Economics Bulletin

Volume 38, Issue 4

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I acknowledge the anonymous referee for his useful comments and suggestions for improving the paper.
Citation: Padmaja Mundakkad, (2018) " Firms' leverage and labour productivity: a quantile regression approach", *Economics Bulletin*, Volume 38, Issue 4, pages 2331-2344
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Submitted: September 10, 2018. **Published:** December 10, 2018.

Economics Bulletin

Submission Number: EB-18-00738

FIRMS' LEVERAGE AND LABOUR PRODUCTIVITY: A QUANTILE REGRESSION APPROACH

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Abstract

In the aftermath of financial crisis, many studies using macro level data has argued that financial pressure and higher debt will negatively affect the firm growth. This paper is an attempt to investigate the micro level explanation of the relationship between leverage and labour productivity. The study examines the relationship between firm leverage and labour productivity using a rich dataset on Indian manufacturing firms over the period 1995-2010. Financial status of firms are considered as one of the major factor effecting firm performance in terms of productivity, size and real decisions such as R&D, physical capital investments, exports ,FDI etc. We employ a quantile regression approach to examine the effect of leverage on firm's labour productivity. We find that leverage do not increase productivity at the low levels of productivity. But for medium and higher productivity firms, leverage tend to increase the productivity. The empirical results points to non-monotonic relationship between leverage and labour productivity. Thus we conclude that increase in leverage adversely affect the productivity of less productive firms.

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1. Introduction

Last few decades have witnessed a resurgence in the literature on link between finance and firm productivity both at theoretical as well as empirical level. Macro level studies have found evidence that financial development foster economic growth whereas, micro level studies shows that firm financial variables and productivity are significantly related to each other (Coricelli et.al., 2012). Firm productivity is one of the emerging issue of discussion at both macro as well micro level. Existing theoretical and empirical literature have found that financial constraints are major factor in determining aggregate as well as firm level activities (Fazzari et al., 1988; Chaney 2013). Even though many factors has been identified as the determinants of firm productivity, the relationship between firm financing constraints and firm productivity is less explored.

One of the central issue in corporate finance is whether financial status of firms effects their real investments. One strand of literature following Miller (1958) shows that financial variables does not affect the real decisions of firms following the argument of independence of financial and real decisions. On the other hand, Myers (1977) shows that a higher leverage will result in overhang and will prevent firms from undertaking profitable projects. Jensen (1986) argues that higher leverage will result in bankruptcy probability and therefore mangers try for firm efficiency improvement and then labour productivity. Thus a positive relationship is expected according to this argument. A negative relationship is also argued in case of bank and other fund lending agencies and existence of positive relationship between R&D and leverage. If banks are only lenders, then fall in R&D due to scarcity of funds will result in negative relation between leverage and labour productivity. This is because higher the R&D, higher the leverage (Jensen and Meckling, 1976; Myers, 1977).

The relationship between firm leverage and labour productivity is one most important issue in the corporate finance literature. Finance plays a major role in determining firm productive activities including R&D, profitable investments etc. Existing literature shows that firms with financial constraints face bigger hindrance in their growth path in terms of profitable and productive investment decisions. The capital structure literature points out that the firms with growth opportunities have to choose less leverage. This is because otherwise they will not be able to utilize the investment opportunities. Another way through which higher leverage can adversely affect

firm performance is that firm mangers tend to choose low leverage in case of firms with good growth opportunities. Recent years witnessed a large number of empirical contributions on the link between productivity and firm performance. These set of studies use micro-level data at firm level over a period of time to examine the role of financial variables on firm performance in terms of productivity, exports, FDI, R&D etc. (Coricelli et.al., 2012; Padmaja and Sasidharan 2018, Buch et al, 2014; Sasidharan et al., 2016). This can be ascribed to the availability of firm level data at large scale. However, the studies focusing on the context of emerging economies are scarce.

The assessment of relationship between leverage and productivity and firm leverage in the context of India is important for the following reasons. First, existing literature provides evidence that there is heterogeneity in the productivity levels of manufacturing companies of developed and developing countries (Hseih and Klenow, 2007). Second, even though the role of external factors like resource allocation were examined, the role of internal factors such as role of financial structure are not examined in the context of emerging economy like India. Third, even though labour productivity is an important factor for firm growth, most of the existing studies have focused on total factor productivity (Goldar, 2004; Dougherty et al., 2010). Therefore, the present study aims to empirically explore the relationship between firm leverage and labour productivity in the context of Indian manufacturing firms. The data used is over a period of 16 years ranging from 1995-2010. We contribute to the literature in following ways. Firstly, we provide insights to the relationship between leverage and labour productivity of firms in an emerging economy, India using a longer period of analysis. Secondly, we employ econometric analysis which is more robust and helps to provide evidence on non-monotonic relationship between leverage and labour productivity.

