

Electronic Companion for “Inventory, Risk Shifting, and Trade Credit”

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This document presents the results of a numerical sensitivity analysis under the assumption that the retailer faces linear demand curves subject to additive uncertainty, and chooses retail prices once this uncertainty is realized. In this case, the retailer’s revenue is given by

$$\pi(\mathbf{D}, \mathbf{Q}) = \max_{\mathbf{x} \in \mathbb{R}_+^2} \mathbf{x}' \mathbf{p}(\mathbf{x}) \text{ s.t. } \mathbf{x} \leq \mathbf{Q},$$

where $p_i(\mathbf{x}) = D_i - x_i - \gamma x_{3-i}$ is the retail price, x_i is the quantity sold, and D_i is the demand shock of product i , $i = 1, 2$, and $\gamma \in (0, 1)$ is a measure of product substitutability.

The optimization is based on simulating 100,000 demand shock scenarios drawn from a bivariate lognormal distribution, and the following base-case parameter values: $\mu_1 = \mu_2 = 10$, $\sigma_1 = \sigma_2 = 5$, $\rho = 0$, $\gamma = 0.2$, $c_1 = c_2 = 5$, $W = 0$, and $b = 1$. Once again, we started with a fully symmetrical “base case,” and examined the impact of increasing asymmetry in each of the three product-specific parameters, c_i , μ_i , and σ_i ,¹ on inventory levels and the relative agency cost.

The optimal inventory levels are plotted in Figures 1a, 2a, and 3a. If we compare these figures to Figures 4a, 5a, and 6a from the main body of this article, we observe a striking similarity. Whether the revenue is given by the newsvendor model or by the linear demand model, when the two products differ in profit margin, mean demand, or demand volatility, a bank-financed firm overinvests in the product that represents a larger portion of the total inventory, and underinvests in the other product, i.e.,

$$Q_i^{BF} \geq Q_i^* \geq Q_j^* \geq Q_j^{BF}.$$

Figures 1b, 2b, and 3b illustrate the effect of parameter asymmetry on the relative agency cost $\frac{V^* - V^{BF}}{V^{BF}} 100\%$. Similar to the newsvendor model, the agency cost becomes relatively more significant as the product costs or demand distributions become more asymmetric. Unlike the newsvendor model, the linear demand model allows us to study the effect of product substitutability γ . As the products become closer substitutes, both profit margins shrink, bankruptcy risk increases, and so do the risk-shifting problem and the relative agency cost of debt.

¹The linear demand curves are usually derived by maximizing quadratic utility u of a representative consumer under a budget constraint. In this framework, the product substitutability parameter, $\gamma = -\frac{\partial^2 u}{\partial x_1 \partial x_2} = -\frac{\partial^2 u}{\partial x_2 \partial x_1}$, is always symmetrical for the two products, regardless of the parameters of the consumer’s utility function.

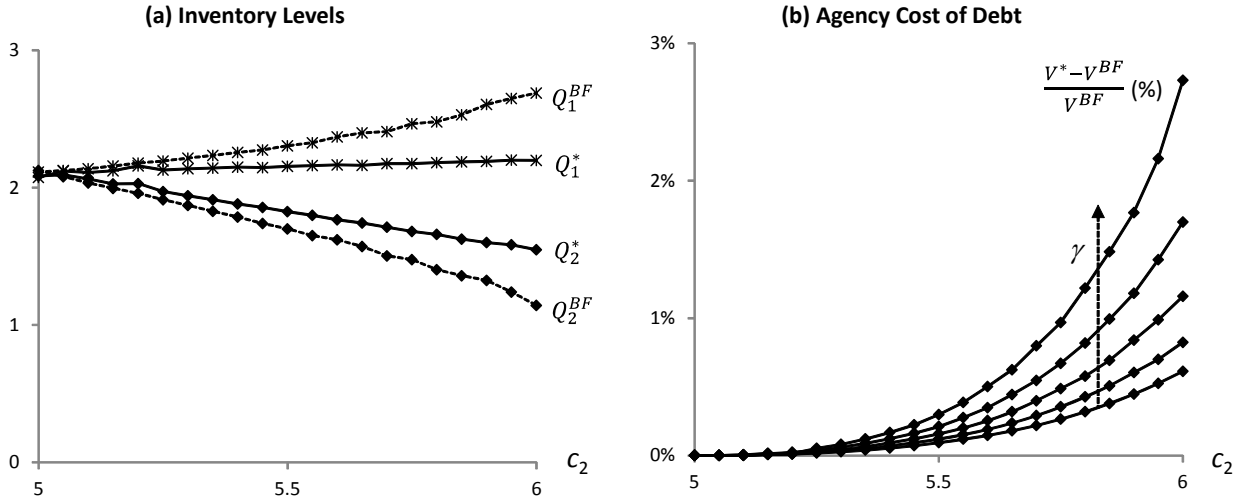


Figure 1: The effect of increasing unit cost c_2 on the inventory levels (a), and the relative agency cost of debt for $\gamma \in (0, 0.2)$ (b).

