Online Appendix to "Dynamic Collusion, Vertical Competition, and Discount Rate Shocks"

Guoman She, K.C. John Wei, Haifeng You

A Model Setup and Predictions

We develop a simple partial-equilibrium model to provide theoretical rationale for our empirical analyses. To capture the interactions between the upstream, focal, and downstream industries, our partial equilibrium model consists of three industries. A focal industry purchases raw materials from the upstream industry (i.e., suppliers) and sells intermediate goods to the downstream industry (i.e., customers). The downstream industry uses intermediate goods to produce the consumption goods for consumers.

The relations between the vertically related industries are illustrated in Figure A1, where D_t denotes the downstream industry's demand for the focal industry's composite good and $D_{i,t}$ denotes the downstream industry's demand for each firm i's good.[1] Firm i has a linear production technology that uses one unit of the good produced by the upstream industry as an input to produce one unit of the good, where ω_t denotes the price of goods produced by the upstream industry, which is also the marginal cost of production for firm i.

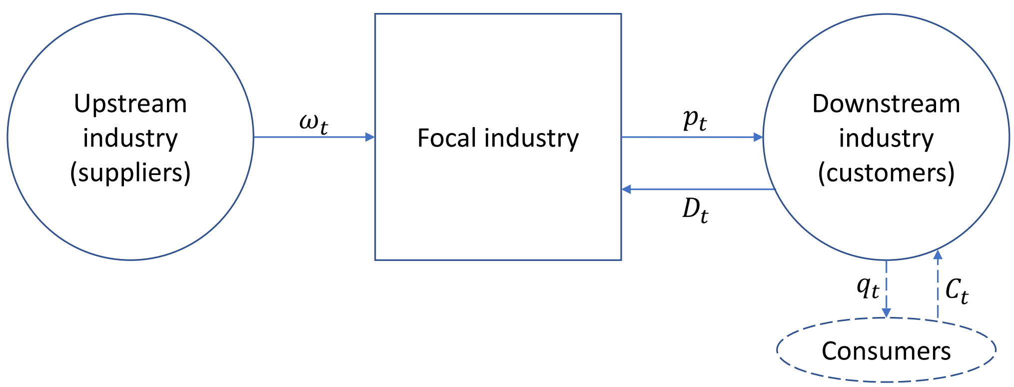

Figure A1: An illustration of the model setup.

[1]For analytical tractability, we exogenously specify the industry-level demand curve and take the SDF as exogenously given, following the modeling approach adopted in industry-equilibruim asset-pricing models (e.g., Chen et al., 2024).

A.1 Focal Industry

Time is continuous and runs from 0 to T. The assumption of finite horizon $[0, T]$ is made for tractability, following Pástor and Veronesi (2012, 2013). The focal industry consists of a continuum of firms of unit measure, with each firm i being atomistic and producing a differentiated good. Thus, the focal industry features monopolistic competition. As discussed above, D_t denotes the downstream industry's demand for the focal industry's composite good and $D_{i,t}$ denotes the downstream industry's demand for each firm i's good. The relation between $D_{i,t}$ and D_t is captured by the standard constant elasticity of substitution (CES) aggregator:

$$D_t = \left(\int_0^1 D_{i,t}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}, \tag{A1}$$

where $\eta > 1$ captures the elasticity of substitution among the differentiated goods produced by the focal industry. Given D_t, solving a standard expenditure minimization problem yields:

$$D_{i,t} = D_t \left(\frac{p_{i,t}}{p_t} \right)^{-\eta}, \text{with } \; p_t = \left(\int_0^1 p_{i,t}^{1-\eta} di \right)^{\frac{1}{1-\eta}}, \tag{A2}$$

where $p_{i,t}$ is the price of firm i's good and p_t is the focal industry's price index. Without loss of generality, we normalize $p_t \equiv 1$ so that the focal industry's composite good is the numeraire.

