Journal of Monetary Economics 66 (2014) 79–94

Contents lists available at ScienceDirect

Journal of Monetary Economics

journal homepage: www.elsevier.com/locate/jme

A macroeconomic approach to corporate capital structure

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ARTICLE INFO

Article history:
Received 27 June 2012
Received in revised form
4 April 2014
Accepted 6 April 2014
Available online 15 April 2014

Keywords:
Corporate capital structure
Dynamic trade-off theory
Firm dynamics

ABSTRACT

The cross-sectional distribution of corporate capital structure and its macroeconomic implications are underexplored research areas. This paper embeds a dynamic trade-off theory of firm financing into a general equilibrium model with firm dynamics. I find that the stationary equilibrium replicates fairly well the distribution of leverage as well as the relationship between leverage, size and profitability. The counterfactual experiment points out relatively small effects of tax benefits on corporate capital structure. It also implies that the effects of the default cost on macroeconomic variables are almost negligible under endogenous capital structure choice.

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1. Introduction

Empirical corporate finance literature has identified a number of cross-sectional determinants of corporate capital structure such as size, profitability, market-to-book ratio, and tangibility of assets. Only fairly recently has the theoretical literature been able to qualitatively and quantitatively rationalize the empirical evidence, namely by means of dynamic models of corporate leverage and investment, in which firms trade off tax benefits of debt against financial distress costs. While this "dynamic trade-off theory" has significantly advanced our understanding of corporate capital structure, a lot of empirical facts still remain controversial from a theoretical viewpoint.[1] Furthermore, in a macroeconomic perspective, the interaction between corporate capital structure choice and macroeconomic variables is an underexplored research area.

This paper contributes to the literature by replicating some characteristic features of leverage distribution as well as the relationship between leverage, size and profitability, particularly non-linearities not captured by traditional leverage regressions. In so doing, this paper embeds the trade-off theory of firm financing and investment into a general equilibrium model with heterogeneous firms and their endogenous entry/exit. In the resulting stationary equilibrium in the sense of Hopenhayn and Rogerson (1993), corporate policies as well as entry/exit of firms are tied to each other, thus making it possible to consider the cross-sectional distribution of firms as an equilibrium outcome. Such a general equilibrium structure combined with endogenous capital structure choice also gives a new insight regarding a macroeconomic implication of corporate finance because few macroeconomic models with financial frictions endogenize corporate capital structure choice.

I find that the resulting cross-sectional distribution in a stationary equilibrium accounts for some empirical regularities which have been controversial. First, the equilibrium distribution of leverage captures the two characteristic features: (1) more than 30% of firms are almost-zero leverage firms, and (2) leverage of non-zero leverage firms differs considerably from firm to firm. This paper suggests that the *endogenous* entry/exit of firms is a key to replicating the first feature, which is

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[1] Graham and Leary (2011) summarize the empirical questions to be investigated in corporate finance.

http://dx.doi.org/10.1016/j.jmoneco.2014.04.003
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sometimes called “low leveraged puzzle,” together with a realistic ROA distribution. The rationale behind this result is as follows: Without *endogenous* exits, there would be many negative profit firms in the economy because they do not have to exit (and cannot exit!), thus leading to an unrealistic distribution of ROA. A realistic distribution of ROA would be restored by lowering the fixed cost parameter, but then firms are so profitable that they do not accumulate internal funds for future financial distress, thus making the distribution of leverage has much more weight on high leveraged firms than data.

Second, this paper captures the following controversial facts regarding the cross-sectional relationship between leverage, size and profitability. *Fact* 1: The correlation between profitability and firm size is *positive* (i.e., economies of scale), but the larger the firm size, the smaller the economies of scale; *Fact* 2: The correlation between leverage and firm size is *positive*; *Fact* 3: The correlation between leverage and profitability is *positive*, but it becomes *negative* if (i) we limit the sample to large firms or (ii) we add firm size as a control variable.

