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RESEARCH ARTICLE

Debt financing in private and public firms

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Abstract Using administrative confidential data on the universe of Canadian corporate firms, we compare debt financing choices of private and public firms. Private firms have higher leverage ratios, which are entirely driven by private firms' stronger reliance on short-term debt. Further, private firms rely more of leverage during economic expansions, while public firms rely on equity financing. Specifically, private firms manage to increase their long-term debt during expansions, while short-term debt is used during downturns. Our findings have implications for a better understanding of the role of asymmetric information in private firms' capital structure decisions.

Keywords Capital structure · Private firms · Leverage

JEL Classification G30 · L11

The views stated herein are those of the authors and not necessarily of the Bank of Canada or the Board of Governors. We are very grateful for the comments and suggestions an anonymous referee.

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1 Introduction

The focus of the empirical capital structure literature is almost exclusively on publicly traded firms without shedding much light on the financial decisions of private firms. The scarce research on the capital structure of private firms is unfortunate since these firms represent most of the economy.[1] Given that private firms are fundamentally different from public firms, we cannot draw reliable conclusions about private firms' debt financing choices based on public firms' financing choices. Towards this end, in this paper we answer the following questions: First, does a firm's private/public status affect its choice of debt versus equity financing? Second, do private firms rely more on short-term debt? Third, do economic conditions influence differently debt financing choices of private and public firms?

One notable difference between private and public firms is the level of information asymmetry between managers (insiders) and investors (outsiders). Due to the cost of asymmetric information, a firm follows a pecking-order rule regarding its financing sources: retained earnings to debt, short-term debt to long-term debt, and debt over equity.[2] Because private firms are more opaque than public firms (the assessment of a firm's risk profile is more difficult), the value of outside equity in private firms is more sensitive to information asymmetry than in public firms. As a result, private firms are likely to rely more (less) on debt (equity) financing than public firms. Similarly, private firms are expected to use more short-term debt than long-term debt, holding all else equal.

Previous studies on corporate policies of private firms consider only the very large private firms, omitting the majority of small and medium size firms (e.g., Brav 2009; Saunders and Steffen 2011; Gao et al. 2013). Knowing that the cost of information asymmetry is more pronounced in smaller and medium-size private firms, the exclusion of these firms potentially renders an incomplete picture of the role of asymmetric information in debt financing of private firms. Using the entire population of Canadian firms allows us to circumvent potential sample selection biases typical for subsamples of firms.

After controlling for standard capital structure determinants, our results show that the leverage of private firms is 12% higher than for public firms. In addition, based on the within-firm estimator, private firms' leverage is 3% higher compared to public firms' leverage, suggesting that unobserved firm heterogeneity drives a substantial portion of leverage choices, and hence the need to use firm fixed effects.

Asymmetric information plays a role not only in financing choices (i.e., debt vs. equity) but in debt maturity as well. Private firms are expected to rely more on short-term than on long-term debt because private firms would likely reap higher benefits of short-term debt by revisiting their creditors more frequently in order to gain from monitoring and consequently lower information asymmetry costs. Similarly, private

[1] For example, private firms generate 90% of total sales and 90% of the employment in Canada. In the UK more than two-thirds of corporate assets are owned by private firms (Brav 2009).

[2] The pecking order theory postulates that the cost of financing increases with asymmetric information (Myers and Majluf 1984). Companies prioritize their sources of financing, first preferring internal financing, followed by debt, and lastly raising equity as a "last resort."

firms with high information asymmetry are expected to issue short-term debt to avoid locking in their cost of financing with long-term debt if they expect to borrow at more favorable terms in the future (e.g., Diamond 1991; Barclay and Smith 1995). Our results show that after controlling for firm time-varying factors and unobserved firm heterogeneity, private firms rely more on short-term debt than public firms.[3]

Next, we explore whether firms' financing policies depend on economic conditions, defined as unexpected sales growth in an industry. Facing higher asymmetric information costs during economic downturns, firms will likely rely less on equity financing. Moreover, this behaviour is expected to be more pronounced for private firms compared to public firms. Our results show that economic conditions affect public and private firms very differently. During economic expansions, public firms rely relatively more on equity, while private firms rely more on debt financing. Regarding debt maturity structure, private firms may follow a pecking order rule and rely more on long-term debt, possibly because they can secure relatively cheaper long-term debt during economic expansions. In addition, when economic uncertainty is elevated (unexpected volatility of firm sales), private firms rely less on long-term debt, possibly because the cost of asymmetric information increases as investors become more risk averse and shift towards investments that are relatively less sensitive to asymmetric information (i.e., public firms).

Our paper contributes to the capital structure literature. Using the population of private firms insures against sample selection issues, and hence, biased estimates. Our results, therefore, provide biased-free impacts of a firm's ownership status on it debt financing and maturity. To make sure that we compare leverage between private and public firms with similar characteristics, we rely on propensity score matching (PSM) estimation. The average difference in leverage between the matched private and public firms allows us to measure the causal impact of a firm's status on leverage. Our results show that the difference in leverage between matched private and public firms still ranges from 6.9 to 11.2% across years. Based on the PSM estimator, the difference of the long-term debt to total debt between public and private firms varies from 3.3 to 8%.

Using a sample of large UK private firms, Brav (2009) documents that private firms rely more on debt financing than public firms, and that the former rely more on short-term debt financing. We find similar patterns among Canadian firms. We put an emphasis on the role of economic conditions in debt financing and maturity of private and public firms. Our findings suggest that during economic expansions, private firms use more long-term leverage (i.e., leverage is pro-cyclical), while public firms rely more on equity financing (i.e., leverage is counter-cyclical). We contribute to the literature on leverage cyclicality and the cost of asymmetric information (e.g., Covas and Haan 2011; Erel et al. 2012) by showing that cyclicality differs across firms—leverage is pro-cyclical in private firms, and counter-cyclical in public firms.

Previous literature has investigated various corporate policies in private firms. Gao et al. (2013) document that the cash holdings of private firms are much lower than those of public firms; Maksimovic et al. (2013) find that private firms participate less in

[3] Using only public firms, Barclay and Smith (1995), Berger et al. (2005) and Custódio et al. (2013) show that firms with higher information asymmetry issue more short-term debt.

mergers and acquisitions and they are less cyclical in terms of acquisitions; Asker et al. (2011) document that private firms' investments are more responsive to changes in investment opportunities compared to public firms; and Michaely and Roberts (2012) show that private firms smooth dividends significantly less than public firms. We add to this literature by studying debt financing and maturity in private and public firms, including in different economic conditions.

The rest of the paper is organized as follows. The next Sect. 2 discusses the data and sample characteristics of public and private firms. Section 3 reports the main results, Sect. 4 reports the results of the propensity score matching exercise, and Sect. 5 presents results regarding the effects of an industry shock to debt financing. Section 6 offers conclusions.

2 The GIFI-T2LEAP database

We use the unique GIFI-T2LEAP database, which contains detailed balance-sheet information on all incorporated firms in Canada. The GIFI-T2 database tracks all incorporated firms that file a tax form with revenue Canada at the four-digit NAICS industry level in a given year. Owners of sole proprietorships and partnerships in Canada have two options regarding taxation: (i) incorporate to file a corporate tax return; or (ii) remain unincorporated and report firm profits as income on their personal income tax return. Due to data availability our sample consists of incorporated firms for which detailed balance sheet and financial information became available only in 2000 with the introduction of the general index of financial information (GIFI). The sample period, therefore, runs from the years 2000–2008.