Firm i has a linear production technology that uses one unit of the good produced by the upstream industry as an input to produce one unit of the good. Let ω_t denote the price of goods produced by the upstream industry, which is also the marginal cost of production for firm i. Thus, the operating profit of firm i over $[t, t + dt)$ is

$$d\Pi_{i,t} = (p_{i,t} - \omega_t) D_{i,t} dt + \sigma dZ_t, \tag{A3}$$

where Z_t is a standard Brownian motion, capturing aggregate cash-flow shocks. The parameter σ captures the firm's exposure to this shock. Substituting (A2) into (A3), it follows that profit maximization requires firm i to charge a constant markup over its marginal cost,

$$p_{i,t} = \frac{\eta}{\eta - 1}\omega_t. \tag{A4}$$

Firm i is financed wholly by equity and has assets $B_{i,t}$ at t. To obtain closed-form solutions, we follow Pástor and Veronesi (2012, 2013) and assume that firms do not pay out their profits. Thus, the firm's assets, $B_{i,t}$, evolve according to

$$dB_{i,t} = B_{i,t} d\Pi_{i,t}. \tag{A5}$$

All net worth is sold at unit price at T.

A.2 Macroeconomic Environment

Before presenting the upstream and downstream industries, we first specify the macroeconomic environment in our model.

For tractability, we exogenously specify the stochastic discount factor (SDF). Let $\gamma_t > 0$ denote the market price of risk for the aggregate cash-flow shock Z_t. We assume that γ_t is a constant $\overline{\gamma}$ for $t \in [0, \tau)$, with $\tau < T$. At $t = \tau$, the macroeconomic condition changes. With probability λ_H, the economy enters a recession for $t \in [\tau, T]$, and γ_t increases to γ_H, with $\gamma_H > \overline{\gamma}$; with probability $\lambda_L = 1 - \lambda_H$, the economy enters a boom for $t \in [\tau, T]$, and γ_t decreases to γ_L, with $\gamma_L < \overline{\gamma}$. This assumption is consistent with the empirical evidence on the countercyclical market price of risk.

We consider a one-time positive shock to γ_t at $t = \tau$ for tractability.[2] This shock can be interpreted as *the aggregate discount rate shock*, which could be driven by time-varying risk aversion, as in Campbell and Cochrane (1999). Because the market price of risk γ_t determines the risk premium, in the remainder of this section, we name γ_t using a more intuitive term, *the aggregate discount rate*. Our focus on aggregate discount rate shocks as primitive shocks driving the intensity of industry competition follows the literature (Opp et al., 2014).

The economy's SDF, denoted by Λ_t, is specified as follows:

$$\frac{d\Lambda_t}{\Lambda_t} = \begin{cases} -r_f dt - \overline{\gamma} dZ_t, & \text{for } t < \tau, \\ -r_f dt - \gamma dZ_t + \kappa(\gamma), & \text{for } t \geq \tau, \end{cases} \tag{A6}$$

where $\gamma = \gamma_L, \gamma_H$, depending on the realized aggregate discount rate shock at $t = \tau$. The parameter r_f is the risk-free rate and $\kappa(\gamma)$ captures the relative jump size of the SDF when the macroeconomic condition changes (e.g., Bolton et al., 2013). We assume that $\kappa(\gamma_L) < 0$ and $\kappa(\gamma_H) > 0$ following Opp et al. (2014), meaning that a rise in the aggregate discount rate, which occurs during a recession, leads to a higher SDF. To ensure that the price of risk-free bonds times SDF is a martingale, we assume that $\kappa(\gamma)$ satisfies $\lambda_L e^{\kappa(\gamma_L)} + \lambda_H e^{\kappa(\gamma_H)} = 1$. Thus $\lambda_L^Q \equiv \lambda_L e^{\kappa(\gamma_L)}$ and $\lambda_H^Q \equiv \lambda_H e^{\kappa(\gamma_H)}$ essentially capture the probability of entering a boom or a recession under the risk-neutral measure, respectively. Our assumption ensures that $\lambda_L^Q < \lambda_L$ and $\lambda_H^Q > \lambda_H$. Relative to the physical measure, it is as if risk-averse investors think a boom is less likely than a recession under the risk-neutral measure.

[2] Technically, the stochastic process of γ_t belongs to the class of piecewise-deterministic Markov Process (Davis, 1984). This process differs from the Poisson process in two main aspects: 1) the jump occurs at a deterministic point in time; and 2) as the length of time interval approaches zero, the probability of the jump does not shrink to zero. Pástor and Veronesi (2012, 2013) adopt a similar process to model government policy changes at a deterministic point in time.

