

Corporate Cash and Inventory Management: Implications for Measuring Market Power

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Abstract

In this paper I show that product market power is a crucial determinant of firms' cash and inventory policies. I start by providing empirical evidence of the importance of market power in affecting cash and inventory holdings. Using within-industry variation, I find that a one percentage-point drop in the industry's concentration ratio leads to an increase of 0.42 percentage points in the industry average cash-to-cash and inventory ratio. I then develop an industry equilibrium model to study the effects of market power on firms' cash and inventory decisions. In the model, individual firms are subject to idiosyncratic productivity shocks and need liquidity to finance their operation. Cash is liquid but earns a low and constant return. Inventory protects firms from uncertainty in product market and can be converted into cash whenever necessary, yet is subject to product market conditions. I show that inventory is particularly valuable for firms that have a high degree of control over prices. The presence of inventory however reduces the benefit of holding cash when firms manage their liquidity needs, as inventory is a reversible store of liquidity. As a result, firms with greater market power hold more inventory but less cash relative to firms having less market power. The calibrated model is able to replicate a number of empirical features. Lastly but most importantly, exploiting the model implication on the role of market power in shaping firms' cash and inventory policies, I use the structural model to infer the degree of market power for the manufacturing sector from its cash and inventory behavior.

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1 Introduction

Cash and inventory are two crucial components of a firm's assets. They account for 60% of total current asset and 33% of total assets for U.S. non-financial, non-utility publicly traded firms in 2009, with the both ratios staying roughly constant over the last four decades. Both cash and inventory can act as buffers against uncertainties. The former facilitates the daily operation of firms and hedges against adverse shocks, while the latter provides protection from uncertainty in product demand and is a reversible store of liquidity as it can be converted into cash when necessary. This paper analyzes cash and inventory within a unified framework to shed new light on corporate working capital and liquidity management.

Although empirical studies in corporate finance treat inventory as a substitute to cash by including working capital net of cash as an explanatory variable in cash regressions (see for example, Opler et al. (1999) and Bates et al. (2009)), almost nothing is known regarding the resource allocation choices between these two margins. This paper contributes to the literature by providing theoretical foundation and empirical support for the cash-inventory tradeoff.

In this paper I investigate how firms manage cash and inventory. I first show empirically that product market power is a critical determinant of the tradeoff. I then use a three-period model characterized by uncertainty and imperfect capital markets to rationalize the empirical observation and illustrate the main mechanism through which market power affects firms' cash and inventory decisions. More specifically, I set up a model in which a risk-neutral firm operates in a product market with some degree of market power (captured by the price elasticity of demand) and faces stochastic productivity shocks. The firm has an investment opportunity which can be financed through three channels: cash flows generated from selling inventory and newly-produced products, cash holdings, and external equity. The capital market is assumed to be imperfect and modelled by equity issuance costs. To avoid raising expensive external funds, the firm attempts to meet liquidity needs by saving cash and/or holding inventory. Cash earns a low and constant return, while inventory earns a return contingent on the future state of the world and firms' pricing power.

How do firms allocate resources between cash and inventory when they face the tradeoff described above? My model implies that the choice between these two margins depends largely on firms' market power. Firms with greater market power place more weight on inventory relative to cash. The intuition for the result is as follows. When firms face

relatively inelastic demand, that is, have greater market power, firms are able to charge a higher product price without losing customers, which in turn yields a higher expected return from holding inventory. Therefore firms facing less elastic demand allocate more resources in inventory than those with more elastic demand.

To analyze this tradeoff in a quantitative manner, I relax the restrictions imposed in the three-period model and extend it to a dynamic industrial equilibrium. The results of comparative statics confirm the crucial role of market power in affecting firms' cash and inventory management. Lastly but most importantly, using the model implication, I estimate the degree of market power (i.e., the price elasticity of demand) in the U.S. manufacturing sector by extracting information from its cash and inventory policies. The calibrated model successfully replicates a number of empirical regularities, which in turn strengthens the reliability of the estimate of market power.

This paper contributes to the literature in several ways. First, it studies working capital management by putting two of the most important components in firms' current assets — cash and inventory — within a unified framework and exploring the interaction between them. There is a rich literature focusing on the precautionary motive for corporate cash. It suggests that in the face of financing frictions and uncertainty, firms accumulate cash to fund future investments and/or to cover expenses. This paper incorporates another source of internal funds and examines how firms make choices between inventory and cash in the presence of costly external finance. Gao (2014) and Kulchania and Thomas (2014) also explore the negative correlation between cash and inventory. However, unlike those two studies, this paper proposes a complementary explanation that underlies the negative correlation and aims to explain cross-sectional differences rather than the time trend observed in the data.

Second, this paper helps to understand the effect of market power on corporate cash holdings both theoretically and empirically. Morellec et al. (2014) and Della Seta (2011) examine the effects of product market competition on cash and link the cash hoarding behavior to the increased market competition. My paper derives the same conclusion, but distinguishes itself from those two studies by presenting a different mechanism through which market competition shapes cash policy. The above papers suggest that market competition increases the option value of remaining active in the market and therefore firms hold cash to avoid inefficient closure. My model provides a more concrete story. Increased market competition limits firms' pricing ability and in turn reduces firms' profitability. This affects cash through two channels: first, it lowers cash flows and increases needs

for internal resources; second, it lowers the return on inventory and in turn makes cash more valuable when liquidity is needed. Hence, as the product market becomes more competitive, firms raise more cash. In addition, the identification strategy used in this paper is different from previous studies. To estimate the effect of market competition on cash holdings, Morellec et al. (2014) and Lyandres and Palazzo (2014) use intra-industry cross-firm variation, and Ma et al. (2013) use cross-industry variation. Differently, this paper uses within-industry over-time variation to identify the role of market power. Also, the above three studies construct market competition measures only with publicly-traded firms in Compustat, which ignores private firms operating in the same industries. This may provide misleading results. To address this concern, this paper uses market competition measures containing both publicly-traded firms as well as privately-held firms.

Lastly, this paper contributes to the industrial organization literature. The measurement of market power is central from both academic perspective and policy perspective. However, there is no clear consensus in the literature regarding the value of market power.¹ This paper provides a novel, simple and reliable framework to estimate it. Unlike previous studies that measure industry market power from markups, this paper infers it from firms' cash and inventory choices.

The remainder of the paper is structured as follows. Section 2 demonstrates the empirical importance of market power in influencing corporate cash and inventory policies. Section 3 presents a simple three-period model to highlight the main mechanism that underlies market power and the inventory-cash tradeoff. Section 4 describes an industrial equilibrium model and the estimation results are presented in Section 5. Section 6 concludes.

2 Empirical Evidence

In this section, I use industry fixed-effects and thus exploit within-industry variation over time to identify the effect of market power in one industry on firms' cash and inventory management.

¹For instance, Golosov and Lucas (2007) set the demand elasticity to be 7. Devereux and Siu (2007) select a value over 10. Nakamura and Steinsson (2010) set it equal to 4, whereas Midrigan (2011) chooses 3.