We use the definition of the Canadian tax law to distinguish between public and private firms. A private company is either a Canadian-controlled private corporation (CCPC), or other private corporation. A public corporation has its shares listed on a prescribed Canadian stock exchange, or a corporation controlled by a public corporation.[4]

2.1 Summary statistics

Table 1 reports the sample distribution across years. The sample contains 560,256 firms with 3,172,601 firm-year observations. There are 3475 publicly traded firms in the sample, which provide 15,858 firm-year observations. We note that, over the 2000–2008 sample period, the fraction of public firms remains relatively constant at 0.5%.[5] In terms of industry distribution, as reported in Table 2, 20% of all public firms are in manufacturing (NAICS 31–33); 15% in mining, quarrying, and oil and gas extraction (NAICS 21); and 13% in professional, scientific and technical services (NAICS 54). As for private firms, 16% are in the construction of buildings (NAICS

[4] See Appendix A.2 for details.

[5] We compare the total number of firms in COMPUSTAT with the number of firms in our sample. COMPUSTAT is widely used to conduct research on US and Canadian public firms. The total coverage of public firms in COMPUSTAT is 2869, or 82% of the population.

Table 1 Distribution of Canadian firms over time

Year	COMPUSTAT	Public	Private	All
2000	1367	1553	281,956	283,509
2001	1379	1708	309,272	310,980
2002	1436	1847	332,107	333,954
2003	1506	1805	353,241	355,046
2004	1611	1799	372,707	374,506
2005	1738	1853	385,533	387,386
2006	1828	1938	404,192	406,130
2007	1834	1943	420,149	422,092
2008	1811	2024	440,621	442,645

Note This table reports the number of firm-year observations for public and private firms over the period 2000–2008. Column 'COMPUSTAT' reports the firm-year observations for Canadian public firms as reported in COMPUSTAT, an alternative data source. Columns 'Public' and 'Private' use the GIFI-T2LEAP data. 'All' is the sum of columns 'Private' and 'Public'. Firms in the financial sector (NAICS 52–53) and public administration (NAICS 91) are omitted

Table 2 Industry composition

NAICS	Public	Private	All
11 Agriculture, forestry, fishing and hunting	167	241,356	241,523
21 Mining, quarrying, and oil and gas extraction	2528	43,802	46,330
22 Utilities	169	2804	2973
23 Construction	591	516,153	516,744
31–33 Manufacturing	3300	295,868	299,168
41 Wholesale trade	1661	297,070	298,731
44–45 Retail trade	597	460,718	461,315
48–49 Transportation and warehousing	529	183,881	184,410
51 Information and cultural industries	1130	47,554	48,684
54 Professional, scientific and technical services	2088	487,000	489,088
55 Management of companies and enterprises	790	92,214	93,004
56 Administrative and support, waste management	805	171,179	171,984
71 Arts, entertainment and recreation	482	48,957	49,439
72 Accommodation and food services	500	197,668	198,168
81 Other services (except public administration)	1133	213,554	214,687
Total	16,470	3,299,778	3,316,248

Note This table shows the distribution of firms across 2-digit NAICS industry classification. Firms in the financial sector (NAICS 52–53) and public administration (NAICS 91) are omitted

23), followed by professional, scientific and technical services (NAICS 54), and retail trade (NAICS 44), contributing 15 and 14%, respectively. Consistent with previous studies, we exclude from the analysis firms in the financial sector (NAICS 52–53) and public administration (NAICS 91). Financial sector is typically excluded from the

Table 3 Contribution of private firms to the Canadian economy

Year	Number	Employment	Profitability	Sales	Assets	Total debt
2000	0.995	0.922	0.846	0.900	0.767	0.811
2001	0.995	0.917	0.875	0.888	0.718	0.742
2002	0.994	0.885	0.814	0.847	0.601	0.676
2003	0.995	0.887	0.676	0.831	0.570	0.644
2004	0.995	0.884	0.754	0.822	0.592	0.651
2005	0.995	0.881	0.709	0.810	0.566	0.619
2006	0.995	0.874	0.666	0.817	0.543	0.619
2007	0.995	0.876	0.616	0.809	0.538	0.596
2008	0.995	0.876	0.772	0.830	0.570	0.617

Note The table shows the proportional contributions of private firms to the aggregate values of employment, profitability, sales, assets and total debt. Number is the ratio of the number of private firms over total firms. Employments is the number of employees in the private sector over all employees. Profitability is the ratio of the total net income for tax purposes for all private firms over the total net income for tax purposes for the entire economy. The same applies for sales, assets and total debt

analysis of corporate leverage because most of these firms are financial intermediaries that are subject to deposit insurance, leverage, capital and liquidity regulation which makes the leverage choice very different from those of a nonfinancial corporation without similar regulations.

Regarding the relative importance of private firms in the Canada, Table 3 shows that they contributed 92% to total employment in 2000 and 87% in 2008. They also accounted for 84% of total profitability in 2000 and 77% in 2008. In terms of sales, the relative contribution dropped from 90 to 83% from the start of the sample in 2000 to the end in 2008. The largest drop was in the contribution to total assets: in 2000, private firms comprised 76% of all assets and only 57% in 2008. Although the relative importance of private firms has declined over the period 2000–2008, their absolute contribution to the economy is still significant.

Table 4 offers the mean characteristics of public and private firms. We winsorize each variable at 1 and 99%. The ratios of total debt to assets is 44 and 50% for public and private firms, respectively. A sample means test rejects the null hypothesis that leverage in public and private firms is the same at the 1% level. Private and public firms have different debt-maturity structure. The average long-term leverage defined as a percentage of long-term debt to total debt is 33% in public firms and 29% in private firms. The difference is statistically significant and is preserved for each year in our sample. In contrast, the average short-term debt as a percentage of total debt is close to 70% in private firms and approximately 65% for public firms. Statistically significant differences in short-term leverage between private and public firms are observed for each year.

Table 4 shows that public firms have higher sales than private firms, which is observed for the sample of UK firms in Brav (2009) and the US firms in Gao et al. (2013). Similar to the US and UK firms, Canadian public firms are less profitable than private firms, and private firms exhibit much higher levels of tangibility than public firms. To examine whether these factors jointly affect leverage, we implement multivariate regression analysis in the next section.

Table 4 Descriptive statistics

	Public	Private	Difference
Leverage			
Mean	0.440	0.508	− 29.250***
SD	(0.295)	(0.293)	
Long-term leverage			
Mean	0.336	0.295	15.464***
SD	(0.221)	(0.227)	
Short-term leverage			
Mean	0.655	0.698	− 16.220***
SD	(0.242)	(0.257)	
Size			
Mean	14.802	13.029	89.392***
SD	(2.494)	(1.837)	
Profitability			
Mean	0.027	0.120	− 47.49***
SD	(0.243)	(0.275)	
Δ ln *Sales*			
Mean	0.513	0.188	27.639***
SD	(1.508)	(0.875)	
Tangibility			
Mean	0.402	0.658	− 64.861***
SD	(0.494)	(0.684)	

Note This table reports the mean and standard deviation for several characteristics of public and private firms. Leverage is the ratio of total debt to total assets. Long-term leverage is the ratio of long-term debt to total debt. Short-term leverage is the ratio of short-term debt to total debt. Size is the logarithm of firm sales. Profitability is the ratio of net income for tax purposes to total assets. Δ ln *Sales* is the difference in the logarithmic values of firm output from year $t-1$ to year t. Tangibility is the ratio of fixed assets to total assets. The last column reports t tests of the difference between columns 'Private' and 'Public'

We observe interesting developments in leverage, short- and long-term leverage around firms' transitions from private to public status, from public to private status, and firms that remain either private or public over the entire period. Starting with leverage on the left-hand-side graph, top row in Fig. 1, we observe that the leverage of firms that become public through IPO declines compared to firms that are public throughout the entire sample period.[6] Firms that undergo a delisting increase their leverage in the period after going private. In the middle graph, post-IPO long-term leverage increases the most, while for firms that do not change their status long-term leverage remains almost unchanged. Similarly, short-term leverage shown at the right-hand-side graph declines post-IPO compared to the pre-IPO period. Somewhat a similar development is observed for the log values of leverage plotted at the second row of the graph.