A.3 Upstream and Downstream Industries

As illustrated in Figure A1, the upstream industry sells raw materials to firms in the focal industry at price ω_t. The downstream industry purchases an amount D_t of the industry's composite good from the focal industry at p_t.[3] This composite good is used as the intermediate good to produce the final good, which is sold to consumers at price q_t.

For simplicity, we directly specify an isoelastic consumer demand for the consumption goods produced by the downstream industry, following Caballero and Pindyck (1996):

$$C_t = \phi_t q_t^{-\epsilon}, \tag{A7}$$

where ϕ_t captures the aggregate demand from consumers.[4] Let $\phi_t \equiv \phi(\gamma_t)$. We make the following assumption regarding $\phi(\gamma_t)$:

Assumption A1. $\phi(\gamma_H) \leq \phi(\overline{\gamma}) \leq \phi(\gamma_L)$.

Our assumption indicates that aggregate demand is low (high) in a recession (boom). The parameter ϵ captures consumers' price elasticity of demand. The downstream industry has access to a linear technology that uses one unit of the intermediate good to produce one unit of the final good. Thus, in equilibrium, the downstream industry's demand for the focal industry's composite good, D_t, must equal to consumers' demand for the downstream industry's outputs, C_t,

$$D_t = C_t. \tag{A8}$$

[3]This is equivalent to purchasing an amount $D_{i,t}$ of each differentiated good at price $p_{i,t}$ from firms in the focal industry and bundle them into the industry composite good using the CES aggregator (A1).

[4]Our model is a partial equilibrium model focusing on three industries, not a general equilibrium model that describes the whole economy. Thus, we directly specify an exogenous SDF in (A.6), rather than endogenously derive it based on an aggregate consumption process, which is not specified in the model. The variable C_t captures consumers' industry-level demand for a particular downstream industry, not the aggregate demand.

Because both the upstream and downstream industries have oligopolistic competition, their product prices, ω_t and q_t, are determined by market leaders' strategic dynamic competition in a Nash equilibrium, which depends on industry characteristics, macroeconomic conditions, etc. Endogenizing the two equilibrium prices requires setting up a game-theoretic framework with rich micro foundations, which goes beyond the illustrative purpose of our simple model. Because our aim is to clarify the theoretical rationale behind our empirical tests, we directly specify a reduced-form relationship between product prices, industry concentration, and discount rates, following the key implications of the mechanism proposed by Opp et al. (2014) and Dou et al. (2021).

In particular, let h^u and h^d denote the concentration of the upstream and downstream industries, respectively. The two prices depend on the aggregate discount rate and the concentration of upstream and downstream industries, respectively, namely, $\omega_t \equiv \omega(\gamma_t, h^u)$ and $q_t \equiv q(\gamma_t, h^d)$.

Assumption A2. *$\omega(\gamma_H, h^u) \leq \omega(\overline{\gamma}, h^u) \leq \omega(\gamma_L, h^u)$ and $q(\gamma_H, h^d) \leq q(\overline{\gamma}, h^d) \leq q(\gamma_L, h^d)$ for all h^u and h^d.*

Assumption A2 indicates that the prices of outputs produced by both the upstream and downstream industries are lower when the aggregate discount rate is higher. This assumption directly follows the theoretical predictions of Opp et al. (2014) and Dou et al. (2021) that a higher discount rate reduces firms' capacity to collude, resulting in lower product prices in the subgame perfect equilibrium of dynamic games. Intuitively, firms collude to achieve higher long-term cash flows. When the aggregate discount rate is higher, firms effectively become more impatient and focus more on short-term cash flows, thereby having larger incentives to deviate from implicit collusion, which reduces the capacity to collude. This intuition generally follows the folk theorem (e.g., Fudenberg and Maskin, 1986) that players can achieve higher average payoffs when they become more patient. The aggregate discount rate γ is an important factor that determines firms' patience.