2.1 Methodology

The regression model is specified as follows:

$$\begin{aligned} \frac{\text{cash}}{\text{inventory} + \text{cash}}_{i,t} &= \alpha_0 + \alpha_1 \text{market power}_{i,t} + \alpha_2 \text{risk dispersion}_{i,t} + \alpha_3 \text{firm size}_{i,t} \\ &+ \alpha_4 \text{market to book}_{i,t} + \alpha_5 \text{cash flow}_{i,t} + \alpha'_6 X_{i,t} + \sum_i \text{industry}_i \\ &+ \sum_t \text{year}_t + \epsilon_{i,t}, \end{aligned} \tag{1}$$

where i refers to industry and t is time. For each industry i and period t , I calculate variables at the firm level and then take average across firms. Therefore, all variables are measured as their industry mean during period t , except for market power and intra-industry risk dispersion. The construction of the latter two will be explained below.

In this regression, dependent variable is the ratio of cash to the sum of cash and inventory holdings. This ratio reflects the relative use of cash versus inventory in liquidity management, as suggested in Sufi (2009) and Acharya et al. (2013). Industry-level market power is proxied by the concentration ratio in that particular industry. This variable is directly collected from the Census of Manufacturers reports provided by the U.S. Census Bureau. To measure the intra-industry risk dispersion, I first obtain the productivity shocks of each firm within industry i during period t by regressing the sales of each firm in that industry during that year on their capital stock and labor, and then compute the standard deviation of those shocks.

Other covariates include firm size, market-to-book ratio, capital investment, net working capital, leverage, R&D expenditures, a dividend dummy, and acquisition expenses. These variables are constructed in the same way as those used in other empirical cash studies. Appendix A provides a detailed description. I include industry dummy variables to remove industry specific effects and include year dummy variables to capture the common trend across industries.

2.2 Data and Summary Statistics

To measure industry-level market power, I collect the four-digit SIC industry concentration ratios for 1958, 1963, 1967, 1972, 1977, 1982, 1987 and 1992 reported by the U.S. Census Bureau. The concentration ratios that I use are the share of value of shipments accounted for by the four (CR_4), the eight (CR_8), the twenty (CR_{20}) and the fifty (CR_{50}) largest

firms in the industry.² Other variables are constructed from Compustat Fundamentals Annual files and winsorized following Bates et al. (2009). I focus on manufacturing firms and eliminate all industries with fewer than five firms in Compustat.

Table 1 shows summary statistics for the regressor variables at the industry level during the years when concentration ratio (CR_4) is available. I first calculate the mean of each variable (except for concentration ratios and intra-industry risk dispersion) for each industry during each period and then take average across periods. The mean and median of industry cash-to-cash and inventory ratios are 29% and 26% respectively. The industry concentration ratios are symmetrically distributed, with the mean close to its corresponding median. Other explanatory variables have similar characteristics to those in previous studies.

[Table 1 about here.]

2.3 Results

2.3.1 The Choice between Cash and Inventory

Table 2 present the estimates of regression model (1) with industry mean, which are identified from the variation within each industry over time. Columns (1)-(4) report the regression results for different measures of concentration ratio, controlling for a list of other explanatory variables as well as 4-digit SIC industry fixed effects and year fixed effects.

[Table 2 about here.]

The variable of particular interest is industry-level market power. The coefficient in Column (1) suggests that the cash-to-cash and inventory ratio declines with market power. A 10 percentage-point increase in the industry's 4-firm concentration ratio pushes the cash-to-cash and inventory ratio down by 3 percentage points. This result is statistically and economically significant. The results are robust to different measures of concentration ratio. The estimated coefficient on market power vary little across columns, moving between -0.31 and -0.42.

²In 1997, the U.S. Census Bureau adopted NAICS and started to publish industry concentration ratios using the new economic classification system. Although data were available for 1997, 2002 and 2007, I do not use that information to identify the effect of market power. Because it is almost impossible to accurately estimate industry fixed effects using three observations. I do not use Herfindahl index (HHI) to proxy market power for the same reason. Data on HHI were unavailable prior to 1982.

I consider several robustness checks. First, I estimate the regression equation (1) with industry median. Panel A in Table 3 reports the corresponding regression results. With industry median, the coefficient of market power is again negative and statistically significant in all cases, and the economic magnitude of the result is even stronger. Second, I change the requirement of the minimum number of firms operating in each industry from five to ten. The effect of market power remains. The results are reported in Panel B of Table 3. Lastly, I regress cash-to-asset ratio and inventory-to-asset ratio separately on market power. This helps to alleviate the concern that market power only significantly impacts one margin (cash or inventory) rather than both. The results shown in Panel C and D of Table 3 suggest that cash ratio decreases while inventory ratio increases with market power.

[Table 3 about here.]

In summary, Table 2 and 3 provide strong evidence in support of the effect of market power on the cash-inventory management. In next section, I present a simple three-period model to rationalize this observation and illustrate the mechanism through which market power affects firms' cash and inventory decisions.

3 A Simple Three-Period Model

3.1 Structure

The model has three periods, denoted by $t = 1, 2$ and 3 . At period 1 and 2, a firm is endowed with $w_1 = 1$ units and e^z units of good, respectively. The productivity shock z is unknown at period 1. It has a normal distribution with mean μ and variance σ^2 , $z \sim N(\mu, \sigma^2)$. At period 2, after the realization of z , the firm faces an investment opportunity that costs $I = 1$. This investment opportunity allows the firm to invest in a risk-free asset. That risk-free asset produces w_3 units of good at period 3. I assume that w_3 is so large that the firm chooses to invest at period 2 with probability 1. The good is divisible.

The firm pays I out of either internal or external funds or a combination of both. The firm has two instruments to transfer resources internally from period 1 to period 2. One is to save cash out of cash inflows. This option earns a gross rate of return $\hat{R} > 1$, which is lower than the gross risk-free rate. The alternative is to carry inventory forward. Inventory depreciates at the end of period 1 at a rate δ , $0 < \delta < 1$, and can be sold to generate cash

flows in period 2. If the firm has insufficient internal resources to finance the investment at period 2, it can borrow externally at rate λ by issuing equity.

The firm operates in a monopolistically competitive market and faces demand with the following specification:

$$q = p^{-\theta}.$$

Variable p denotes the price charged by the firm, while q is the quantity demanded. Product demand exhibits a constant price elasticity θ , $\theta > 1$.³ This parameter θ controls the degree of product substitutability and therefore reflects the degree of market power. The lower the price elasticity θ , the greater the degree of market power. To simplify the model, the firm is only allowed to set prices in period 1, given the endowment level w_1 . The unsold products are stored as inventory and carried forward to period 2. At period 2, I assume that all products must be sold. Therefore, the price at period 2 is no longer a choice variable, but a function of the beginning-of-period inventory holdings and the new endowment. At period 3, product price is exogenous and equal to 1.

3.2 Firm's Problem

At period 1, the firm allocates endowed resources into three choices, cash saving c_2 , inventory s_2 and dividend payment d_1 . Given the endowment w_1 , the firm makes its decision on how many units of good to sell, under a constraint on the quantity of products currently available for sale, w_1 . The unsold products are stored as inventory, s_2 . They depreciate and are transferred to period 2. The firm also decides how much to save as cash, c_2 , out of the cash flows.

$$d_1 = p_1 q_1 - c_2,$$

where

$$q_1 = \min\{w_1, p_1^{-\theta}\},$$

$$p_1 = q_1^{-\frac{1}{\theta}},$$

$$c_2 \geq 0,$$

$$s_2 = (1 - \delta)(w_1 - q_1) \geq 0.$$

At period 2, the firm has an opportunity to invest in a risk-free asset which costs I . If the firm does not have sufficient internal resources to cover the cost, that is, cash saving

³For an equilibrium to exist, the price elasticity of demand must be greater than one.