[6] According to the PWC (2010), there were 731 IPOs for the period 2000–2008.

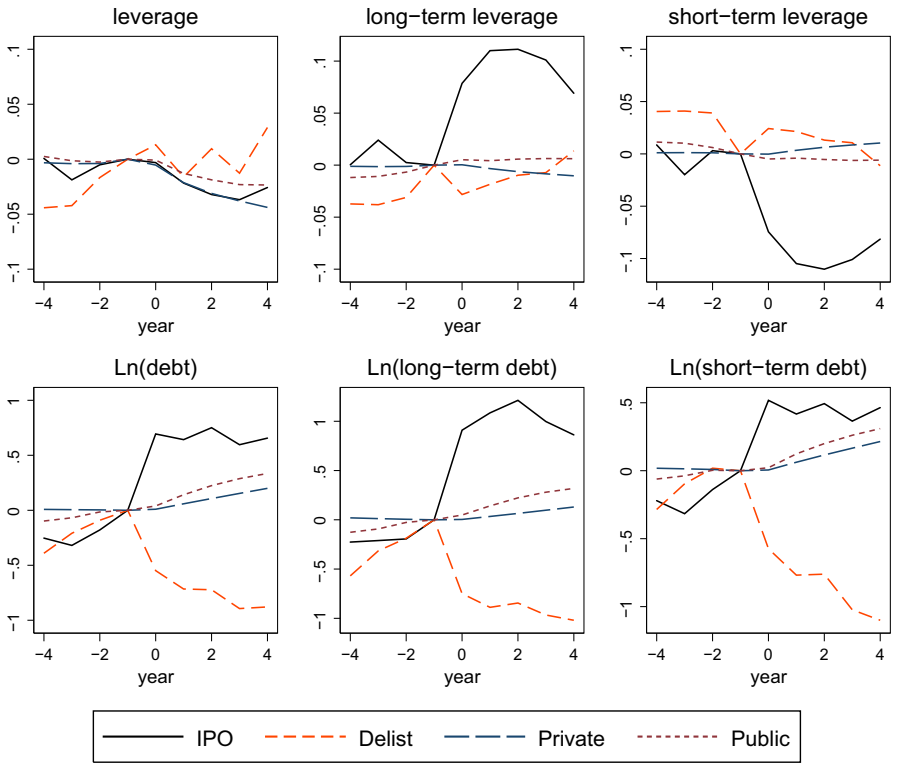

Fig. 1 Firm characteristics before/after a Change in Firms' Status. [a]These graphs illustrate the evolution of total leverage, long- and short-term leverage for four events: firms going public (IPO), firms going private (Delist), firms staying private, and firms staying public. On the horizontal axis, zero denotes the event year that is the year when a firm's status changes. Changes in leverage ratios from t to $t-1$ are shown on the vertical axis. The event window is 4 years before and four after the event year

3 Main results

In this section, we estimate the following OLS regression specification:

$$Leverage_{it} = \alpha Private_{it} + \beta X_{it-1} + \eta_i + \epsilon_{it}, \tag{1}$$

where *Private* is an indicator variable that takes one in a given year if a firm is private and zero if it is public. X_{it-1} is a set of several control variables: profitability ($Profitability_{t-1}$), log size (firm sales) ($LogSize_{t-1}$), tangibility ($Tangibility_{t-1}$) and sales growth ($Sales\ Growth_{t-1}$). These four factors have been found to be the major determinants of firm leverage (e.g., Rajan and Zingales 1995; Hovakimian et al. 2001). We use three different dependent variables: total debt over total assets—leverage, long-term debt over total debt, long-term debt over total assets. To control for time-invariant firm heterogeneity, we include firm fixed effects (η_i). Alternatively, in some specifications, we use industry fixed effects.

Table 5 OLS: leverage for public and private firms

	All	Private	Public	Small	Large
Private	0.120			0.139	0.138
	(0.005)***			(0.009)***	(0.005)***
$Profitability_{t-1}$	−0.110	−0.111	−0.059	−0.058	−0.263
	(0.001)***	(0.001)***	(0.015)***	(0.001)***	(0.003)***
$Tangibility_{t-1}$	0.050	0.050	0.070	0.062	0.027
	(0.001)***	(0.001)***	(0.010)***	(0.001)***	(0.001)***
$Size_{t-1}$	0.037	0.037	0.035	0.033	0.046
	(0.000)***	(0.000)***	(0.002)***	(0.000)***	(0.000)***
$\Delta \ln Sales_{t-1}$	0.023	0.024	−0.002	0.018	0.033
	(0.000)***	(0.000)***	(0.002)	(0.000)***	(0.000)***
Const.	−0.148	−0.028	0.054	−0.134	−0.281
	(0.006)***	(0.003)***	(0.046)	(0.010)***	(0.009)***
Obs.	3,172,601	3,156,743	15,858	1,586,301	1,586,300
R^2	0.104	0.104	0.168	0.083	0.094

Note The dependent variable is leverage, defined as the ratio of total debt to total assets. Profitability is the ratio of net income for tax purposes to total assets. Tangibility is the ratio of fixed assets to total assets. Size is the logarithm of firm sales. $\Delta \ln Sales$ is the difference in the logarithmic values of firm output from year $t-1$ to year t. Columns small/large include the sample of firms with sales lower/higher than the sample median. Standard errors in brackets are clustered at the firm level. All regressions include year and two-digit NAICS fixed effects

***Denotes 1% significant level, **denotes 5% significant level, and *denotes 10% significant level

3.1 Leverage

Table 5 reports results from pooled OLS regressions with leverage as a dependent variable. The estimate of the dummy variable for a firm's status (*Private*) is positive and significant, suggesting that private firms have higher leverage after controlling for time-variant firm factors, year and industry fixed effects (2-digit NAICS). The 12% difference in total leverage between private and public firms is both economically and statistically significant. This finding is consistent with the pecking-order theory whereby firms opt for debt funding being less affected by asymmetric information; hence, having incurring a lower borrowing costs. Our finding is consistent with Brav (2009) and Gao et al. (2013). The first paper uses a sample of UK firms in which private firms have a 32.7% leverage ratio and public firms have a leverage of 22.7%. Based on US data on large private firms, the second paper also documents that leverage for private firms is much larger than for public firms.

Profitability is negatively correlated with total leverage: a 1% increase is associated with an 11% decrease in leverage. The negative correlation between leverage and profitability can be explained with a firm's preference of internal over external funding, which is in line with the pecking-order theory.

