delta MIX_{ijt} = a + b1(\Delta MIX_{ijt-1}) + b2(\Delta REV_{ijt}) + b3(DVS_{ijt}) + e_{ijt},$$

where  $MIX$  is the dependent time-oriented debt ratio given in terms of first-difference and a lag, firm size is given by  $REV$  in terms of first-difference (assets as a proxy for  $K$  in (3) is an alternative for size),  $DVS$  will represent suitable dummy variables (for example, industry classifications and monetary policy conditions) and  $e$  is the error term.

The data is yearly from WRDS Compustat database from Standard & Poor's (2008) data file covering the years 1995 to 2007 for US industrial (manufacturing) corporations. It is unbalanced panel data. The initial sample after deleting Canadian firms consisted of 40,275 observations. After deleting cases with missing values and long-term debt with zero values, the working sample consisted of 30,789 observations. Actual sample sizes will vary with the specification of the regression runs.

Equation (4) is in general the micro equivalent of the typical macro (aggregated) regression model. As indicated earlier, it is not possible to make a perfect equivalence due to the way debt variables are defined and recorded in the micro data. Two short-term debt variables were found to be useful, accounts payable in trade and notes payable, both relative to long-term debt. As indicated below, equation (4) form did not produce significant results, so modifications were made.

### Econometric Results

Several combinations (or forms) of debt ratios were run, but only a few produced significant statistical results. For example, accounts payable in trade and notes payable in absolute and first-difference forms had poor statistical results (not recorded) in terms of very low R-squares and few (if any) significant coefficients for OLS runs and very low likelihood ratios and few significant coefficients for XTGLS runs. The so called short-term borrowings in Compustat for manufacturing firms were all missing.

The best results were obtained using the log of the ratio of accounts payable in trade to long-term debt, running OLS for the pooled data and XTGLS for the panel data. Random effects runs produced similar results as XTGLS and are not recorded. The results using the log of the above debt ratio on revenue, total assets, net income, retained earnings, and the dummy variables for industries and monetary policy conditions are presented in Table 1.

The OLS (robust) results are for comparison purposes and are similar to the XTGLS results. My analysis will focus on the XTGLS results. The revenue (REVENUE) effect on the accounts payable/long-term debt ratio was positive and significant, indicating that as revenue increases the firm's short-run debt (STD) intensity relative to long-term debt(LTD) also increases. In terms of the Slutsky scale effect, it is positive. The more a firm sells, the more trade debt it is willing to take on relative to its long-term debt.

In the case of total assets (TOTASST), however, the scale effect is negative and significant. This makes sense for long-term debt is used to finance capital expansion so the STD/LTD ratio will fall with capital expansion. This result is also consistent with the macro result of an inverse relationship between firm asset size and short-term to total

debt ratio (Gertler and Gilchrist, 1994, Table II). Note, my ratio of STD/LTD is equivalent to the macro ratio of STD/Total Debt for  $STD/(STD + LTD) = 1/(1 + LTD/STD)$ .

Both of these scale effects are subject to industry effects given by the positive and significant dummy variable coefficients. The positive effect is stronger for DV3, SIC sectors at or above 3300 (metals, machinery, electrical, electronics, transportation, and others). The reference effect is referred to as the light industry and is represented by SIC 2000 to 2799 (food, tobacco, textiles, apparel, lumber, furniture, paper products, and printing, primarily nondurables). Its coefficient is given by the negative and significant constant (intercept) coefficient. The light industrial sectors have a relatively low debt structure compared to the medium industrial sectors (SIC 2800 to 32999, chemicals, petroleum, rubber, leather, and stone products) and heavy industrial sectors (SIC 3300 to 3399). In effect, the light industrial sectors are less dependent on short-term debt. The medium and heavy industries are more dependent on short-term debt. This result is opposite from what is expected.

The net income (NETINC) effect on debt term structure is positive but not statistically significant. The debt ratio appears to be independent of net income. A more informative variable is the retained earnings variable (RETERN). Its coefficient is positive and significant, indicating that higher retained earnings allow the firm to take on more risk in the form of more short-term borrowing relative to long-term debt. Short-term debt is apt to be more volatile, but the firm with high retained earnings is in a better financial position to tolerate more risk than what would otherwise be prudent. In

reference to the macro effects of monetary policy, retained earnings can also serve to insulate the firm from its effects.

The retained earnings effect is not part of the macro results cited. From a micro perspective, however, it introduces a new consideration with respect to the impact of monetary policy on firm borrowing. Retained earnings (and the firm's propensity to save) have always been an important consideration when analyzing a firm's sources of financing, but it can also have a role in analyzing monetary policy effects.

The effect of monetary policy on the firm's term debt structure is handled by using dummy variables as indicated earlier. The DVT2 variable equals one for the years 2002 to 2004, a period of loose monetary policy based on the historical behavior of the Federal Funds Rate (Wikimedia.org, 7/23/2009). The DVT3 variable equals one for the years 2005 to 2007, a period of tight monetary policy. The DVT1 is the reference period from 1995 to 2001, a period of tight monetary policy and is represented by the intercept. The coefficient for DVT2 is positive but not statistically significant, indicating that monetary policy had no differential effect on the level of the debt ratio in the transition from the early period to the middle period, given the other variables. The coefficient for DVT3 is positive and significant, indicating that during the transition from the middle period to the later period of tight monetary policy, the short-term to long-term debt ratio was higher. In other words, during the later period of tight monetary policy, firms were more willing to take on short-term debt (as measured by accounts payable in trade). The compustat data I use does not identify the sources (bank versus non-banks) of borrowings, as indicated earlier, but my suspicion is that by relying on accounts payable

in trade firms are able to insulate themselves from the tight-money effects of monetary policy.