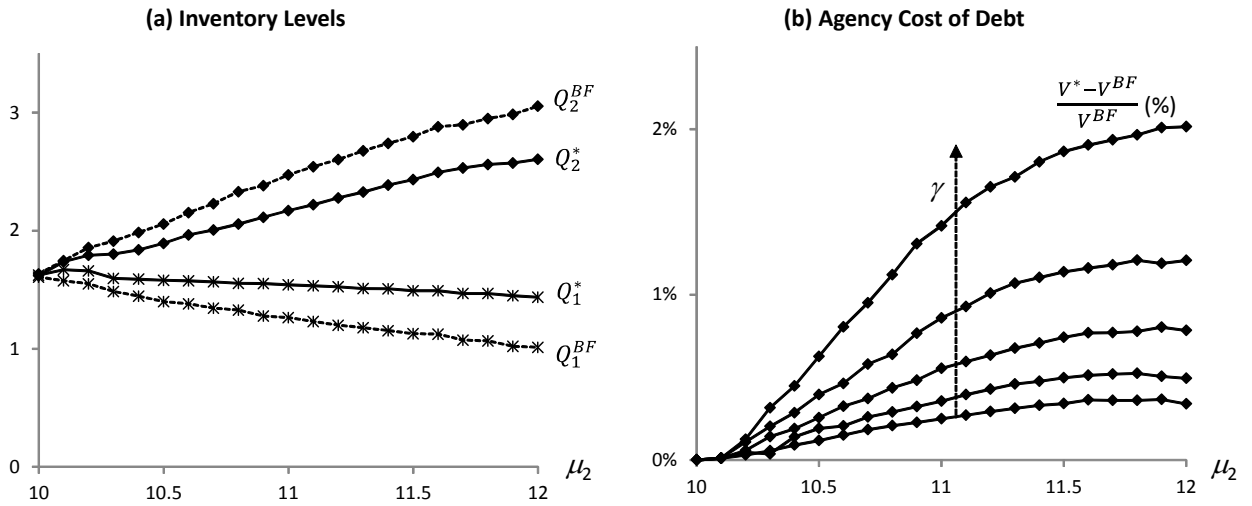


Figure 2: The effect of increasing mean demand shock μ_2 on the inventory levels (a), and the relative agency cost of debt for $\gamma \in (0, 0.2)$ (b), assuming $c_1 = c_2 = 6$.

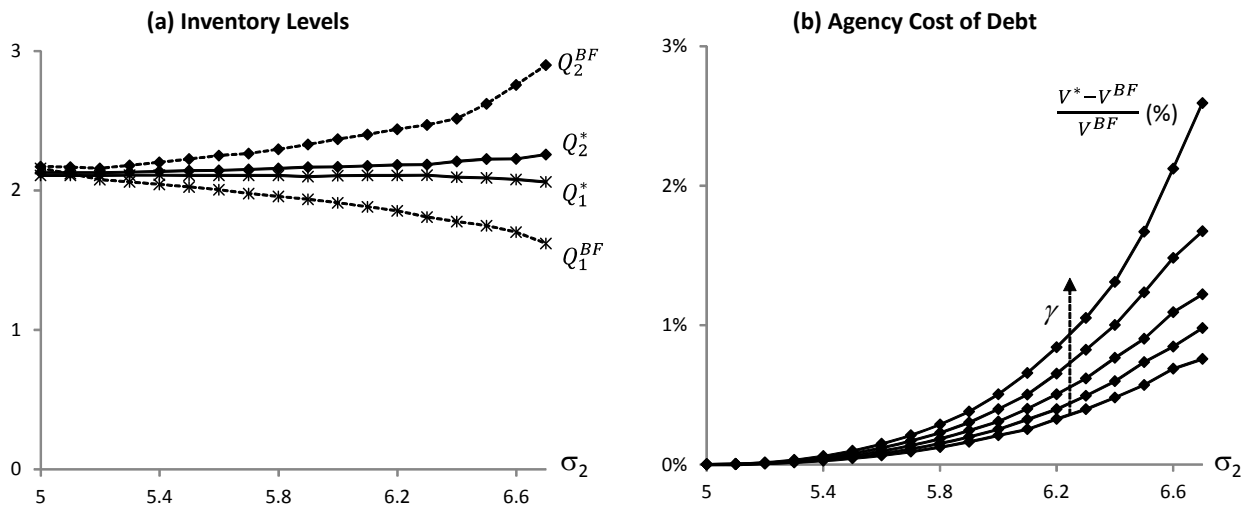


Figure 3: The effect of increasing demand shock volatility σ_2 on the inventory levels (a), and the relative agency cost of debt for $\gamma \in (0, 0.2)$ (b).