Facts 1–3 are not new except for the size-dependency in the profitability–leverage relationship, which are described in the second part of Fact 3. The *negative* profitability–leverage relationship (after controlling for size) has attracted much attention in the capital structure literature because this negative relationship is difficult to be justified on the grounds of the trade-off theory.[2] Fact 3 implies, however, that the simple correlation between profitability and leverage is *positive*, which is consistent with the traditional trade-off argument, but more puzzlingly, the relationship turns out to be *negative* depending on size and profitability.

This paper accounts for those facts and suggests the rationale behind those facts as follows: Fact 1 implies the existence of economies of scale caused by fixed costs. The economies of scale get smaller among large firms because the fixed cost is irrelevant among large firms. Fact 2 is replicated in the model as a kind of spurious correlation. On the one hand, “productivity” and “leverage” are positively correlated because high productivity firms expand their financing gap (the gap between investment and internal funds) and fill the gap mainly by debt, and because the debt market is more accessible to high productivity firms. On the other hand, “productivity” and “firm size” are positively correlated because the optimal size of high productivity firms is large. Those two positive correlations result in the positive correlation between size and leverage.

As the mechanisms to potentially explain Fact 3, this paper assumes idiosyncratic productivity shocks of two types (transitory and persistent), which are emphasized in Gourio (2008) as an important assumption to account for firm financing and investment behavior. Provided those two types of shocks, Fact 3 can be understood as follows. On the one hand, as a combination of Facts 1 and 2, the *persistent* productivity shock causes a *positive* correlation between leverage and profitability. On the other hand, the *transitory* productivity shock causes a *negative* correlation between leverage and profitability, because it *increases* its profitability by boosting current profits whereas it *decreases* its leverage by increasing internal funds. When the correlation between profitability and leverage is measured, the effect of the persistent productivity is more relevant for corporate capital structure on average, inducing the positive correlation between leverage and profitability (the first part of Fact 3). However, the effect of the transitory productivity shock becomes more relevant among *large firms* because economies of scale caused by fixed costs (Fact 1) are small among them, inducing the negative correlation between leverage and profitability (the second part of Fact 3). Similarly, when we add firm size as a control variable, firm size absorbs the effect of the persistent productivity. Therefore, profitability in the regression captures only the effect of transitory productivity, thus making the sign of the coefficient on profitability negative.

Finally, the effects of each friction on corporate capital structure as well as macroeconomic variables are measured through a counterfactual experiment. First, the policy experiment shows that the outside equity costs have different effects on capital structure depending on firm size. In particular, when the outside equity costs are decreased, large firms would *increase* their leverage whereas small firms would *decrease* their leverage. Second, the tax benefit generated from the corporate tax exhibits relatively small effects on the corporate capital structure in the experiment, and the size of the effects highly depends on the size of the outside equity costs. Third, the policy experiment shows that, under the endogenous capital structure choice, the default cost has fairly small effects on the steady state vales of macroeconomic variables as well as their responses to a productivity shock, implying that the effect of default costs might be overemphasized in macroeconomic literature.

1.1. Related literature

Numerous empirical works have identified a number of cross-sectional determinants of corporate capital structure such as size and profitability.[3] Those empirical works have particularly emphasized the negative relationship between leverage and profitability as a puzzling fact. Recently, Graham and Leary (2011), which survey the empirical research of corporate capital structure, emphasize the non-linearity in the profitability–leverage relationship as an interesting fact to be investigated.

After the Modigliani–Miller theorem, many theoretical papers have explored what makes the firm's capital structure relevant.[4] Among them, the most closely related literature to this paper is the dynamic trade-off theory literature. Hennessy

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[2] According to the traditional static trade-off theory, profitable firms should increase their leverage because their probability of financial distress is low and their tax benefits are high.

[3] For example, see Rajan and Zingales (1995), Fama and French (2002) and Frank and Goyal (2009).

[4] See Frank and Goyal (2008) for a recent survey of this literature.

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