Because the one-time aggregate discount rate shock occurs at $t = \tau$, we focus on the exposure of ω_t and q_t to γ_t at $t = \tau$. Define

$$\Psi_\omega(\gamma, h^u) = \frac{1}{\gamma - \overline{\gamma}} \left[\frac{\omega(\gamma, h^u)}{\omega(\overline{\gamma}, h^u)} - 1 \right] \quad \text{and} \quad \Psi_q(\gamma, h^d) = \frac{1}{\gamma - \overline{\gamma}} \left[\frac{q(\gamma, h^d)}{q(\overline{\gamma}, h^d)} - 1 \right], \tag{A9}$$

where $\gamma = \gamma_L, \gamma_H$. Equation (A9) captures the loadings of ω_t and q_t on the aggregate discount rate shock at $t = \tau$, respectively. Thus, Assumption A2 implies that prices have negative loadings on the aggregate discount rate; i.e., $\Psi_\omega(\gamma, h^u) < 0$ *and* $\Psi_q(\gamma, h^d) < 0$ for $\gamma = \gamma_L, \gamma_H$. As our focus is on the focal industry's aggregate risk exposure (to discount rate shocks) when the concentration of downstream and upstream industries varies, we further postulate that both loadings have positive sensitivity to industry concentration.

Assumption A3. $\frac{\partial}{\partial h^u} \Psi_\omega(\gamma, h^u) \geq 0$ *and* $\frac{\partial}{\partial h^d} \Psi_q(\gamma, h^d) \geq 0$ *for* $\gamma = \gamma_L, \gamma_H$.

Assumption A3 indicates that, in more concentrated industries, prices decline less in response to a higher aggregate discount rate. Theoretical support for the assumption can be found in Opp et al. (2014) and Dou et al. (2021). Opp et al. (2014) develop a model featuring homogeneous firms within industries, where industry concentration is inversely related to the number of firms. Opp et al. (2014, Figure 2) show that, as the number of firms increases, firms' profits and markups decline more significantly when the economy moves from booms (with a low aggregate discount rate) to recessions (with a high aggregate discount rate). Dou et al. (2021) construct a duopolistic model with heterogeneous firms. In their model, industry concentration is captured by the relative market share of the two firms: the industry becomes more competitive when the market shares of the two firms are more similar. Dou et al. (2021, Figure 3) show that, as the two firms have more similar market shares, the magnitude of the profit margin change in response to a higher discount rate increases.

A.4 Profitability of the Focal Industry

Consider firm i in the focal industry. Using equations (A2), (A4), (A7), and (A8), the firm's conditional expected operating profits over $[t, t+dt)$ can be derived from (A3):

$$\mathbb{E}_t\left[d\Pi_{i,t}\right] = (p_{i,t} - \omega_t)D_{i,t}dt = A\phi_t\omega_t^{1-\eta}q_t^{-\epsilon}dt, \tag{A10}$$

where $A = (\eta/(\eta-1))^{-\eta}/(\eta-1) > 0$ is a constant. The focal industry's profitability over $[t, t+dt)$ is

$$\Theta_t = \frac{\int_0^1 (p_{i,t} - \omega_t)D_{i,t}di}{\int_0^1 B_{i,t}di} = \frac{A\phi_t\omega_t^{1-\eta}q_t^{-\epsilon}}{B_t}. \tag{A11}$$

The industry's profitability captures the economic gain from an industry's assets, $B_t \equiv \int_0^1 B_{i,t}di$. The exposure of Θ_t to the aggregate discount rate shock at $t = \tau$:

$$\begin{aligned}\Psi_\Theta(\gamma, h^u, h^d) =& \frac{1}{\gamma - \overline{\gamma}}\left[\frac{\Theta_\tau(\gamma, h^u, h^d)}{\Theta_\tau(\overline{\gamma}, h^u, h^d)} - 1\right] \\ =& \frac{1}{\gamma - \overline{\gamma}}\left[\underbrace{\frac{\phi(\gamma)}{\phi(\overline{\gamma})}}_{\text{Agg. demand}} \underbrace{\left[\frac{\omega(\gamma, h^u)}{\omega(\overline{\gamma}, h^u)}\right]^{1-\eta}}_{\text{upstream}} \underbrace{\left[\frac{q(\gamma, h^d)}{q(\overline{\gamma}, h^d)}\right]^{-\epsilon}}_{\text{downstream}} -1\right],\end{aligned} \tag{A12}$$