### Summary and Conclusions

The recent macro monetary policy debate over the existence of bank lending channels has been over short-term bank borrowing versus short-term non-bank borrowing by firms. The debate makes empirical sense at the macro level for it is possible to separate the data by financial sources of borrowing. With the micro data (at least with compustat data), however, such a separation is not possible. It is possible to separate the data by the term structure of a firm's debt. This separation makes empirical and analytical sense in the context of the firm scale effect (Slutsky effect). In this context, the scale or size of the firm is an important determinant of the short-term debt to long-term debt ratio.

The econometric results (covering the period 1995 to 2007) were most significant for the positive relationship of the log of the ratio of accounts payable in trade to long-term debt to revenue (as a proxy for firm output and size) and retained earnings. Assets as an indicator of firm size had an inverse relationship to the log of the debt ratio. In summary, an increase in revenue results in an increase in short-term debt relative to long-term debt and an increase in assets results in a decrease in the debt ratio.

Both scale effects were affected by the firm's industry type. Although the industry types used were somewhat arbitrary for simplicity purposes, roughly the evidence suggests that light industries were less apt to use short-term debt relative to long-term debt as compared to medium and heavy industries.

The monetary policy effect on the debt ratio was analyzed by using dummy variables representing an early period of tight monetary policy as shown by the behavior of the Federal Funds Rate, a middle period of loose monetary policy, and a later period of tight monetary policy. The reference period was the early period. There was no differential policy effect on the level of the debt ratio for a change from the early period to the middle period. In other words, early on the change in monetary policy from tight to loose had no significant effect on the level of the debt ratio. But, later on for a policy change from the middle period to the later period (loose to tight), the level of the debt ratio increased. In other words, on the down side a loosening of monetary policy was not significantly effective but on the upside a tightening of monetary policy was effective.

Even here it may be argued that monetary policy was ineffective in the sense that firms rather than borrow cash simply took on more accounts payable in trade relative to long-term debt. In any case, firms can avoid the intended policy goal of a tightening of monetary policy by letting their accounts payable in trade ride out. In effect, accounts payable in trade represents a form of “money,” insulating the firm from monetary policy. Such insulation is similar to that found by Oliner and Rudebusch (1995). Also, since the QFR reports retained earnings for manufacturing corporations, it may be useful in the future to include it in macro regression studies. Retained earnings are a sizable source of finance, totaling some \$1,513,403 (million dollars) for 1Q 2006 (QFR, June 2006, Table 1.1).

#### Footnote

<sup>1</sup>No source distinction is possible with the WRDS compustat data. From a detailed description of the variables, LTD is usually long-term non-bank debt. Accounts payable in trade represents trade obligations due within one year with other firms. Notes payable include bank acceptances and overdrafts, interest payable, and loans payable to banks and various other entities.

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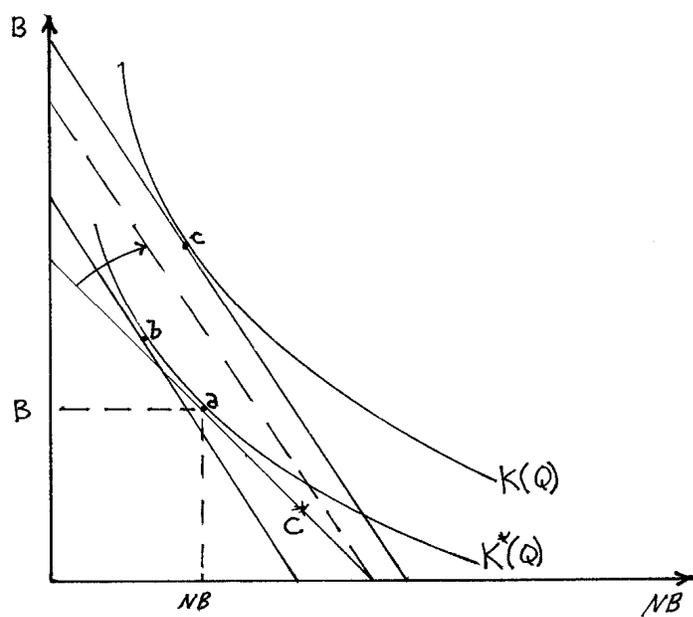


Figure 1. Equilibrium Points Before (a) and After (c) Scale Effect

Table 1. Regression Results for the log of the ratio of accounts payable in trade to long-term debt as the dependent variable

Coefficients OLS(Robust)		XTGLS
Constant	-.754 (-30.45)	-.994 (-58.41)
REVENUE	.000017 (7.44)	.000016 (17.06)
TOTASST	-.000022 (-8.36)	-.000019 (-21.31)
NETINC	-.000026 (-1.91)**	.000006 (1.19)*
RETERN	.000021 (6.05)	.000011 (5.60)
DV2	.281 (8.98)	.352 (16.44)
DV3	.819 (29.63)	.810 (39.86)
DVT2	-.110 (-4.04)	.00004 (0.00)*
DVT3	-.0066 (-.22)*	.0603 (3.93)
R-square	.036 (F=141.00)	
LL(fit)	-39273.94	
Wald	2167.00	
n	30,351	29,839
Common AR(1)		.661
No. Co-variances		4,385

Notes: The t or z values less than 2.00 are not significant even at the 10 percent level and are marked with an \*. All the rest of the coefficients are highly significant at .0000 or

less, except \*\* with a  $p=.056$ . The F and Wald are significant at .0000 or less. Heteroscedasticity across groups was handled by the co-variance matrix, using generalized least squares (XTGLS).