Next, we find that higher levels of tangible assets are positively correlated with leverage. It is possible that the problem of asymmetric information is attenuated when

a firm has more tangible assets that can be readily valued and pledged as collateral. Higher levels of tangible assets also imply higher liquidation value, which lowers a firm's bankruptcy costs, and hence increases a firm's capacity to borrow.

The estimate on firm size is positive: 1% increase in firm size is associated with a 3.7% increase in leverage. Typically, there is more information about larger firms than about smaller ones and informational asymmetries will be less severe in the former. This implies that larger firms can enjoy easier access to external debt than smaller ones. Also, larger firms are likely to be more diversified, hence having lower default risk and better access to debt financing. This result is somewhat puzzling knowing that the expected costs of financial distress are grater for a firm with better growth opportunities, which should lead to a negative relationship between proxies of growth opportunities and firm leverage.

The estimate on sales growth in column 1 is positive and significant.[7] Because firms do not have enough internal funds to finance their strong growth opportunities, they are likely to opt for external debt financing.

Next, we estimate the same leverage regression separately for private and public firms, reported in columns 2 and 3 of Table 5. With the exception of the estimate on sales growth in column 3, all other coefficients in columns 2 and 3 preserve their signs from column 1. The leverage of private firms is positively related to the growth rate of sales, while in public firms the opposite relationship holds.

The coefficient on profitability is negative for both public and private firms, but is larger in magnitude for private firms. This result is consistent with the hypothesis that private firms prefer internal over external capital more than public firms do, possibly because private firms face higher asymmetric information costs to access the capital markets than public firms do. Leverage increases as tangibility rises for both private and public firms, with higher leverage–tangibility sensitivity for public firms. Finally, the coefficients on firm size are virtually identical for private and public firms.

Since public and private firms differ substantially in terms of size, in columns 4 and 5 we split the sample into firms above and below the median firm size. The sample of large firms includes most public firms and large private firms, while the sample of smaller firms is dominated by private firms. The effect of a firm's status on leverage for both subsamples is basically the same, 14%. The sensitivity of leverage to profitability and sales growth seems to be much stronger for larger than smaller firms. Tangibility is more important determinant of leverage for smaller than for larger firms, which is not surprising given that tangibility is expected to weaken the information asymmetry cost the most in smaller firms.

Table 6 reports results from the same specifications as in Table 5, but includes firm fixed effects. It has been found that unobserved heterogeneity at the firm-level plays an important role in explaining leverage ratios (e.g., Lemmon et al. 2008). A firm's status is strongly correlated with firm-specific unobservable factors, and not including these factors may result in biases in the estimate of a firm's status. Firm fixed effects sweep

[7] We use sales growth as opposed to the market-to-book ratio as a proxy for growth opportunities because private firms do not have market values. Both measures are conceptually different because the market-to-book ratio as a market-based measure contains forward-looking information, unlike firm-level sales growth.

Table 6 Firm fixed effects: leverage for public and private firms

	All	Private	Public	Small	Large
Private	0.030			0.029	0.033
	(0.011)***			(0.071)	(0.011)***
$Profitability_{t-1}$	−0.101	−0.101	−0.095	−0.077	−0.158
	(0.001)***	(0.001)***	(0.016)***	(0.001)***	(0.002)***
$Tangibility_{t-1}$	0.027	0.027	0.028	0.023	0.029
	(0.001)***	(0.001)***	(0.009)***	(0.001)***	(0.001)***
$Size_{t-1}$	0.012	0.012	0.009	0.005	0.018
	(0.000)***	(0.000)***	(0.003)***	(0.000)***	(0.001)***
$\Delta \ln Sales_{t-1}$	0.015	0.015	0.001	0.012	0.018
	(0.000)***	(0.000)***	(0.001)	(0.000)***	(0.000)***
Const.	0.343	0.373	0.316	0.299	0.194
	(0.012)***	(0.003)***	(0.037)***	(0.071)***	(0.015)***
Observations	3,172,601	3,156,743	15,858	1,586,301	1,586,300
Number of firms	560,256	557,325	3475	354,168	300,549
Within R^2	0.067	0.068	0.026	0.050	0.077
σ_u	0.269	0.269	0.277	0.289	0.248
σ_e	0.135	0.135	0.140	0.142	0.122
σ	0.301	0.301	0.310	0.322	0.277
ρ	0.798	0.798	0.797	0.806	0.805

Note The dependent variable is leverage, defined as the ratio of total debt to total assets. Profitability is the ratio of net income for tax purposes to total assets. Tangibility is the ratio of fixed assets to total assets. Size is the logarithm of firm sales. $\Delta \ln Sales$ is the difference in the logarithmic values of firm output from year $t-1$ to year t. Columns small/large include the sample of firms with sales lower/higher than the sample median. Standard errors in brackets are clustered at the firm level. All regressions include year and firm fixed effects. The firm-level variance is σ_u, idiosyncratic variance is σ_e, total variance is σ and ρ is the ratio of firm to total variance

***Denotes 1% significant level, **denotes 5% significant level, and *denotes 10% significant level

away any time-constant firm-specific effects. Our results suggest that firm status and firm fixed effects have meaningful effects in the leverage regressions. In column 1 of Table 6, the estimate on private status is 3 percent compared to 12% when firm fixed effects are not controlled for. These results also highlight that differences in leverage between private and public firms are smaller within firms than across firms that never change their status. One can consider the 3% estimate on leverage to be a lower bound driven by firms that switch their ownership status, while 12% is an upper bound derived from the cross-sectional variation between public and private firms. For the rest of the analysis we report fixed effect estimation results as they are more conservative by controlling for unobserved time-invariant effects.

Table 7 Firm fixed effects: debt-maturity structure for public and private firms

	Leverage	Long/debt	Long/assets
Private	0.030	−0.062	−0.028
	(0.011)***	(0.013)***	(0.010)***
$Profitability_{t-1}$	−0.101	−0.045	−0.048
	(0.001)***	(0.0009)***	(0.0006)***
$Tangibility_{t-1}$	0.027	−0.002	0.003
	(0.0006)***	(0.0007)***	(0.0004)***
$Size_{t-1}$	0.012	−0.005	0.000
	(0.0003)***	(0.0003)***	(0.0002)
$\Delta \ln Sales_{t-1}$	0.015	−0.005	0.001
	(0.0002)***	(0.0002)***	(0.0001)***
Const.	0.343	0.432	0.215
	(0.012)***	(0.013)***	(0.010)***
Observations	3,172,601	3,142,073	3,172,601
Number of firms	560,256	555,728	560,256
Within R^2	0.067	0.006	0.018
σ_u	0.269	0.293	0.215
σ_e	0.135	0.175	0.114
σ	0.301	0.341	0.243
ρ	0.798	0.738	0.779

Note The dependent variable in column leverage is defined as the ratio of total debt to total assets. The dependent variable in the long/debt column is the ratio of long-term debt to total debt, while the dependent variable in the long/assets column is the ratio of long-term debt to total assets. Profitability is the ratio of net income for tax purposes to total assets. Tangibility is the ratio of fixed assets to total assets. Size is the the logarithm of firm sales. $\Delta \ln Sales$ is the difference in the logarithmic values of firm output from year $t-1$ to year t. Standard errors in brackets are clustered at the firm level. All regressions include year and firm fixed effects. The firm-level variance is σ_u, idiosyncratic variance is σ_e, total variance σ and ρ is the ratio of firm to total variance

***Denotes 1% significant level, **denotes 5% significant level, and *denotes 10% significant level

3.2 Debt maturity structure

The firms' choice of debt maturity depends on the cost of asymmetric information as long-term debt is less information sensitive than short-term debt. All else equal, being subject to higher asymmetric information costs, private firms are expected to rely more on short-term than long-term debt as the first source of financing is less information sensitive than the second one. Similarly, as in Diamond (1991), when choosing short-term debt firms face a trade-off between liquidity risk and a lower cost of asymmetric information. Given that private firms face higher asymmetric information costs, they are expected to choose short-term versus long-term debt, holding all else equal. In this section, we explore the debt maturity choices of private and public firms.