$\hat{R}c_2$ plus the realized cash flows p_2q_2 is less than I , the firm uses external borrowings. If the firm can afford the cost with the available internal resources, the remaining funds are distributed as dividend. The parameter \hat{R} denotes the effective rate of return on cash saving.

$$d_2 = (1 + \lambda\phi)[p_2q_2 + \hat{R}c_2 - I],$$

where

$$\begin{aligned} q_2 &= e^z + s_2, \\ p_2 &= q_2^{-\frac{1}{\theta}}, \\ \phi &= \begin{cases} 1 & \text{if } d_2 \leq 0, \\ 0 & \text{otherwise.} \end{cases} \end{aligned}$$

The first constraint corresponds to the assumption that all products must be sold at period 2. The quantity q_2 and the price p_2 therefore are determined by the shock realization z and the beginning-of-period inventory holdings s_2 . The indicator function ϕ equals to 1 if the firm needs to access to the capital market and borrow externally, and 0 otherwise.

In the last period, the dividend distributed is the cash flows generated by the investment, w_3 units of good valued at a price of 1:

$$d_3 = w_3.$$

The risk neutral firm's objective is to maximize the expected discounted value of future stream of dividends, by choosing optimal inventory holdings s_2 and cash saving c_2 . The firm's problem can be written as follows:

$$\max_{s_2 \geq 0, c_2 \geq 0} d_1 + \beta \mathbb{E}_1 d_2 + \beta^2 \mathbb{E}_1 d_3, \quad (2)$$

where the discount factor β equals to $\frac{1}{1+r}$, r is the risk-free rate, and dividends d_1 , d_2 and d_3 are specified as above.

3.3 Optimal Policy Rules

In this subsection, I characterize optimal decision rules for the firm's problem and develop the intuition behind them.

3.3.1 Cash

Solving the optimization problem (2) gives the optimal cash saving, which satisfies

$$1 = \hat{R}\beta + \lambda\hat{R}\beta\mathbb{E}\phi + \mu_1, \quad (3)$$

where

$$\phi = \begin{cases} 1 & \text{if } d_2 \leq 0, \\ 0 & \text{otherwise.} \end{cases}$$

The left-hand side of equation (3) represents the marginal cost of saving an extra unit of cash, that is, forgone dividend in period 1. The right-hand side of the equation is the marginal benefit of cash saving, the sum of discounted expected return (the first term) and discounted expected reduction in the cost of external borrowing (the second term). The last term of the right-hand side in equation (3) is the Lagrange multiplier of the nonnegativity constraint on cash and gives the shadow price of cash holdings.

3.3.2 Inventory

Next, I turn to the optimal inventory policy, or equivalently, the firm's pricing rule. The optimality condition is given by

$$\frac{\theta - 1}{\theta}q_1^{-\frac{1}{\theta}} = (1 - \delta)\beta\mathbb{E}\frac{\partial d_2}{\partial s_2} + \mu_2, \quad (4)$$

where parameter θ is price elasticity of demand. The left-hand side of equation (4) gives the marginal cost of carrying one additional unit of good forward to period 2, which is $\frac{\theta-1}{\theta}q_1^{-\frac{1}{\theta}}$ dollars of forgone revenue and in turn foregone dividends in period 1. The right-hand side shows the marginal benefit, which is the expected present marginal value of an additional unit of end-of-period inventory for period 2 after depreciation. The parameter μ_2 is the Lagrange multiplier of the nonnegativity constraint on inventory.

Substituting the demand function into equation (4), I can rewrite the optimal condition in a more familiar form. In the case of an interior solution, equation (4) becomes

$$p_1 = \frac{\theta}{(\theta - 1)}[(1 - \delta)\beta\mathbb{E}\frac{\partial d_2}{\partial s_2}]. \quad (5)$$

The above equation describes the optimal pricing rule of a monopolistically competitive firm. That is, the firm charges a constant markup over marginal cost. Here, the constant

markup is $\frac{\theta}{\theta-1}$. The marginal cost is the firm's marginal value of an additional unit of inventory, $(1-\delta)\beta\mathbb{E}\frac{\partial d_2}{\partial s_2}$.

Under the assumption that all products must be sold in period 2, equation (5) can be written as follows, which relates the price set at period 1 with the expected price that would be set at period 2,

$$\frac{\theta-1}{\theta}p_1 = (1-\delta)\beta\mathbb{E}\left\{\frac{\theta-1}{\theta}p_2\right\} + \lambda(1-\delta)\beta\mathbb{E}\left\{\phi\frac{\theta-1}{\theta}p_2\right\}. \quad (6)$$

According to equation (6), there are two motives for holding inventory in this model. The first is the stockout-avoidance motive, captured by the first term on the right-hand side of the equation. The firm makes the carrying decision based on the prospects for benefiting from a price increase between the current and next period. This might happen when the firm expects a large negative productivity shock which will drive up next period's product price and create an expectation of a gain from holding inventory. Conditional on this, the second motivation of holding inventory is to reduce borrowing costs, as indicated by the second term on the right-hand side of equation (6). Inventory is ready for sale to generate cash flows. As a source of funds, it can save expected borrowing costs, playing the same role as cash.

3.4 Choice between Cash and Inventory

As shown in the model, both cash and inventory can be sources of funds. To understand how the firm chooses between these two margins, holding cash or carrying inventory, I next take a closer inspection of Euler equations. The first order condition associated with inventory is,

$$\frac{\theta-1}{\theta}q_1^{-\frac{1}{\theta}} = (1-\delta)\beta\mathbb{E}\left\{\frac{\theta-1}{\theta}q_2^{-\frac{1}{\theta}}\right\} + \lambda(1-\delta)\beta\mathbb{E}\left\{\phi\frac{\theta-1}{\theta}q_2^{-\frac{1}{\theta}}\right\} + \mu_2.$$

Consider first the limit case in which elasticity of demand is unity, $\theta = 1$. Then the expression becomes

$$0 \cdot q_1^{-1} = (1-\delta)\beta\mathbb{E}\{0 \cdot q_2^{-1}\} + \lambda(1-\delta)\beta\mathbb{E}\{\phi \cdot 0 \cdot q_2^{-1}\} + \mu_2.$$

As the unit-elastic demand implies that total revenue is irresponsive to changes in price, the marginal cost of carrying one more unit of inventory forward to next period is always zero. On the other hand, because of the shadow price of inventory, the marginal benefit of

holding one more unit of inventory is greater or equal to its marginal cost. Therefore, in this extreme case of unit-elastic demand, firms hold a positive level of inventory. Besides, the value of holding cash in this case is zero. This result follows from the positive-infinity markup and hence zero probability of being financially constrained.