where $\gamma = \gamma_L, \gamma_H$. In equation (A12), the exposure of Θ_t to γ_t depends on three terms. To illustrate the intuitions, let us focus on the case with $\gamma = \gamma_H$, indicating that the economy enters a recession for $[\tau, T]$. The intuitions for $\gamma = \gamma_L$ are similar. The first term, $\phi(\gamma_H)/\phi(\overline{\gamma}) \leq 1$, captures the direct negative exposure of aggregate demand to the discount rate. That is, aggregate demand declines in a recession with γ_H. The second term, $[\omega(\gamma_H, h^u)/\omega(\overline{\gamma}, h^u)]^{1-\eta} = [1 + (\gamma_H - \overline{\gamma})\Psi_\omega(\gamma_H, h^u)]^{1-\eta} \geq 1$, captures a hedging effect from the upstream industry, according to Assumption A2. Intuitively, the procyclical prices ω_t of raw materials produced by the focal industry imply procyclical marginal costs of production for the focal industry. Because profitability relates negatively to marginal costs, the movement in ω_t provides a hedging effect that reduces the focal industry's exposure to the aggregate discount rate. The third term, $\left[q(\gamma_H, h^d)/q(\overline{\gamma}, h^d)\right]^{-\epsilon} = \left[1 + (\gamma_H - \overline{\gamma})\Psi_q(\gamma_H, h^d)\right]^{-\epsilon} \geq 1$, captures a hedging effect from the downstream industry, according to Assumption A2. Intuitively, the procyclical prices q_t generate procyclical consumer demand for the final good. This, in turn, generates procyclical demand for the focal industry's outputs, which are used as intermediate goods to produce the final good. This consequently provides a hedging effect that increases the sales and profitability of the focal industry in a recession (i.e., when the aggregate discount rate is high).[5]

In the empirically relevant case, the aggregate demand channel (i.e., $\phi(\gamma_H)/\phi(\overline{\gamma}) \leq 1$) in equation (A12) should dominate the upstream (i.e., $[\omega(\gamma_H, h^u)/\omega(\overline{\gamma}, h^u)]^{1-\eta} \geq 1$) and downstream (i.e., $\left[q(\gamma_H, h^d)/q(\overline{\gamma}, h^d)\right]^{-\epsilon} \geq 1$) channels. Thus profitability has a negative exposure to the aggregate discount rate; i.e., $\Psi_\Theta(\gamma_H, h^u, h^d) < 0$. As a result, the focal industry's profitability declines (increases) during a recession (boom).

[5]We do not incorporate network effects in our model for the sake of tractability. In Gofman et al. (2020), a positive productivity shock to an upstream industry will provide a hedging effect to a downstream industry by reducing the replacement cost of capital for downstream industries, but this hedging effect decays at rate α along the supply change. Therefore, in Gofman et al. (2020), more downstream industries are more exposed to the hedging effects because they are affected from all upstream industries. Following their insight, it could still be true that more downstream industries should be affected by the concentration of all upstream industries in our model. However, fully extending the model to incorporate network effects is beyond the scope of this paper and left for future research.

Further, according to Assumption A3, when the upstream (downstream) industry is more concentrated, the price ω_t (q_t) becomes less negatively exposed to the aggregate discount rate γ. Thus, when the upstream (downstream) industry becomes more concentrated, the hedging effect from the upstream (downstream) weakens, making the focal industry more negatively exposed to the aggregate discount rate. We summarize the above results in Proposition 1. The proof is in Online Appendix B.1.

Proposition 1. *The focal industry's profitability Θ_t is negatively exposed to the aggregate discount rate shock at τ; i.e.,*

$$\Psi_\Theta(\gamma, h^u, h^d) < 0 \ \textit{for all} \ \ h^u, h^d \ \ \textit{and} \ \ \gamma = \gamma_L, \gamma_H.$$

The exposure becomes more negative when h^u or h^d increases; i.e.,

$$\frac{\partial}{\partial h^u}\Psi_\Theta(\gamma, h^u, h^d) < 0 \ \textit{and} \ \frac{\partial}{\partial h^d}\Psi_\Theta(\gamma, h^u, h^d) < 0 \ \textit{for all} \ \ h^u, h^d \ \ \textit{and} \ \ \gamma = \gamma_L, \gamma_H.$$

The focal industry's sales over $[t, t+dt)$ is

$$S_t = \int_0^1 p_{j,t} D_{j,t} jt = \eta A \phi_t \omega_t^{1-\eta} q_t^{-\epsilon} dt. \tag{A13}$$

Thus sales and profitability are related by $S_t = \eta \Theta_t B_t$. Because B_t is a stock variable, the model's prediction for the profitability's exposure to γ_t in Proposition 1 carries over to the sales's exposure.