In column 1 of Table 7 the dependent variable is total leverage measured as the ratio of total debt to total assets (the same specification as in column 1, Table 6), and

in columns 2 and 3 the dependent variables are the ratios of long-term debt over total debt and long-term debt over total assets, respectively.[8] Long-term debt over total debt measures the maturity structure of debt while total debt to total assets and long-term debt to total assets capture leverage effects.

In column 2, the results indicate that long-term debt for private firms is 6.2% lower than for public firms. Given that short-term debt is one minus long-term debt to total debt, short-term debt is higher for private firms. This finding is consistent with theoretical models, such as Flannery (1986) and Diamond (1991) in which the preference for short-term debt increases when asymmetric information is more acute, as in the case of private firms.

The dependent variable in column 3 is long-term debt to total assets.[9] The negative estimate on *Private* suggests that long-term leverage over total assets is 2.8% lower for private firms. Since the ratio of long-term debt over assets includes both the leverage effect and the maturity effect, the larger magnitude of the maturity effect in column 2 suggests that the latter effect plays more important role than the former effect.

The estimates on size, sales growth and tangibility take negative signs. One explanation for the negative relationship between size and debt maturity is that larger firms tap the short-term market as they are relatively less constrained by rollover risk. Firms with high growth opportunities rely more on short-term debt possibly because the cost of financial distress increases, and hence, the lower availability of long-term debt. Finally, tangibility and long-term debt are negatively correlated. One explanation is that tangible assets reduce information asymmetry, which makes equity issuance less costly, consequently resulting in a switch from long-term debt to equity.

Overall, we document that private firms rely more on leverage than equity compared to public firms. Further, private firms rely more on short-term leverage than public firms which is consistent with theories on the role of asymmtric information such as Diamond (1991) and Flannery (1986).

4 Propensity score matching

A limitation of the OLS approach is that a firm's private/pubuc status is endogenous. The choice depends on firms' financing structure and characteristics. Based on Table 4, we observe that private and public firms differ substantially in terms of observable financial characteristics. For example, public firms are significantly larger, less profitable, with higher sales growth and lower tangibility than private firms. Having such a pronounced difference between private and public firms runs the risk of having an OLS estimator that misleadingly projects the conditional leverage distribution of private firms onto regions of the public firms in which private firms are nonexistent.

Ideally, to compare the leverage of private and public firms one would like to compare identical firms in terms of all characteristics except for the private/public status. The observed differences in leverage across all pairs is robust estimate of the

[8] See Appendix A.1 for definitions of short- and long-term debt.

[9] The total number of observations in columns 2 and 3 is different because some firms have zero debt in column 2 and as a result the ratio of long-term debt to total debt cannot be computed.

effect of a firm's status on leverage. For that purpose, we employ the propensity score matching method (Heckman et al. 1997).[10]

This technique essentially estimates the predicted probabilities of being in the treatment (public) group versus the control (private) group based on observed characteristics. We use firms' profitability, tangibility, size and growth in each year as controls to generate the probability of being a private firm (propensity score). Using the propensity scores, we match each private firm score with a set of public firms that have similar propensity scores. To perform the matching, we rely on kernel estimator which uses weighted average of all public firms with more weight given to public firms whose propensity scores are closer to those of the private firms. The weights are inversely proportional to the distance between the treated and control groups' propensity scores.

A basic requirement for the implication of the matching method is a sufficiently large overlap between the propensity scores of the private and public firms which ensures, known as the common support condition. Basically, it ensures that any combination of characteristics observed in the treatment group can also be observed among the control group. For the ATT, it is sufficient to ensure the existence of potential matches in the control group. When inspecting the propensity score distributions for each year between private and public firms, we note a substantial overlap between both groups of firms.

In Table 8 we report the ATTs and ATEs for each year. The ATE is the difference between the private and public firms' conditional expected leverage. The ATT estimates the missing counterfactual of what a private firm leverage would be if the firm were public. The answer is given by comparing the leverage of public firms with the same set of characteristics as those of private firms. The difference between ATE and ATT is the 'self-selection' bias that comes from differences in leverage for private and public firms even in the absence of treatment. Our main parameter of interest is the ATT.

Starting with ATT for *Leverage*, we note that even after the matching, private firms have higher leverage than public firms ranging from 11.2% in 2000 to 7.2% in 2008. These differences are significant at the 1% level using bootstrapping with thousand observations. ATE in column 2 differs slightly from ATT pointing to the small size of the self-selection bias. Compared to the 12% leverage difference between private and public firms as reported in Table 5, column 1, the matching procedure produces leverage differences from 6.9% in 2004 to 11.2% in 2000 suggesting that leverage differences do not disappear even when we compare similar private and public firms.

For *Long/Debt*, we also confirm that private firms have lower long-term debt after comparing private and public firms with similar characteristics. As for long/assets, the results show that the difference in private and public firms are not sizable except for 2005 and 2008.

[10] This method has been widely used in corporate finance papers such as Michaely and Roberts (2012), Gao et al. (2013), Saunders and Steffen (2011) and Brav (2009) among others.

Table 8 Propensity score matching

Year	Leverage		Long/debt		Long/assets	
	ATT	ATE	ATT	ATE	ATT	ATE
2000	0.112	0.121	−0.057	−0.049	−0.005	0.007
	(0.031)***	(0.028)***	(0.029)*	(0.026)	(0.022)	(0.020)
2001	0.093	0.088	−0.080	−0.078	−0.015	−0.016
	(0.031)***	(0.027)***	(0.027)***	(0.024)***	(0.019)	(0.018)
2002	0.088	0.094	−0.069	−0.071	0.005	0.009
	(0.036)***	(0.031)***	(0.027)***	(0.024)***	(0.022)	(0.021)
2003	0.082	0.081	−0.069	−0.062	−0.019	−0.015
	(0.029)***	(0.026)***	(0.028)***	(0.025)**	(0.025)	(0.023)
2004	0.069	0.075	−0.077	−0.087	−0.039	−0.043
	(0.037)***	(0.032)***	(0.034)**	(0.029)***	(0.033)	(0.028)
2005	−0.005	0.009	−0.066	−0.068	−0.059	−0.052
	(0.037)	(0.032)	(0.039)*	(0.033)**	(0.028)**	(0.025)**
2006	0.072	0.078	−0.062	−0.055	−0.022	−0.013
	(0.039)**	(0.034)**	(0.033)*	(0.029)*	(0.027)	(0.024)
2007	−0.014	0.012	−0.033	−0.033	−0.039	−0.023
	(0.045)	(0.039)	(0.030)	(0.027)	(0.031)	(0.029)
2008	0.072	0.075	−0.068	−0.065	−0.028	−0.023
	(0.013)***	(0.012)***	(0.011)***	(0.010)***	(0.011)***	(0.009)***

Note Leverage is defined as ratio of total debt to total assets. Long/debt column is the ratio of long-term debt to total debt, while long/assets is the ratio of long-term debt to total assets. The average treatment effect (ATE) and average treatment effect on the treated (ATT) are calculated using kernel matching. Bootstrapped standard errors are reported in the brackets

***Denotes 1% significant level, **denotes 5% significant level, and *denotes 10% significant level

5 Do economic conditions affect firms' debt financing?

In this section, we explore the impact of economic conditions on the capital structures of public and private firms. We use industry shocks to proxy for the state of the economic environment. We do not have enough economic downturns in Canada and that is why we rely on industry conditions. Industry shocks are useful because they have clear interpretation for the demand for credit. Because firms have industry-specific assets, and hence, these shocks are expected to play a major role in collateral values of firms' assets, and hence, the availability of credit. For example, during an industry downturn, firms may not be able to raise external funds due to a decline in collateral values of their assets.[11] Therefore, industry-specific shocks can be viewed as shocks to credit availability due to changes in collateral values.