An increase in the price elasticity of demand has impacts on the return of holding inventory. Consider another extreme case in which firms face perfectly elastic demand, $\theta \rightarrow \infty$. The first order condition of inventory becomes

$$1 \cdot q_1^0 = (1 - \delta)\beta\mathbb{E}\{1 \cdot q_2^0\} + \lambda(1 - \delta)\beta\mathbb{E}\{\phi \cdot 1 \cdot q_2^0\} + \mu_2 = (1 - \delta)\beta\mathbb{E}\{1 + \phi\lambda\} + \mu_2. \quad (7)$$

In this case, firms are price takers, and market price is constant across periods. Therefore the expected gain from price changes is zero. Firms hold inventory only when the benefit from the expected reduction in the borrowing costs dominates the losses from depreciation. Relative to inventory, cash is more valuable in this case, as can be seen from the optimal condition for cash,

$$1 = \beta\hat{R}\mathbb{E}(1 + \phi\lambda) + \mu_1. \quad (8)$$

Given the same marginal cost of holding cash and inventory, the additional dollar of cash saving is valued at the rate of $\hat{R}\mathbb{E}(1 + \phi\lambda)$ which is greater than the return on inventory, $(1 - \delta)\mathbb{E}(1 + \phi\lambda)$. As a result, in the case of perfectly elastic demand, cash is preferred to inventory as an instrument for managing liquidity.

The above discussion of two limit cases provides a flavor that firms' cash and inventory decisions depends on market power, i.e. price elasticity of demand. The intuition is that, the degree of market power largely affects firms' profitability as well as the return on inventory. When the elasticity of demand is relatively low, firms are able to set a high price over cost and more importantly, to transfer products across time without lowering future prices significantly. Therefore they have high gross margins and a high return on holding inventory. In the presence of inventory, the value of cash drops, as firms can sell inventory to meet liquidity needs. As demand becomes more responsive to prices, both the profit and the prospect of gaining from holding inventory drop. Firms then start raising cash to preserve financial flexibility.

3.5 Comparative Statics

Figure 1 provides a graphical description of the impacts of market power (θ), inventory carrying costs (δ), the effective return on cash holdings (\hat{R}), and the mean of productivity shock (μ) on the tradeoff between cash and inventory.

[Figure 1 about here.]

Illustrated in the upper left panel of Figure 1, an increase in θ leads the firm to re-allocate resources from inventory to cash. As θ increases, the demand function becomes flatter, and the degree of responsiveness in demand quantity with respect to price rises. The firm therefore has lower pricing power and is more likely to experience a cash flow shortfall. To avoid raising expensive external funds, the firm needs to hold more liquid assets. Considering the firm has a lower degree of control over price, holding inventory becomes less desirable, so the firm holds less inventory and more cash.

A rise in the effective rate of return on cash, \hat{R} , drives up the value of cash saving in each state of the world. The firm therefore shifts resources from inventory to cash, as shown in the upper right panel. Similarly, a higher inventory carrying cost δ makes it more expensive to hold inventory. As a result, the firm chooses to transfer less inventory and more cash over periods to meet future liquidity needs.

The lower right panel of Figure 1 illustrates the effect of the expected future supply (captured by the mean productivity shock μ) on the cash and inventory decisions. The larger the mean value of productivity shocks, the higher a cash flow is expected to arrive in the future, and also less likely the firm will need to borrow externally next period. Accordingly, the firm has a weaker incentive to accumulate liquid assets and reduces both inventory and cash. In addition, an increase in the mean value of future relative supply drives down the expected price increase and in turn the value of inventory. The firm thus reduces inventory holdings even further.

All of these results remain as I replace the productivity shock with a demand shock in the model. Results are available upon request.

4 A Dynamic Model of Industry Equilibrium

This section relaxes the restrictions imposed in the three-period model and analyzes the interactions between industry market power and firms' cash and inventory decisions in an

industry equilibrium, but keeps the main mechanism. In addition, exploiting the model implications, I estimate the degree of market power using the information on corporate cash and inventory holdings.

Time is discrete and infinite. Within an industry, there is a finite number of firms who produce differentiated goods, indexed by i . Firms face a downward-sloping demand and subject to financial frictions and idiosyncratic productivity shocks. Each period, after productivity shocks are realized, firms set product prices, produce goods and make financial and dividend payout decisions.

I first specify the demand for each firm's product, its production technology and financing options, and then describe firm's problem and industry equilibrium.

4.1 Demand and Technology

A monopolistically competitive firm i faces demand with the following specification,

$$y_i^d = \left(\frac{p_i}{P}\right)^{-\theta} Q, \quad (9)$$

where $P = [\int_0^1 p_i^{1-\theta} di]^{\frac{1}{1-\theta}}$ and $Q = [\int_0^1 y_i^{\frac{\theta-1}{\theta}} di]^{\frac{\theta}{\theta-1}}$. Here θ denotes the elasticity of substitution between differentiated goods, p_i denotes the price charged by the firm i , P and Q are the industry price and quantity level, and y_i^d is the quantity demanded for good i . This demand curve can be derived from the optimal choices of households. They consume a composite consumption good which is a Dixit-Stiglitz index of differentiated goods in the industry.

The firm faces uncertainty from productivity and its output at current period is given by

$$y_i = e^{z_i}, \quad (10)$$

where productivity shock z follows an $AR(1)$ process with persistency ρ and innovation ε . The innovation ε has a normal distribution with mean 0 and variance σ^2 , $\varepsilon \sim N(0, \sigma^2)$.

4.2 Inventory

Product is storable and let s_i denote the stock of inventory at the beginning of each period for firm i . The sales of the firm, q_i , are constrained to not exceed goods available for sale, that is, goods produced at the beginning of this period plus inventory transferred from

previous period,

$$q_i = \min\{e^{z_i} + s_i, (\frac{p_i}{P})^{-\theta} Q\}. \quad (11)$$

Unsold products are held as inventory and depreciate. The end of period inventory holdings are therefore given by:

$$s'_i = (1 - \delta)(e^{z_i} + s_i - q_i), \quad (12)$$

where δ is inventory depreciation rate, a reduced form parameter capturing inventory carrying costs.

4.3 Financing

Firms need to pay fixed operating costs in advance of production. They can get financing through four different sources: cash flow generated by selling inventories, internal cash balance, intra-period debt, and/or equity issuance.

Inventory can be sold at the price that firms set at the beginning of each period. The generated cash flow then can be used to fund their operation. Cash balance, c , earns a zero rate of return. That is, the cost of holding cash is the risk-free interest rate.

In addition to internal resources, firms can finance externally. They can raise funds with an intra-period debt b , but are subject to a borrowing constraint, $b < \kappa$. They repay a risk-free interest rate r on their borrowing at the end of each period. Firms can also opt to issue equity. Following Hennessy and Whited (2007), I denote $e < 0$ as equity issuance and $e > 0$ as dividend payment. The equity issuance cost is proportional to the amount issued at a rate of λ . I assume that equity financing is more expensive than debt financing, $\lambda > r$. Therefore, debt is preferred to equity as the pecking order theory suggests.