This paper is structured as follows. Section 2 discuss empirical literature on the link between financial variables and firm productivity. Section 3 presents the data and empirical methodology. Section 4 discuss the findings and section 5 concludes the study.

2. Empirical Evidence

Schiantarelli and Sembenelli (1997) finds a negative relationship between leverage and labour productivity using a sample of U.K. firms. Nickell and Nicolitsas (1995) examined the role of financial pressure in the context of U.K firms over the period 1979-1986. The study found evidence

on adverse effect of financial pressure on the firm employment and small positive effect in firm productivity. Nucci et al (2005) examines the link between financial structure and TFP of firms using panel data of Italian firms over the period of 1982-1998. Empirical findings using between group estimator and fixed-effect instrumental variable estimator shows that the firms with lower leverage are on an average more productive. Gatti and Love (2008) examines the relationship between access to credit and firm productivity. The findings from 2SLS model show that access to credit is positively associated with the firm productivity performance.

Musso and Schiavo (2008) examine the impact of financial constraints on firm survival and growth of French manufacturing firms over the period 1996-2004. The findings using Clog-log proportional model and within regression shows that financial constraints play an important role in firm survival. Ghosh (2009) finds a negative effect of leverage on productivity in the context of a sample of Indian companies. Coircelli et al., (2012) examines the non-monotonic relationship between leverage and firm productivity growth using cross country data of Central and East European countries over the period 1999-2008. The findings supports non- monotonic relationship between leverage and firm productivity growth.

Avarmaa et al., (2013) finds evidence on non-linear relationship between firm leverage and labour productivity and it differs between local and multinational firms in the context of Baltic firms over the period of 2001-2008. Girma and Vencappa (2015) investigates the role of financing sources in determining productivity growth of Indian manufacturing firms. Sample period ranges from 1989-2008. The findings using average treatment effects and OLS shows that external finance is major source of finance and there is evidence of pecking order. Nunes et al., (2007) examines the effect of firm leverage on labour productivity in the context of Portuguese firms over the period 1999-2003.Using a quantile regression approach, leverage negatively effects labour productivity of firms with relatively lower labour productivity. Whereas, leverage have a positive effect on firms with higher productivity.

The above discussion shows that the empirical evidence on the relationship between leverage and productivity is ambiguous. Few studies have found a positive relationship between two, whereas, set of studies have evidence on a negative relationship. Therefore, this study is an attempt to examine the relationship between leverage and labour productivity in the case of Indian manufacturing firms.

3. Data and Empirical Strategy

We used firm level data on Indian manufacturing firms from PROWESS[1] database provided by Centre for Monitoring Indian Economy (CMIE) over a period of 15 years from 1995-2010. Prowess database provides financial information and information on total assets, ownership, sales etc at firm level of around 20000 manufacturing companies. Before undertaking the empirical exercise, we resorted to clean the data and following criteria is applied. *First*, we restricted our sample to only those firms that report positive sales and fixed assets. *Second*, those firms with less than three years of continuous observations in the sample period have not been considered. *Finally*, we eliminated all firms having less than 10 employees since they fall under the category of unorganised industrial sector. We deflated all the flow variables using appropriate industry specific wholesale prices obtained from Central Statistical Organisation (CSO). Other monetary values like total assets are deflated using GDP deflator. All monetary values are winsorized from upper and lower 0.5 percentiles. After the cleansing process, we are left with 23475 firm year observations during the period 1995-2010.

Labour productivity measured as the log of ratio of output to number of employees. This measure is used widely in the literature as measure of labour productivity (for example., Minetti and Zhu 2011; Wagner 2014; Bhattacharya and Narayan, 2015; Gomis and Khatiwada, 2016; Ahlawat and Renu, 2018). We also control for few other firm specific variables in our analysis in addition to the leverage which is the explanatory variable of interest in the study. Leverage is defined as the ratio of short term debt to total debt. A detailed description of variables and expected sign of the variables are given in Table (1).

[1] PROWESS database provides firm level information on Corporate companies in India which is maintained by Centre for Monitoring Indian Economy (CMIE). This database is used by many studies such as Topalova (2011); Ghosh (2006); Sasidharan and Kathuria (2011).