[11] Carvalho (2015) shows that during industry downturns firms experience significantly greater valuation losses if their peers are financially constrained. Huynh et al. (2010) demonstrate that industry conditions impact firms' operations and performance in a meaningful way.

5.1 Industry shocks

To construct industry shocks, we use a two-step procedure developed by Castro et al. (2015). We rely on shocks defined as the unexpected sales growth portion in the industry-year sales growth without its systematic component.[12] The unexpected sales growth shocks (denoted either *Unexp growth* or $\widehat{\Psi}_{jt}$) and their variance (denoted either *Unexp volatility* or $\widehat{\Gamma}_{jt}$) are then used as separate regressors in the leverage equations:

$$\begin{aligned} Leverage_{it} &= \alpha Private_{it} + \beta X_{it-1} + \lambda_{11}\widehat{\Psi}_{jt} + \lambda_{12}\widehat{\Psi}_{jt} \\ &\quad \times Private_{it} + \eta_i + \epsilon_{it}, \qquad (2) \\ Leverage_{it} &= \alpha Private_{it} + \beta X_{it-1} + \lambda_{21}\widehat{\Gamma}_{jt} + \lambda_{22}\widehat{\Gamma}_{jt} \\ &\quad \times Private_{it} + \eta_i + \epsilon_{it}. \qquad (3) \end{aligned}$$

Firm sales' shocks aggregated at the industry level in a given year ($\widehat{\Psi}_{jt}$) do not contain anticipatory changes in industry conditions and leverage, which allows us to rule out potential feedback effects from industry conditions to firm leverage, and vice versa. $\widehat{\Psi}_{jt}$ can be viewed, therefore, as a clean measure of industry shocks presumably driven by changes in technology, supply and demand conditions.

Do industry shocks actually differ across industries in the population of Canadian firms? We note that the unexpected sales growth differs across industries as much as it differs within industries (Fig. 2). For example, industry shocks in NAICS 21, 22, 54, and 55 differ substantially from the rest.[13] The bottom graph depicts the volatility of the firm sales-growth shocks, *Unexp volatility*, for each industry category. The between-industry volatility of the shock is smaller than the within-industry volatility; nevertheless, the between-industry variation in both *Unexp growth* and *Unexp volatility* is substantially higher to trigger changes in firm financing.

5.2 Results: the effect of industry conditions on leverage

In this section, we report firm fixed effect estimates of the effect of industry conditions on financial decisions and debt maturity. In columns 1–3 of Table 9, the coefficients of interest are *Unexp growth* and their interactions with *Private*.[14] In column 1, the base coefficient on *Unexp growth* is -0.192, which implies that a 1% point increase in the unexpected industry growth is associated with 21% lower leverage for public firms. This result is consistent with the pecking-order theory whereby firms opt to build up their capital base (i.e., decrease leverage) during economic expansions when the overall cost of information asymmetry is relatively lower. Given the negative

[12] Appendix A.3 provides details on this procedure.

[13] NAICS 21, 22, 54 and 55 correspond to "Mining, quarrying, and oil and gas extraction, "Utilities," "The Professional, Scientific, and Technical Services," and "Management of Companies and Enterprises," respectively. The complete list of industry definitions is available in Table 2.

[14] The $H_0 : \sum \text{Unexp} = 0$ row provides the F-statistic on the null hypothesis that the industry conditions do not affect private firms. The null hypothesis is $(Unexp\ growth + Unexp\ Growth \times Private) = 0$ in columns 1–3, while in columns 4–6 the null hypothesis is $(Unexp\ volatility + Unexp\ volatility \times Private) = 0$.