4.4 Firm's Problem

4.4.1 Timing

The timeline of the model is illustrated below. At the beginning of period t , after observing the shock z_t , the firm sets a price p_t on its product and needs to pay fixed costs f in advance of production. The firm can draw down its inventory holdings but is subject to a demand constraint, $q_{1,t} = \min\{s_t, (\frac{p_t}{P_t})^{-\frac{1}{\theta}} Q_t\}$, its cash reserves c_t and/or raise an intra-period debt under a borrowing constraint, $b_t \leq \kappa$. If these internal and external funds are

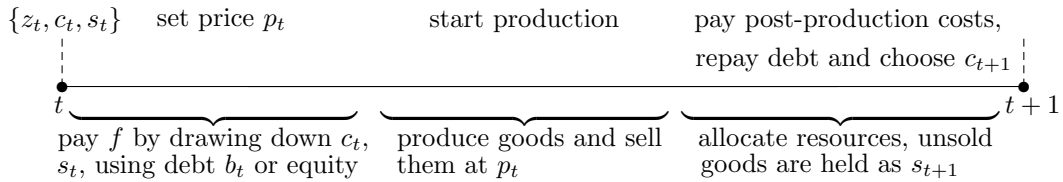
still insufficient to cover the fixed operating costs, the firm issues equity and pays issuance costs. Otherwise, the unused funds will be used to pay post-production expenses. The net cash flow before production therefore is given by:

$$g(e_{1,t}) = \phi_{e_{1,t}}(1 + \phi_{e_{1,t}}\lambda)e_{1,t},$$

where

$$e_{1,t} = p_t q_{1,t} + c_t + b_t - f.$$

The indicator function $\phi_{e_{1,t}}$ equals one if the firm issues equity before production, and zero otherwise.



After paying the fixed operating costs, the firm starts producing and sells its products at price p_t which is set at the beginning of the period, but again is subject to a demand constraint, $q_{2,t} = \min\{e^{z_t}, (\frac{p_t}{P_t})^{-\frac{1}{\theta}} Q_t - q_{1,t}\}$. Unsold products are held as inventory s_{t+1} and transferred to period $t+1$.

In addition to the fixed operating costs, the firm needs to pay post-production costs associated with marketing and advertising. Those costs are proportional to current-period total sales, $\gamma p_t(q_{1,t} + q_{2,t})$. Besides, the firm needs to repay debt and makes decisions on cash saving. If resources available are insufficient to cover post-production costs, pay off debt and meet cash saving demand, the firm again issues equity; otherwise, it distributes dividends. The post-production net cash flow is

$$g(e_{2,t}) = (1 + \phi_{e_{2,t}}\lambda)e_{2,t},$$

where

$$e_{2,t} = p_t q_{2,t} + \phi_{e_{1,t}}e_{1,t} - \gamma p_t(q_{1,t} + q_{2,t}) - (1 + r)b_t - c_{t+1}.$$

The indicator function $\phi_{e_{2,t}}$ equals one if the firm issues equity after production, and zero otherwise.

4.4.2 Set-up

The risk neutral firm maximizes the equity value of the firm by choosing product price p_t , intra-period debt b_t and cash holdings c_{t+1} :

$$\max_{p_t, b_t, c_{t+1}} \mathbb{E} \sum_{t=0}^{\infty} \beta^t \{g(e_{1,t}) + g(e_{2,t})\},$$

subject to

$$c_{t+1} \geq 0$$

$$b_t \leq \kappa$$

$$s_{t+1} = (1 - \delta)(e^{z_t} + s_t - q_{1,t} - q_{2,t}) \geq 0,$$

at all dates $t \geq 0$, where the discount factor β equals $\frac{1}{1+r}$.

The problem can be summarized by a Bellman equation. Let $V(z, c, s)$ denote the firm's value as a function of productivity shock, cash stock and inventory holdings. Then the firm's problem is

$$V(z, c, s) = \max_{p, b, c'} \{g(e_1) + g(e_2) + \beta \mathbb{E}V(z', c', s')\}$$

subject to constraints, $b \leq \kappa$, $c' \geq 0$ and $s' \geq 0$. Here prime denotes a variable in the subsequent period.

4.5 Industry Equilibrium

The focus of this paper is a stationary industry equilibrium.

Definition 1 *A stationary industry equilibrium is a stationary distribution μ , a price P , a quantity Q and policy functions $p(z, c, s; P, Q)$, $b(z, c, s; P, Q)$, and $c'(z, c, s; P, Q)$ such that:*

- (i) *Policy functions solve the firm's problem given industry price P and quantity Q ;*
- (ii) *The distribution μ is invariant over time;*
- (iii) *The product market clears.*

5 Quantitative Results

To examine the quantitative effects of market power on firms' cash and inventory management, I calibrate the industry equilibrium model presented above and show comparative statics results. I then take the model to the data and estimate model parameters with a particular interest in the elasticity of substitution θ . The latter exercise helps to shed light on the degree of industry market power, which is one of the main goals of this paper.

5.1 Calibration

The time period t in the model corresponds to one year, that is, firms set product prices once a year. Accordingly, I set the risk-free interest rate r to be 4%, implying the discount factor $\beta = 0.96$.

To calibrate the idiosyncratic productivity shock processes governed by the persistence ρ and volatility σ , I construct a sample of manufacturing firms (SIC 2000-4000) covering the period from 1950 to 2009 from Compustat and use it to estimate the following regression model:

$$\log Y_{i,t} = \alpha_0 + \sum_i firm_i + \sum_t year_t + \epsilon_{i,t}, \quad (13)$$

where $Y_{i,t}$ denotes the sales of firm i in year t , and the error term $\epsilon_{i,t}$ is the empirical counterpart of the productivity shock $z_{i,t}$ in the model. Firm fixed effects and time fixed effects are also included to control for firm specific time-invariant characteristics and common macroeconomic shocks across firms, respectively. I then collect the estimated residuals from regression model (13) to calibrate ρ and σ . The persistence ρ is obtained directly by estimating the following regression

$$\hat{\epsilon}_{i,t} = \rho \hat{\epsilon}_{i,t-1} + \varepsilon_{i,t},$$

which gives $\rho = 0.73$. I then compute the standard deviation/dispersion of the estimated residuals $\hat{\epsilon}_{i,t}$ for each year and average it across time. This calculated average gives the volatility of the idiosyncratic productivity shock, $\sigma = 0.38$.

I calibrate the linear post-production costs γ to match the median selling, general and administrative expense (SG&A) to sales ratio. Considering the fact that the expense measure includes salaries of non-sales personnel, I set γ to be 0.2, 75% of the median expense-to-sales ratio.

[Table 4 about here.]

Table 4 presents the parameters used to solve the model. Panel A summarizes the parameters discussed above, which are directly calibrated from data. The remaining parameters, reported in Panel B, are estimated by matching moments and discussed in subsection 5.3.

5.2 Comparative Statics

In this subsection, I investigate how firms' cash, inventory and debt decisions respond to changes in several key parameters that are not predetermined: price elasticity of demand θ , linear equity issuance costs λ , inventory depreciation rate δ and borrowing limit κ . These parameters take the values of equally spaced points in the following intervals respectively: $\theta \in [2, 12]$, $\lambda \in [0.05, 0.20]$, $\delta \in [0, 0.10]$, and $\kappa \in [0.01, 0.20]$. I change one parameter at a time, holding all other parameters at the values close to those in Table 4.

Figure 2 plots the comparative statics results. The panels on the left column show the sensitivity of industry mean of three variables of interest (cash-to-sales, inventory-to-sales and debt-to-sales ratios) with respect to each parameter, while the panels on the right present the sensitivity of industry median of each variable.

[Figure 2 about here.]

The effect of market power θ , shown in the top two panels, echoes the comparative statics analysis in section 3.5. As industry market power declines, industry average cash-to-sales ratio rises, while inventory-to-sales ratio drops. Besides, the debt-to-sales ratio slightly and gradually increases with market power. This result comes from the drop in firms' markup and thus price and sales. The industry median exhibits very similar patterns but at different levels.