A.5 Equity Returns of the Focal Industry

We now turn to the analysis of industry returns. Let $V_{i,t} \equiv V_{i,t}(\gamma, h^u, h^d)$ denote the value of firm i in the focal industry at t. The focal industry's value is given by $V_t \equiv V_t(\gamma, h^u, h^d) = \int_0^1 V_{i,t} di$. Because the focal industry does not pay dividends until T, its equity return is due to the change in industry value. The exposure of the focal industry's industry equity returns to the aggregate discount rate shock at $t = \tau$ is

$$\Psi_V(\gamma, h^u, h^d) = \frac{1}{\gamma - \overline{\gamma}} \left[\frac{V_\tau(\gamma, h^u, h^d)}{V_{\tau^-}(\overline{\gamma}, h^u, h^d)} - 1 \right]. \tag{A14}$$

Where V_{τ^-} is the focal industry's value at $t = \tau^-$, before the realization of γ. Because industry profitability Θ_t determines industry value V_t, it is expected that the exposure of V_t to γ_t to have similar properties as the exposure of Θ_t to γ_t at $t = \tau$. We summarize it in Proposition 2. The proof is in Online Appendix B.2.

Proposition 2. *The focal industry's equity return is negatively exposed to the aggregate discount rate shock at τ; i.e.,*

$$\Psi_V(\gamma, h^u, h^d) < 0 \ \textit{ for all } \ h^u, h^d.$$

The exposure becomes more negative when h^u or h^d increases; i.e.,

$$\frac{\partial}{\partial h^u} \Psi_V(\gamma, h^u, h^d) < 0 \ \textit{ and } \ \frac{\partial}{\partial h^d} \Psi_V(\gamma, h^u, h^d) < 0 \ \textit{ for all } \ h^u, h^d \ \textit{ and } \ \gamma = \gamma_L, \gamma_H.$$

The focal industry's expected equity return of over $[0, T]$ is defined by

$$e^{r(h^u, h^d)T} = \mathbb{E}_0 \left[\frac{V_T(\gamma, h^u, h^d)}{V_0(\overline{\gamma}, h^u, h^d)} \right], \tag{A15}$$

where $r(h^u, h^d)$ is the continuously compounded expected industry return. The risk premium of the focal industry is $r(h^u, h^d) - r_f$. We characterize how the risk premium depends on upstream/downstream concentration in Proposition 3. The proof is in Online Appendix B.3.

Proposition 3. *The focal industry's risk premium is positive; i.e.,*

$$r(h^u, h^d) - r_f > 0$$

The risk premium is increasing in h^u and h^d, i.e.,

$$\frac{\partial}{\partial h^u} r(h^u, h^d) > 0 \ \textit{and} \ \frac{\partial}{\partial h^d} r(h^u, h^d) > 0 \ \textit{for all} \ \ h^u, h^d.$$

Intuitively, the positive risk premium is attributed to two channels. First, the focal industry is negatively exposed to the aggregate discount rate shock, which carries a negative market price of risk. Second, the focal industry's cash flows are positively exposed to the aggregate cash-flow shocks Z_t, which carries a positive market price of risk. The positive relationship between risk premium and upstream/downstream concentration is purely attributed to the first channel, as indicated by Proposition 2.

B Proofs

B.1 Proof of Proposition 1

As discussed for equation (A12) in Online Appendix A.4, in the empirically relevant case, the aggregate demand channel (i.e., $\phi(\gamma_H)/\phi(\overline{\gamma}) \leq 1$) should dominate the upstream (i.e., $[\omega(\gamma_H, h^u)/\omega(\overline{\gamma}, h^u)]^{1-\eta} \geq 1$) and downstream (i.e., $\left[q(\gamma_H, h^d)/q(\overline{\gamma}, h^d)\right]^{-\epsilon} \geq$ 1) channels. Thus, we have $\Psi_\Theta(\gamma_H, h^u, h^d) < 0$, indicating that the focal industry's profitability declines (increases) during a recession (boom).

