

# The limited liability effect in experimental duopoly markets

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## Abstract

Brander and Lewis [Am. Econ. Rev. 76 (1986)] show that firms with limited liability can use debt to commit to aggressive behavior in Cournot markets. In our duopoly experiments, we find that subjects choose much less debt than predicted by theory. Although subjects try to exploit the strategic advantage of debt, they do not (want to) acknowledge possible strategic advantages of opponents' debt. Replacing quantity with price competition, our data support the theoretical prediction of Showalter [Am. Econ. Rev. 85 (1995)] that demand and cost uncertainty have opposing effects on the strategic choice of debt. However, observed behavior is more in line with collusion than with the subgame perfect equilibrium prediction.

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## 1. Introduction

The influence of debt on firms' product market behavior is not just of academic interest. For example, most European telecom firms have accumulated huge debt levels in the aftermath of the UMTS auctions. By August 2001, Deutsche Telekom and France Telecom each had debts totaling more than 60 billion euro (while their competitor Vodafone managed with only about 12.5 billion euro). The question whether such enormous debt levels have detrimental effects on product market behavior is clearly an important one.

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The literature that explores the interaction between product market competition and financial structure of firms begins with the pioneering work of [Brander and Lewis \(1986\)](#).<sup>1</sup> They observe that in a market characterized by quantity competition, debt can work as a commitment for more aggressive behavior in the product market giving firms an incentive to choose the debt–equity ratio strategically.

The key insight for this result is that managers acting in the interest of equityholders ignore profits in bankrupt states, in which debtholders become residuals claimants of profits.<sup>2</sup> Since the firm is acting in an oligopolistic market, the effect of the firm's financial policy on its own production behavior strategically influences the rival firm's production behavior as well. Foresighted owners anticipate these effects and use the financial structure so as to influence the output market equilibrium in their favor. [Brander and Lewis \(1986\)](#) call this the limited liability effect of debt financing in oligopoly. In this paper, we present the first experimental study of this theory.<sup>3</sup>

We are accustomed to see theoretical results for quantity competition being exactly reversed when price competition is assumed instead. Yet, [Showalter \(1995\)](#) points out that with price competition the limited liability effect also depends on whether the uncertainty in the model derives from uncertain demand conditions or from uncertain cost conditions. In particular, under price competition with demand uncertainty, debt yields higher profits (for given debt level of the other firm). However, with cost uncertainty debt does not yield a strategic advantage and does not increase profits. Hence, at least for strategic reasons, firms would choose as little debt as possible.

The intuition for the difference between demand and cost uncertainty is the following. With limited liability, firms ignore bad states of the world. Hence, with cost uncertainty and price competition, firms exclusively focus on low cost states, which implies lower prices and lower profits given the action of the other firm. Whereas with demand uncertainty, firms focus on states with high demand, which implies higher prices and higher profits. When firms choose quantities, firms also focus on low cost and high demand states, respectively. However, with quantity competition both effects work in the same direction, namely increasing quantities and profits. [Table 1](#) summarizes the results concerning the effects of debt on prices and quantities and the use of strategic debt in subgame perfect equilibrium.

Thus, theory makes some very specific predictions depending on the type of product market competition (quantity versus price) and the type of uncertainty (demand versus cost). In principle, there are four empirically testable implications of the theory. (1) A firm's financial structure affects its own product market behavior. (2) A firm's financial structure affects other firms' product market behavior. (3) Those linkages depend in a particular way on the type of product market competition and on the type of uncertainty. And (4), firms choose the debt–equity ratio strategically. In general, the available empirical data will not allow to test all those hypotheses. For this reason, the application of experimental methods yields a useful supplement to empirical studies on the matter.

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<sup>1</sup> For an overview, see [Maksimovic \(1995\)](#).

<sup>2</sup> See [Jensen and Meckling \(1976\)](#) and [Myers \(1977\)](#).

<sup>3</sup> Experiments that study structurally similar problems in different contexts include [Anderhub et al. \(2001\)](#), [Huck et al. \(2000\)](#) and [Engelmann and Normann \(2001\)](#).

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