The second row present the responses of variables to the linear equity issuance cost λ . Overall, cash-to-sales ratio decreases with λ . At the first glance, this result seems surprising. It contradicts the common implication of previous cash models.⁴ The possible reason for this difference is that an increase in λ in my model reflects the disadvantage of equity finance relative to debt finance. Therefore, as λ increases, firms rely more heavily on debt finance. The increased usage of debt in turn makes cash less valuable in liquidity

⁴See, for instance, Riddick and Whited (2009).

management. The inventory-to-sales ratio does not respond to the changes in λ . Its industry mean and industry median stay around 5% and 3%, respectively.

The sensitivity of variables with respect to the inventory depreciation rate δ is depicted in the third row. Evidently, the effects of δ on cash and inventory are pretty similar to the effects of θ , yet with two noticeable distinctions. First, all variables of interest are more sensitive to changes in δ than changes in θ when both parameters take values close to their upper end of the interval, implied by the slope of curves at those points. Second, the industry mean of inventory-to-sales ratio drops to a value close to zero as δ rises above 6%, while the ratio remains positive for all the values that θ usually takes in the literature.

The bottom two panels show the effects of borrowing limit κ . As κ rises, firms' borrowing constraint is gradually relaxed. This leads to an increase use in risk-free debt and simultaneous reductions in cash and inventory in both industry mean and median.

5.3 Results

In the previous subsection, I showed that market power θ plays a crucial role in shaping firms' cash and inventory policies. Exploiting this model implication and using the moment-matching approach, I in this subsection infer the degree of market power from firms' cash and inventory behavior.

More specifically, I construct data moments using Compustat manufacturing sector from 1950 to 2009 and winsorize all variables at the bottom and top 1% level. The targeted moments include the industry mean and median of cash-to-sales ratio, inventory-to-sales ratio, debt-to-sales ratio and cash-to-cash and inventory ratio.⁵ I then use these selected data moments to calibrate the market power parameter θ , linear equity issuance cost λ , inventory depreciation rate δ , borrowing limit ϵ and fixed operating costs f .

The calibrated parameters are reported in Panel B of Table 4. Particular attention is paid to the estimate of θ . In the literature regarding the value of market power, the estimates range from below 3 to over 10.⁶ Using this model and extracting information contained in firms' cash and inventory choices, I find that the market power for the U.S. manufacturing sector is 4.278, which falls within the lower end of the estimates suggested

⁵The theoretical setup focuses on output inventory. Accordingly, here I use finished-good inventory to construct inventory-related moments.

⁶See, for example, Berry et al. (1995) report an average markup of 0.239 which implies a demand elasticity of 5.2, while Nevo (2001) finds the median markup for single product firms to be 0.358 and thus a demand elasticity of 3.8. Broda and Weinstein (2006), using trade data, suggest that the average elasticity is 13.1 among five-digit goods and the median is 2.7. Burstein and Hellwig (2007) find a demand elasticity of 4.4.

by the literature.

The value of linear equity issuance cost λ is in line with the range established in previous studies. Hennessy and Whited (2007) estimate a value close to 0.09. Nikolov and Whited (2014) use a model of agency conflicts and find it approximately within the range [0.13, 0.18]. The estimated inventory depreciation rate δ is however below the value used in Alessandria et al. (2010).

[Table 5 about here.]

Panel A of Table 5 present the eight targeted moments. Overall, the data are well matched. The model generated moments are close to the data moments in most cases, except for industry median cash-to-sales ratio and industry median inventory-to-sales ratio. The latter two model moments overshoot their empirical counterparts, 12.9% versus 6.3% and 12.9% versus 5.5%.

To further evaluate the model performance and validate the model, I examine a number of non-targeted moments including the overall distributions of cash-to-sales ratio, inventory-to-sales ratio, debt-to-sales ratio and cash to cash and inventory ratio. The results are reported in Panel B of Table 5. Evidently, the model-implied distributions of the variables of interest resemble the data quite well. The exceptions are the 10th and 25th percentiles of cash to cash and inventory ratio. Relative to the data, the model implies a thinner left tail. The reason for this result is that this model generates a slightly thinner left tail and a slightly fatter left tail of the cash-to-sales and inventory-to-sales distributions. These two minor discrepancies exacerbate the problem when I analyze the cash-to-cash and inventory ratio.

On the whole, the model is able to reproduce the key features of the data. This in turn strengthen the reliability and validity of the estimate of market power.

6 Conclusion

While previous studies have focused on cash holdings, I in this paper consider another important component of firms' current assets: inventory. I analyze the tradeoff firms face when choosing between cash and inventory as their buffer against future liquidity shortage.

I start by showing that industries with higher market power tend to accumulate more inventory but less cash, after controlling for other determinants. I rationalize this finding by using a simple three-period model that assumes uncertain productivity shocks and

imperfect capital markets, In the model, the degree of market power largely affects firms profitability as well as the return on inventory. Firms facing relatively inelastic demand have greater pricing power. They are able to set a high price over cost and to transfer products across time without lowering future prices significantly. Therefore, they find themselves more likely to benefit from carrying inventory than saving cash.

I then extend the three-period model to a dynamic industry equilibrium and take the model to the data. Using the model implication on the role of market power on firms' cash and inventory choices, I infer the degree of market power for the manufacturing sector from its cash and inventory behavior. The estimated value falls within the lower end of the range suggested in the literature. Lastly, I show that the calibrated model behaves consistently with the data.

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Appendix

A. Variable Definitions

I define variables used in the cash-to-cash and inventory regression as follows:

Cash-to-cash and inventory is defined as the ratio of cash over the sum of cash and inventory holdings, where cash is measured as cash, cash equivalents and short-term investments;

Concentration ratio- n is the share of value of shipments accounted for by n largest firms in the industry;

Risk dispersion is the standard deviation of idiosyncratic productivity shock within one industry;

Firm size is the natural logarithm of total assets;

Risk is computed as the standard deviation of annual operating cash flow in the past five years, with operating cash flow defined as earnings after interest, dividends and tax but before depreciation divided by total assets;

Market-to-book ratio is the sum of market value and debt over total assets;

Net working capital is equal to working capital net of cash and inventory over total assets;

Capital investment is the ratio of capital expenditure over total assets;

Leverage is the sum of long-term debt and debt in current liabilities normalized by total assets;

R&D investment is research and development expenses to total asset ratio;

Dividend is a dummy variable taking value of one if dividend payout (common) is non-zero;

Acquisition is the ratio of acquisition over total assets.