Table 1. Description of Variables

Variable	Definition	Expected Sign
Labour productivity	Log of output to number of employees	Dependent Variable
Leverage	Short term debt / Total debt	Non-Linear
Tangibility	Net Fixed Assets /Total Assets	-
Size	Log of Total Assets	+
Growth	Sales Growth	+
Ownership	=0 if domestically owned =1 if foreign owned	+

Source: Data extracted from Prowess database

Size and growth rate is also controlled for since it is argued in the literature that these are major heterogeneity factors which differentiate the firm level performance and firm level investment decisions. Size is measured as natural logarithm of total assets and growth is measured as growth of sales. Size of the firm is one of the most important factor identified as determinant of capital structure of the firm. Existing literature argues that larger firms are more likely to use leverage compared to small firms. The reasons identified are i) higher credibility ii) better network access.

Tangibility is another major factor which effects the firms. Tangibility is measured as ratio of net fixed assets to total assets. Tangibility is associated to leverage as it acts as a collateral for leverage using bank loan. So we account for size, growth rate and tangibility. We account for heterogeneity in terms of ownership by including an ownership dummy which takes value 1 if foreign owned and 0 otherwise. Foreign owned firms are expected to have better financial health compared to their counterparts particularly because they can access funds from their parent companies (Manova et al., 2013). However, few studies argue that foreign owed firms are subject to financing constraints (Guariglia et al. 2011). Therefore, the role of foreign ownership is ambiguous in existing literature. So we explicitly control for the role of ownership. Table (2) reports the descriptive statistics of the variables used in the study.

Table 2. Descriptive Statistics

Variable	Observations	Mean	SD	Min	Max.
Labour productivity	23475	2.91	0.98	0	6.01
Leverage	23475	0.67	1.18	0.004	25.14
Tangibility	23475	1.45	0.18	1.00	1.98
Size	23475	3.93	1.59	0.25	7.79
Growth	23475	0.55	5.49	-0.99	248
Ownership	23475	0.05	0.22	0	1

Source: Author's calculations using data extracted from Prowess database. Labour productivity and size are measured in logs.

Table (3) reports the correlation matrix along with significance of all the covariates used in the study. Correlation values shows that there is positive relationship between leverage and labour productivity. Other control variables such as growth rate, size, and ownership also found to be positively correlated with labour productivity except tangibility, which is negatively correlated.

3.1 Empirical Strategy

The above section briefly discuss the theoretical and empirical literature on the relationship between firm financial status and productivity. Since the effect of leverage on firm productivity is ambiguous, we use a quantile regression method (Koenker and Hallock, 2001) to examine the relationship between leverage and productivity across the distribution of labour productivity.

$$Q_\theta(y_{it} / x_{it}) = \beta_0 + \beta_0' x_{it} + z \qquad (1)$$

Where y_{it} denotes the labour productivity and x_{it} is the vector of explanatory variables. In addition to leverage we also control for the factors such as tangibility (ratio of fixed asset to total assets), size (log of total assets), sales growth and ownership (foreign versus domestic) Time and industry effects are controlled by including year and industry dummies. We expect the control

variables such as tangibility, size, ownership etc to have a significant effect the firm labour productivity.

Table 3. Correlation Matrix

Variable	Labour Productivity	Leverage	Tangibility	Size	Growth rate	Ownership
Labour productivity	1.0000					
Leverage	0.0184*	1.0000				
Tangibility	-0.0152	-0.3376*	1.0000			
Size	0.2795*	-0.0102	-0.0078	1.0000		
Growth rate	0.0399*	-0.0067	0.0071	0.0774*	1.0000	
Ownership	0.0133*	-0.0599*	0.0366	0.0175	0.0195	1.0000

Source: Author's calculation using data extracted from Prowess database. * $p<0.1$.
Note: Labour productivity measured in logs.

4. Empirical Results and Discussion

We used a quantile regression approach to examine the link between leverage and labour productivity. We report the results of both OLS as well as quantile regression. First, we discuss the simple linear relationship between leverage and labour productivity. Further, we report the results of quantile regression for 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantiles. Table (3) and (4) results helps to compare the results of OLS to the quantile regression approach. The findings shows that the OLS results in this case is misleading since the positive relationship is only significant to the right hand side of labour productivity distribution.

Table (4) reports the results of univariate regression using OLS and quantile regression at 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantiles. Using OLS, it is found that there is a positive relationship between leverage and labour productivity. i.e., leverage increases firms productivity. Using quantile regression, the link between leverage and productivity is found to be non-linear. The results shows

that for low and medium productive firms leverage tend to decrease the labour productivity. However, leverage tends to increase the labour productivity in context of high productivity firms.