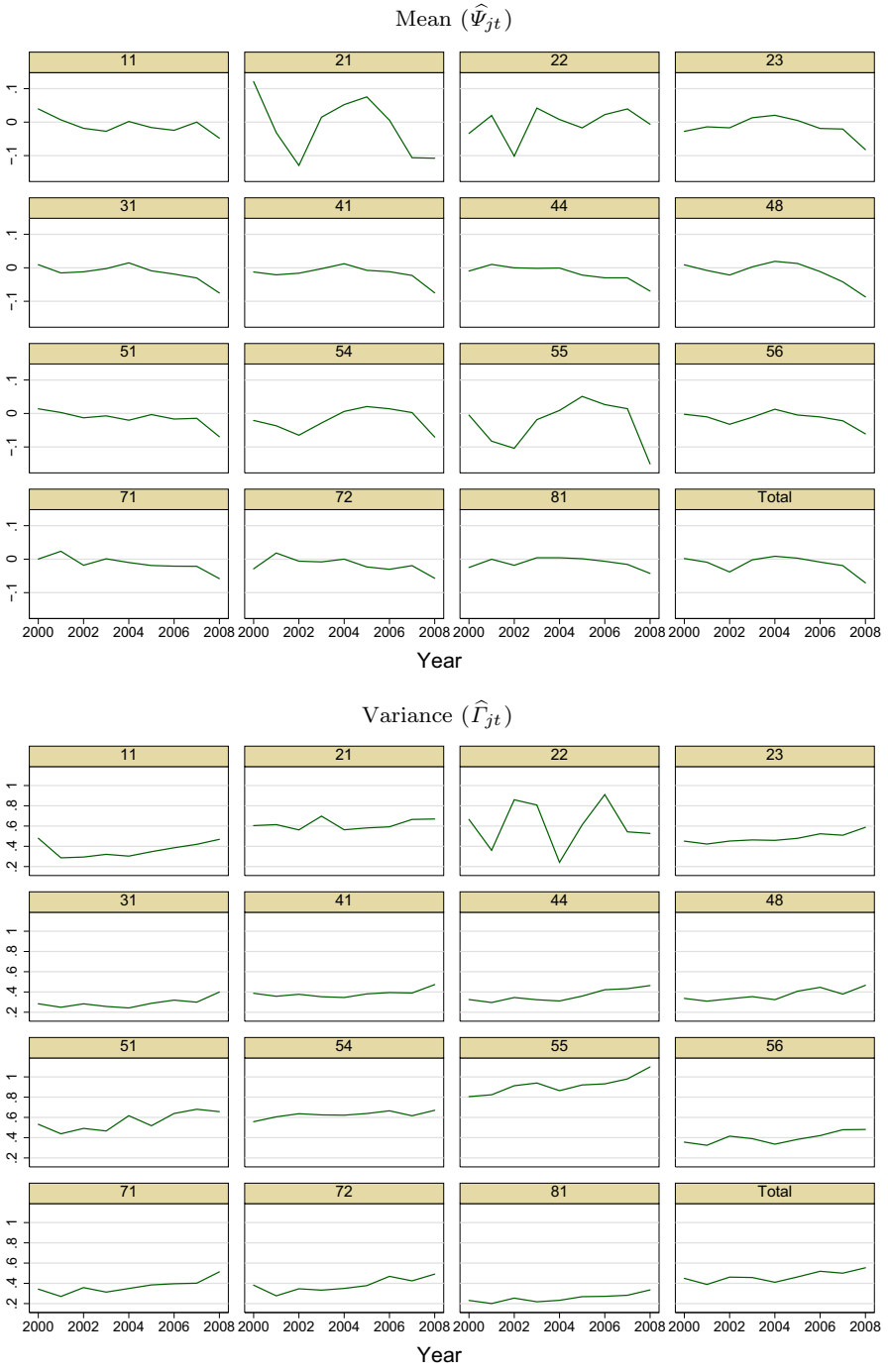

Fig. 2 Unexpected sales growth and variance by industry. [a]These graphs show the unexpected sales growth ($\widehat{\Psi}_{jt}$) and the variance of unexpected sales growth ($\widehat{\Gamma}_{jt}$) by two-digit NAICS codes and year. See Table 2 for the definition of industry codes

Table 9 The role of industry conditions

	Leverage	Long/debt	Long/assets	Leverage	Long/debt	Long/assets
Private	0.034	−0.060	−0.027	0.110	−0.016	0.018
	(0.011)***	(0.013)***	(0.010)***	(0.019)***	(0.022)	(0.017)
Unexp growth	−0.192	−0.095	−0.087			
	(0.033)***	(0.050)*	(0.028)***			
Unexpgrowth × *Private*	0.218	0.128	0.123			
	(0.034)***	(0.050)**	(0.028)***			
Unexp volatility				0.162	0.057	0.061
				(0.032)***	(0.038)	(0.026)**
Unexpvolatility × *Private*				−0.174	−0.101	−0.100
				(0.032)***	(0.038)***	(0.026)***
$Profitability_{t-1}$	−0.101	−0.044	−0.048	−0.101	−0.044	−0.048
	(0.001)***	(0.0009)***	(0.0006)***	(0.001)***	(0.0009)***	(0.0006)***
$Tangibility_{t-1}$	0.027	−0.002	0.003	0.027	−0.002	0.003
	(0.0006)***	(0.0007)***	(0.0004)***	(0.0006)***	(0.0007)***	(0.0004)***
$Size_{t-1}$	0.012	−0.005	0.0004	0.012	−0.005	−6.00e-06
	(0.0003)***	(0.0003)***	(0.0002)	(0.0003)***	(0.0003)***	(0.0002)
$\Delta \ln Sales_{t-1}$	0.015	−0.005	0.0007	0.015	−0.005	0.0008
	(0.0002)***	(0.0002)***	(0.0002)***	(0.0002)***	(0.0002)***	(0.0001)***
Const.	0.339	0.430	0.212	0.268	0.404	0.185
	(0.012)***	(0.013)***	(0.009)***	(0.019)***	(0.022)***	(0.017)***
H_0: $\sum$ Unexp = 0	21.35***	17.75***	55.42***	10.68***	84.43***	163.73***
Observations	3,172,601	3,142,073	3,172,601	3,172,601	3,142,073	3,172,601
Number of Firms	560,256	555,728	560,256	560,256	555,728	560,256
Within R^2	0.067	0.006	0.018	0.067	0.006	0.018
σ_u	0.269	0.293	0.214	0.269	0.293	0.214
σ_e	0.135	0.175	0.114	0.135	0.175	0.114
σ	0.301	0.341	0.243	0.301	0.341	0.243
ρ	0.798	0.738	0.779	0.798	0.738	0.778

Note The dependent variable in the leverage column is the ratio of total debt to total assets. The dependent variable in the long/debt column is long-term leverage or the ratio of long-term debt to total debt, while the dependent variable in the long/assets is the ratio of long-term debt over total assets. Profitability is the ratio of net income for tax purposes to total assets. Tangibility is the ratio of fixed assets to total assets. Size is the the logarithm of firm sales. $\Delta \ln Sales$ is the difference in the logarithmic values of firm output from year $t-1$ to year t. *Unexp growth* and *Unexp volatility* are defined in Sect. 5.1. Standard errors in brackets are clustered at the firm level. All regressions include year and firm fixed effects. The firm-level variance is σ_u, idiosyncratic variance is σ_e, total variance is σ and ρ is the ratio of firm to total variance
***Denotes 1% significant level, **denotes 5% significant level, and *denotes 10% significant level. Row H_0 : $\sum$ Unexp = 0 provides the F-statistic on the null hypothesis (*Unexp growth* + *Unexp Growth* × *Private*) = 0 or (*Unexp volatility* + *Unexp volatility* × *Private*) = 0

positive correlation between leverage and industry conditions, public firms' leverage is counter-cyclical.

The coefficient on *Unexp Growth* × *Private*, which gives the differential impact between private and public firms, is 0.218. The sum of *Unexp growth* and *Unexp Growth* × *Private* gives the total effect of industry growth for private firms. The magnitude of the estimate is 0.026, statistically significant at the 1% level, the positive estimate implies that leverage is procyclical in private firms.

Public firms build up their equity base during industry expansions and rely on presumably cheaper debt when industry conditions deteriorate, which is consistent with Erel et al. (2012)—firms shift to less information-sensitive funding sources, such as debt, in downturns. Following the pecking-order rule in economic expansions, private firms rely more on debt financing. To the extent that private firms play a major role in the economy, aggregate leverage in the economy may build up in expansions and decline during downturns, though this effect will be attenuated by the public firms' financing choices, which exhibit the opposite pattern. This result highlights that a firm's status plays a crucial role in the build up of leverage in the economy.

In column 2, we focus on the debt maturity structure during different economic conditions. The dependent variable is debt maturity, calculated as the ratio of long-term debt to total debt. As *Unexp growth* increases, long-term leverage falls for public firms (-0.095) and rises for private firms ($0.128 + (-0.095)$). Private firms rely more on long-term debt during economic expansions, possibly because the cost of information asymmetry is lower and long-term debt is a relatively cheaper source of funding (Diamond 1991; Flannery 1986).

On the flip side, during an economic downturn (i.e., *Unexp growth* decreases), private firms rely more on short-term debt, which is less information sensitive source. This result is consistent with supply-side explanations whereby investors become more risk averse and shy away from financing firms that are subject to relatively high asymmetric information (e.g., Caballero and Krishnamurthy 2008). As for public firms, the relatively strong reliance on short-term debt compared to long-term debt in good times could be explained with firms' incentives to signal their ability to rollover debt. Note, that public firm rely more on equity than on debt financing.

In column 3, we use the ratio of long-term debt over assets. This measure does not separate the maturity from the leverage decision in a way that the ratio of long-term debt over total debt does (Barclay and Smith 1995). We note that the results of interest are very similar to those in column 2, confirming that unexpected industry growth affects debt maturity and long-term leverage in a similar way.