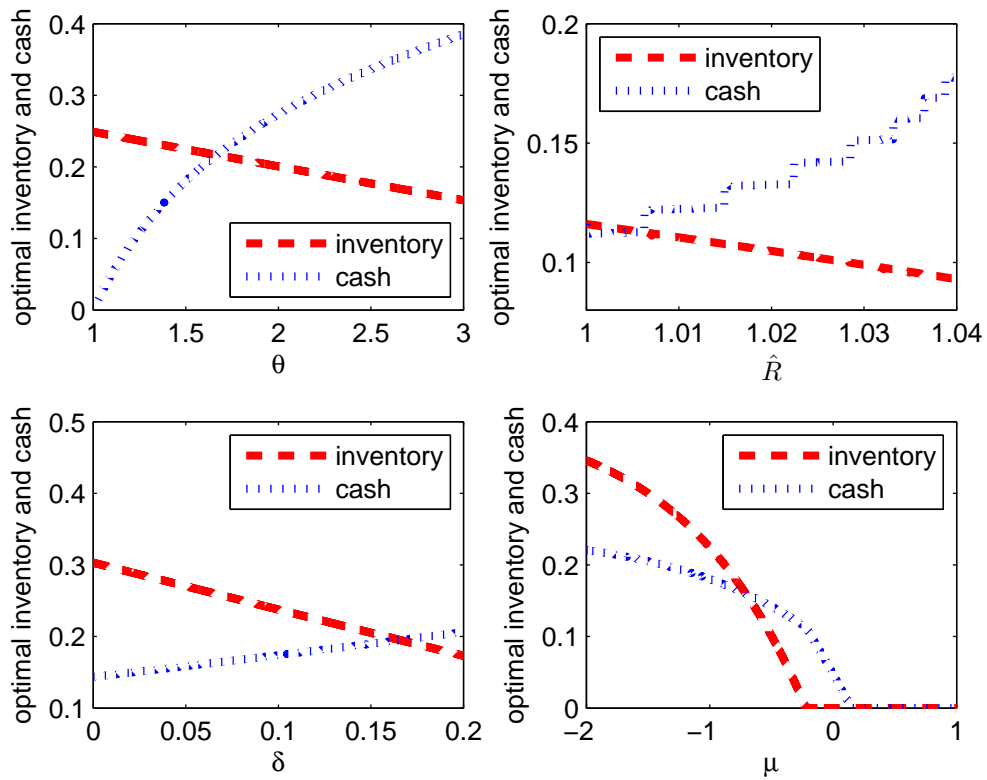


Figure 1: **Comparative Statics of a Simple Three-period Model.** This figure illustrates the impacts of product market environment θ (the top left panel), the effective return on cash \hat{R} (the top right panel), inventory carrying costs δ (the bottom left panel) and the expected future productivity μ (the bottom right panel) on the optimal cash and inventory holdings.

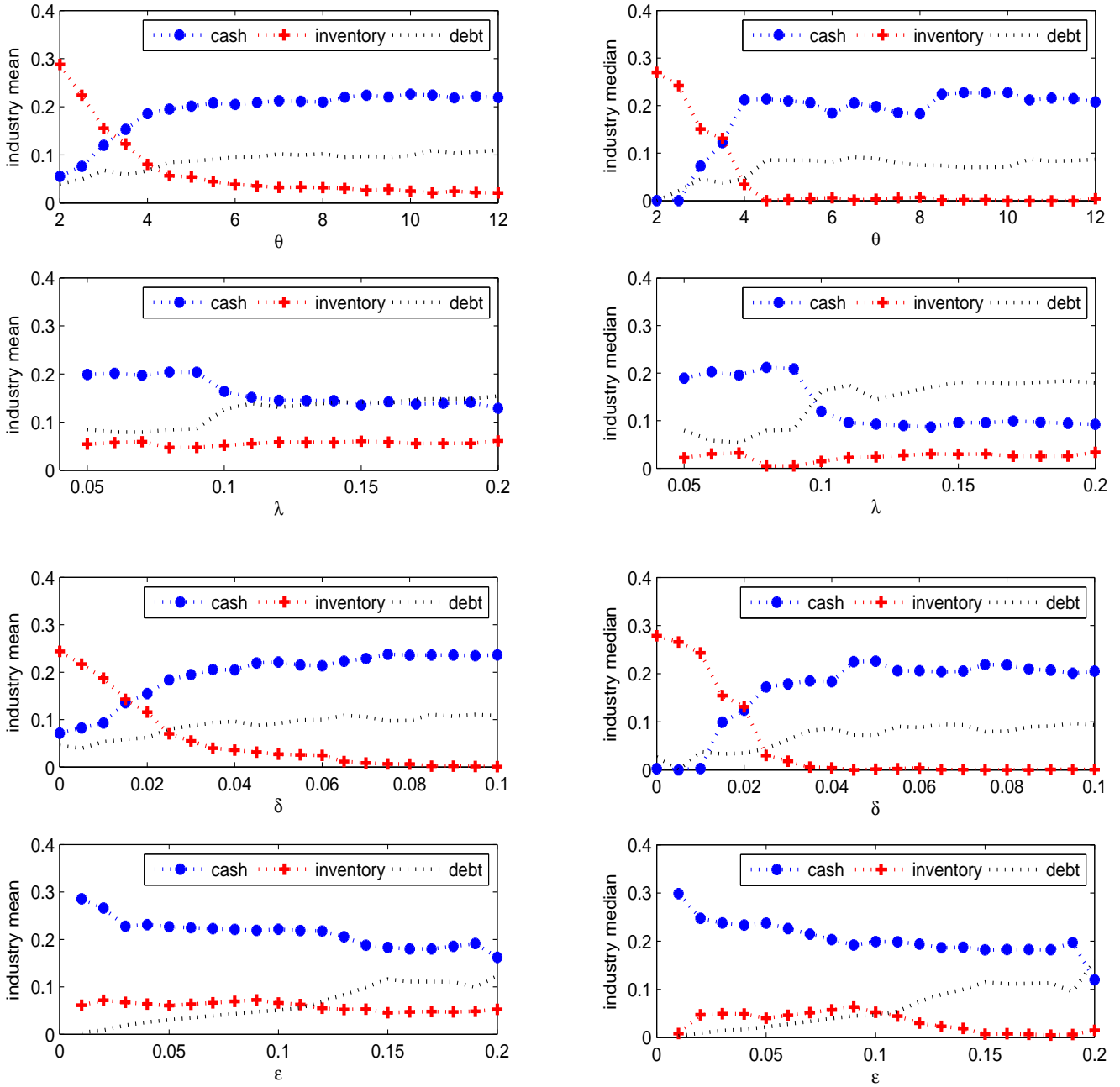


Figure 2: **Comparative Statics of the Dynamic Industry Equilibrium Model.** This figure plots the effects of market power (θ), linear equity issuance cost (λ), inventory depreciation rate (δ) and borrowing limit (κ) on (i) the cash-to-sales ratio, (ii) the inventory-to-sales ratio, and (iii) the debt-to-sales ratio.

Table 1: **Summary Statistics: Industry Level**

Table 1 presents descriptive statistics for the industry mean of each variable used in the regression equation (1). It reports the mean, median, standard deviation, 25th and 75th percentile, and number of observations. The sample is constructed from Compustat Annual files and the Census of Manufacturers for 1958, 1963, 1967, 1972, 1977, 1982, 1987 and 1992. A detailed definition of variables is provided in Appendix A.