Table 4. Univariate Regression

Variable	OLS	10th Q	25th	50th	75th	90th
Leverage	0.0136**	-1.9005	-0.00695	0.0131**	0.0243***	0.0502***
	(0.00656)	(0.00994)	(0.00641)	(0.00647)	(0.00753)	(0.0102)
R^2/Pseudo R^2	0.2517	0.2261	0.2447	0.2643	0.2845	0.2769
N	23475	23475	23475	23475	23475	23475

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
A constant and set of year and industry dummies are introduced but not shown.

Table (5) reports the results of OLS and quantile regression using main variable of interest; leverage and other control variables such as size, tangibility, growth and ownership. In order to account for non-linear relationship between leverage and labour productivity, OLS regression reported in column 1 also includes leverage squared (Leverage2) as additional explanatory variable. And as given in Table (1), result shows a significant non-linear relationship between leverage and labour productivity which motivates us to carry out quantile regression. Overall, the multivariate regression results confirm the relationship between leverage and labour productivity and the results does not vary compared to univariate regression results. Leverage decreases labour productivity for lower productivity firms. This supports the agency argument that banks will require real collateral from these firms to lend money. This prevents firms from financing their investments with leverage. Similarly for the firms with high productivity, leverage enhance their productivity. The findings are supports some of the recent empirical evidences (for example, Avarmma et al., 2013).

The results suggests that for low and medium productivity firm, leverage do not increase productivity, whereas, for high productivity firms, leverage increases productivity. High leverage adversely affect the productivity of less productive firms. In case of other control variables, tangibility does not increase the firm productivity. The findings shows that the ratio of fixed assets to total assets does not significantly effect labour productivity. Firm size and growth positively

effects the labour productivity which is true for all the quantiles of labour productivity. The positive effect of size on labour productivity may be due to higher credit rating for larger firms than their counterparts. Therefore, it is easy for the larger firms to access external financing due to lower information asymmetries (Subadar 2011). This shows that firms with higher growth rate experience larger labour productivity. Regarding ownership, foreign ownership tends to increase the firm labour productivity particularly in the third quartile.

5. Conclusion

The paper is an attempt analyze the link between the relationship between leverage and labour productivity. The results of quantile regression suggests that the relationship between leverage and labour productivity is nonlinear. For the first and second quantiles of labour productivity, leverage does not increase labour productivity. However, at third, fourth and fifth quartiles leverage significantly improves labour productivity. The empirical results shows that there is a positive relationship between leverage and labour productivity towards the right hand side of the productivity distribution. Further, findings of the study shows that controlling for other covariates such as tangibility, firm size, growth rate, firm liquidity etc, leverage effect the labour productivity positively in the case of high productive firms. Size of the firm shows a positive and significant effect on labour productivity. Thus, the findings suggests that low productive firms have to depend more on the internal funds for investments rather than on leverage which will adversely affect their productivity and in turn the investment opportunities.

Table 5. Multivariate Analysis: OLS and Quantile Regression

Variable	OLS	10th Q	25th Q	50th Q	75th Q	90th Q
Dependent Variable: Labour productivity						
Leverage	0.0451***	-0.00161*	-0.00384*	0.0135**	0.0219*	0.0621***
	(0.0122)	(0.0115)	(0.00914)	(0.00669)	(0.0129)	(0.0137)
Leverage2	-0.00190***					
	(0.000717)					
Tangibility	0.0203	0.0281	-0.0620	-0.0484	-0.0477	0.122
	(0.0423)	(0.0784)	(0.0463)	(0.0557)	(0.0572)	(0.0785)
Size	0.172***	0.195***	0.156***	0.143***	0.154***	0.191***
	(0.00438)	(0.00808)	(0.00581)	(0.00488)	(0.00607)	(0.00653)
Growth	0.00338**	0.00162	0.000456	0.00253	0.00861	0.0198**
	(0.00153)	(0.00233)	(0.000949)	(0.00317)	(0.00586)	(0.0101)
Ownership	0.0555*	0.0942	0.0555	0.104***	0.0722	0.00204
	(0.0306)	(0.0591)	(0.0447)	(0.0367)	(0.0497)	(0.0505)
R^2/Pseudo R^2	0.287	0.2597	0.2429	0.2356	0.2338	0.2545
N	23475	23475	23475	23475	23475	23475

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.01
A constant and set of year and industry dummies are introduced but not shown.

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