In columns 4–6 of Table 9, we examine the role of uncertainty measured by the volatility of sales growth (see Appendix A.3). We view high volatility periods to increase the cost of asymmetric information. Higher values of *Unexp volatility* indicate greater uncertainty at the industry level. In column 4, public firms rely more on leverage in periods of elevated uncertainty, which is not the case for private firms ($-0.174 + 0.162$). In terms of debt-maturity structure, when uncertainty is elevated private firms end up with more short-term debt (column 5 and 6), which is expected since the cost of asymmetric information increases and/or creditors become more risk averse to invest in long-term debt. These results are consistent with the results in columns 1–3.

Overall, economic conditions at the industry level affect public and private firms differently. In particular, leverage is procyclical for private and countercyclical for public firms. Further, long-term debt is countercyclical in public firms, while it is procyclical in private firms (i.e., in good economic conditions long-term debt is preferred). Our findings show that private firms' leverage and debt-maturity choices depend on economic conditions, consistent with theories on the role of asymmetric information in firm leverage. This finding has important implication for the sources of leverage buildup in different stages of the economic cycle.

6 Conclusion

In this paper, we examine leverage and debt maturity of private and public firms using the entire population of Canadian firms from 2000 to 2008, which ensures that our estimates are free from sample-selection issues.

Three empirical findings unveil the role of a firm's private/public status in debt financing and debt-maturity structure. First, private firms have significantly higher leverage than public firms after accounting for firm-specific differences and unobserved firm factors. This effect remains after we condition for the effects of typical firm-level factors such as size, tangibility, profitability, growth opportunities and firm fixed effects. Second, private firms rely more on short-term debt than public firms. Third, economic conditions affect debt financing choices. Private firms rely on debt financing when financial conditions are good, while public firms use equity financing. Moreover, private firms rely on long-term debt, while in downturns they shift towards short-term debt. Both private firms' leverage and debt maturity are procyclical, while they are countercyclical for public firms. These findings are consistent with the the role of information asymmetry in debt financing.

Our findings leave some important questions for future research—to the extent that private firms contribute significantly to the Canadian economy, do private firms' reliance on short-term debt especially in downturns affect financial system stability. What is the cost of debt for private and public firms during different economic conditions? What is the likelihood of a supply cut of short-term debt to private firms? Does the nature of the economic shock play a role?

A Appendix

A.1 Data appendix

The data appendix provides details on the assets, equity, short-term debt, long-term debt, debt, profits, tangible assets and sales variables. The following information lists the components of each variable along with the corresponding tax line from the T2 tax forms in brackets. The information is taken from the general index of financial information (GIFI) on the T2 corporate tax return.

1. Total assets (2599) =

  - Total current assets (1599) [Cash and deposits (1000) + Accounts receivable (1060) + Allowance for doubtful accounts (1061) + Inventories (1120) + Short term investments (1180) + Loans and notes receivable (1240) + Other currents assets (1480)]
  - Tangible capital assets (2008) [Land (1600) +Depletable assets (1620) +Buildings (1680) +Machinery, Equipment, Furniture and Fixtures (1740) +Other tangible assets (1900)]
  - Intangible capital assets (2178) [Intangible assets (2010) (i.e., goodwill, quota, licenses, incorporation costs, trademarks/patents, customer lists, rights, and research and development). + Resource rights (2170)]
  - Long term assets (2589) [Due from shareholder(s) and/or director(s) (2180) + Due from members (2190) + Investment in joint venture(s) and/or partnership(s) (2200) + Long term investments (2300) + Long term loans (2360) + Other long term assets (2420)]
  - Assets held in trust (2590)
2. Total liabilities and shareholder equity (3640)
3. Total debt = Total liabilities (3499) =
  - Total short-term debt = Total current liabilities (3139)
  - Total long-term debt = Total long-term liabilities (3450)
4. Total shareholder equity (3620) =
  - Common shares (3500) +
  - Preferred shares (3520) +
  - Retained earnings/deficit (3600) [Retained earnings/deficit—Start (3660) + Net income/loss (3680) + Capital contributed at the beginning of the fiscal period (3690) + Dividends declared (3700) + Prior period adjustments (3720) + Other items affecting retained earnings (3740)]
5. Total sales = total revenues (8299)
  - Total sales of goods and services (8089) +
  - Investment revenue (8090) +
  - Interest income (8100) +
  - Commission revenue (8120) +
  - Rental revenue (8140) +
  - Vehicle leasing (8150)
  - Fishing revenue (8160) +
  - Realized gains/losses on disposal of assets (8210) +
  - NPO amounts received (8220) +
  - Other revenue (8230) (Income/loss on subsidiaries/affiliates + Income/loss on joint ventures + Income/loss on partnerships + Alberta royalty tax credits)
6. Profits = Net income for tax purposes (300)

All variables are measured in nominal terms within the database. We use the consumer price index data available through CANSIM (CANSIM Table No. 326-0001) to deflate values of these variables.
Accounting rules dictate that:

- total assets (2599) $\equiv$ total liabilities (3499) + total shareholder equity (3620) identity holds.

A.2 Definition: private versus public firms

We classify firms as private or public on the following criteria:

1. Canadian-controlled private corporation (CCPC):
   - Resident incorporated firm not directly or indirectly controlled by non-residents, a public corporation or any combination; or
   - a private, resident corporation not directly or indirectly controlled by one or more public corporations or Federal Crown corporation
2. Public corporation:
   - Resident in Canada and having a class of shares listed on a prescribed Canadian stock exchange; or
   - Any Canadian corporation controlled by a public corporation

A.3 Industry sales growth and volatility of unexpected firm sales growth

Following Castro et al. (2015), we use a two-step procedure to measure unexpected industry sales growth and its volatility. As the first step, a firm's sales growth is decomposed into predicted and unexpected components using the following regression:

$$\ln(Sales_{it}) = \alpha_i + \beta_1 \ln(Sales_{i,t-1}) + \beta_2 \ln(Sales_{i,t-2}) + \phi_1 \ln Firm\,age_{it} + \tau d1984_i + \phi_2[d1984_i \times \ln Firm\,age_{it}] + \mu_{it}, \quad \text{(A.1)}$$

where the residual μ_{it} captures the unexpected component to firm sales growth. The dummy variable $d1984$ takes the value one for firms that existed prior to 1984 because we do not know their exact age, and zero otherwise. In the second stage, both μ_{it} and μ_{it}^2 are regressed against time-specific, two-digit industry dummy variables given in the following equation:

$$\mu_{it} = \sum_{i \in j} \sum_{t} \Psi_{jt} + \varepsilon_{it}, \quad \text{(A.2)}$$

and

$$\mu_{it}^2 = \sum_{i \in j} \sum_{t} \Gamma_{jt} + \nu_{it};, \quad \text{(A.3)}$$

for firm i in industry j at time t. These regressions include a full set of industry-time dummy variables Ψ and Γ.[15] Ψ_{jt} gives the unexpected firm sales growth within industry j at time t, while $\Gamma_j t$ gives the variance of the unexpected sales growth within industry j at time t. The estimated coefficients on the dummy variables in Eq. (A.2) capture the average unexpected sales growth within an industry at a given time

[15] For the Ψ coefficients, this procedure is equivalent to having industry time-specific dummy variables in the firm growth Eq. (A.1) via the Frisch–Waugh–Lovell theorem see (Greene 2012).

($\widehat{\Psi}_{jt}$), while the estimated coefficients on the dummy variables in Eq. (A.3) capture the volatility of the unexpected firm sales-growth at a given time and industry ($\widehat{\Gamma}_{jt}$).

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