Variables	Mean	Median	Std. Dev.	25%	75%	Obs.
Concentration-4	0.36	0.34	0.17	0.24	0.45	421
Concentration-8	0.49	0.49	0.19	0.37	0.61	420
Concentration-20	0.66	0.68	0.18	0.54	0.79	378
Concentration-50	0.81	0.84	0.16	0.71	0.94	378
Risk dispersion	0.36	0.30	0.24	0.21	0.45	421
Cash-to-(Cash+Inventory)	0.29	0.26	0.14	0.19	0.36	421
Size	3.85	3.74	1.20	3.00	4.54	421
Within-firm risk	0.05	0.03	0.05	0.02	0.06	420
Market-to-Book	1.40	1.09	0.86	0.84	1.64	420
Cash flow	0.00	0.04	0.11	-0.01	0.07	421
Net working capital	0.08	0.11	0.16	0.03	0.17	420
Capital investment	0.06	0.06	0.03	0.04	0.08	421
Leverage	0.27	0.27	0.08	0.22	0.31	421
R&D	0.05	0.03	0.05	0.01	0.06	404
Dividend dummy	0.48	0.50	0.27	0.27	0.71	421
Acquisition	0.01	0.01	0.01	0.00	0.01	378

Table 2: **The Choice between Cash and Inventory: Baseline**

Table 2 reports the results of regressions of cash-to-cash and inventory ratio on concentration ratio, risk dispersion, size, risk and other commonly-included control variables. Industry and year fixed effects are included in the regressions and the heteroskedasticity-consistent standard errors reported in parenthesis. Significance levels are indicated by *, **, and *** for 10%, 5%, and 1%, respectively.

Variables	Variable: Cash-to-(Cash+Inventory)			
	(1) CR_4	(2) CR_8	(3) CR_{20}	(4) CR_{50}
Market power	-0.30*** (0.09)	-0.31*** (0.10)	-0.32*** (0.10)	-0.42*** (0.10)
Risk dispersion	0.07** (0.03)	0.07*** (0.03)	0.07*** (0.03)	0.08*** (0.03)
Size	-0.03*** (0.01)	-0.03** (0.01)	-0.03** (0.01)	-0.03** (0.01)
Within-firm risk	-0.00 (0.15)	-0.01 (0.15)	0.01 (0.15)	0.00 (0.14)
Market-to-Book	0.02*** (0.01)	0.02*** (0.01)	0.02*** (0.01)	0.02*** (0.01)
Cash flow	-0.12 (0.08)	-0.12 (0.08)	-0.10 (0.08)	-0.08 (0.09)
Net working capital	-0.00 (0.05)	0.00 (0.05)	0.01 (0.05)	0.00 (0.05)
Capital investment	-0.32 (0.25)	-0.34 (0.25)	-0.34 (0.25)	-0.37 (0.25)
Leverage	-0.45*** (0.07)	-0.44*** (0.08)	-0.44*** (0.08)	-0.43*** (0.08)
R&D	0.01 (0.18)	-0.01 (0.18)	-0.02 (0.18)	0.01 (0.18)
Dividend	0.07 (0.04)	0.07 (0.04)	0.06 (0.04)	0.06 (0.04)
Acquisition	-0.24 (0.40)	-0.18 (0.40)	-0.16 (0.41)	-0.22 (0.41)
Industry FE (4-digit)	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	362	362	362	362
R-squared	0.85	0.85	0.85	0.85

Table 3: **The Choice between Cash and Inventory: Robustness**

Table 3 reports several robustness checks to the main result presented in Table 2. Panel A summarizes the results when regression model (1) is estimated using industry median variables. Panel B considers a sample of industries with over 10 firms. Panel C estimates the impact of market power on cash-to-asset ratio, while Panel D shows the results on inventory. Other control variables, industry fixed effects and year fixed effects are included in all regression models. The heteroskedasticity-consistent standard errors reported in parenthesis. Significance levels are indicated by *, **, and *** for 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
Panel A: Industry Median				
Variables	CR_4	CR_8	CR_{20}	CR_{50}
Market power	-0.41***	-0.42***	-0.42***	-0.54***
	(0.11)	(0.11)	(0.13)	(0.15)
X	Yes	Yes	Yes	Yes
Industry FE (4-digit)	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	362	362	362	362
R-squared	0.83	0.83	0.83	0.83
Panel B: Industries with At Least 10 Firms				
Variables	CR_4	CR_8	CR_{20}	CR_{50}
Market power	-0.28***	-0.27***	-0.29***	-0.29***
	(0.10)	(0.11)	(0.11)	(0.11)
X	Yes	Yes	Yes	Yes
Industry FE (4-digit)	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	202	202	202	202
R-squared	0.92	0.92	0.92	0.92
Panel C: Cash-to-Asset				
Variables	CR_4	CR_8	CR_{20}	CR_{50}
Market power	-0.12***	-0.12***	-0.13***	-0.15***
	(0.04)	(0.04)	(0.05)	(0.06)
X	Yes	Yes	Yes	Yes
Industry FE (4-digit)	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	363	363	363	363
R-squared	0.85	0.85	0.85	0.85
Panel D: Inventory-to-Asset				
Variables	CR_4	CR_8	CR_{20}	CR_{50}
Market power	0.09**	0.07*	0.08**	0.12***
	(0.04)	(0.04)	(0.04)	(0.05)
X	Yes	Yes	Yes	Yes
Industry FE (4-digit)	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	363	363	363	363
R-squared	0.90	0.90	0.90	0.90

Table 4: **Model Parameterizations**

Table 4 summarizes the parameters used to solve the model at annual frequency. Panel A reports the parameters estimated separately by one-to-one matching. Panel B presents the calibration results by taking parameters in Panel A as given and matching eight selected data moments jointly.

Panel A: Parameters Calibrated Separately	
risk-free rate (r)	0.04
persistence of idiosyncratic shock (ρ)	0.73
standard deviation of idiosyncratic shock (σ)	0.38
linear post-production cost (γ)	0.20
Panel B: Parameters Calibrated Jointly	
elasticity of demand (θ)	4.289
linear costs of equity issuance (λ)	0.106
inventory depreciation rate (δ)	0.027
borrowing limit (κ)	0.197
fixed operating costs (f)	0.298

Table 5: **Model Moments**

Table 5 reports both data moments and simulated moments. The data moments are calculated based on a sample of manufacturing firms over the period from 1950 to 2009. Panel A shows the moments used for joint calibration. Panel B presents non-targeted moments for cash-to-sales ratio, inventory-to-sales ratio, short-term debt-to-sales ratio and relative use of cash.

Moments	data	model
Panel A: Targeted Moments		
average cash to sales (c_t/y_t)	0.169	0.157
average inventory to sales (s_t/y_t)	0.073	0.097
average short-term borrowing to sales (d_t/y_t)	0.088	0.080
average relative use of cash ($c_t/(c_t + s_t)$)	0.540	0.524
median cash to sales (c_t/y_t)	0.063	0.129
median inventory to sales (s_t/y_t)	0.055	0.129
median short-term borrowing to sales (d_t/y_t)	0.024	0.031
median relative use of cash ($c_t/(c_t + s_t)$)	0.550	0.500
Panel B: Non-Targeted Moments		
(i) distribution of cash to sales (c_t/y_t)		
10-percentile	0.010	0.000
25-percentile	0.022	0.015
75-percentile	0.166	0.202
90-percentile	0.278	0.431
(ii) distribution of inventory to sales (s_t/y_t)		
10-percentile	0.000	0.001
25-percentile	0.022	0.026
75-percentile	0.098	0.150
90-percentile	0.158	0.155
(iii) distribution of short-term debt to sales (d_t/y_t)		
10-percentile	0.00	0.00
25-percentile	0.003	0.009
75-percentile	0.077	0.100
90-percentile	0.171	0.197
(iv) distribution of cash to cash and inventory ($c_t/(c_t + s_t)$)		
10-percentile	0.074	0.00
25-percentile	0.207	0.065
75-percentile	0.874	0.881
90-percentile	1.00	1.00