Rewrite equation (A12) as follows:

$$\Psi_{\Theta}(\gamma, h^u, h^d) = \frac{1}{\gamma - \overline{\gamma}} \left[\frac{\phi(\gamma)}{\phi(\overline{\gamma})} [1 + (\gamma - \overline{\gamma})\Psi_{\omega}(\gamma, h^u)]^{1-\eta} [1 + (\gamma - \overline{\gamma})\Psi_{q}(\gamma, h^d)]^{-\epsilon} - 1 \right]. \tag{A16}$$

Holding h^d unchanged, when h^u increases, $\Psi_{\omega}(\gamma, h^u)$ increases according to Assumption A3. Thus, the term $\frac{1}{\gamma - \overline{\gamma}}[1 + (\gamma - \overline{\gamma})\Psi_{\omega}(\gamma, h^u)]^{1-\eta}$ in equation (A16) decreases, for $\gamma = \gamma_L, \gamma_H$. This implies $\frac{\partial}{\partial h^u}\Psi_{\Theta}(\gamma, h^u, h^d) < 0$ for $\gamma = \gamma_L, \gamma_H$.

Holding h^u unchanged, when h^d increases, $\Psi_{q}(\gamma, h^d)$ increases according to Assumption A3. Thus, the term $\frac{1}{\gamma - \overline{\gamma}}[1 + (\gamma - \overline{\gamma})\Psi_{q}(\gamma, h^d)]^{1-\eta}$ in equation (A16) decreases, for $\gamma = \gamma_L, \gamma_H$. This implies $\frac{\partial}{\partial h^d}\Psi_{\Theta}(\gamma, h^u, h^d) < 0$ for $\gamma = \gamma_L, \gamma_H$.

B.2 Proof of Proposition 2

To simplify notations, we define $\phi_L \equiv \phi(\gamma_L)$, $\overline{\phi} \equiv \phi(\overline{\gamma})$, $\phi_H \equiv \phi(\gamma_H)$, $\omega_L \equiv \omega(\gamma_L, h^d)$, $\overline{\omega} \equiv \omega(\overline{\gamma}, h^d)$, $\omega_H \equiv \omega(\gamma_H, h^d)$, $q_L \equiv q(\gamma_L, h^u)$, $\overline{q} \equiv q(\overline{\gamma}, h^u)$, and $q_H \equiv q(\gamma_H, h^u)$.

Without loss of generality, we normalize the initial capital stock of firm i in the focal industry at $B_{i,0} = 1$. The capital stock $B_{i,T}$ at T depends on the realized aggregate discount rate γ for $t \in [\tau, T]$. Equations (A3) and (A5) implies that

$$B_{i,\tau}(h^u, h^d) = e^{\left(A\overline{\phi}\overline{\omega}^{1-\eta}\overline{q}^{-\epsilon} - \frac{1}{2}\sigma^2\right)\tau + \sigma(Z_\tau - Z_0)}, \tag{A17}$$

$$B_{i,T}(\gamma, h^u, h^d) = B_{i,\tau} e^{\left[A\phi(\gamma)\omega(\gamma, h^u)^{1-\eta} q(\gamma, h^d)^{-\epsilon} - \frac{1}{2}\sigma^2\right](T-\tau) + \sigma(Z_T - Z_\tau)}, \tag{A18}$$

where $\gamma = \gamma_L, \gamma_H$.

Because capital is sold at unit price at T, the firm's value $V_{i,T}$ at T is equal to its capital stock $B_{i,T}$. Using the SDF (A6), we derive the firm's value at $t=\tau$ as follows:

$$
\begin{aligned}
V_{i,\tau}(\gamma,h^u,h^d) =& \mathbb{E}_\tau\left[\frac{\Lambda_T}{\Lambda_\tau}B_{i,T}\right] \\
=& B_{i,\tau}\mathbb{E}_\tau\left[e^{\left[-r_f+A\phi(\gamma)\omega(\gamma,h^u)^{1-\eta}q(\gamma,h^d)^{-\epsilon}-\frac{1}{2}(\sigma^2+\gamma^2)\right](T-\tau)+(\sigma-\gamma)(Z_T-Z_\tau)}\right] \\
=& B_{i,\tau}e^{-r_f(T-\tau)+\left(A\phi(\gamma)\omega(\gamma,h^u)^{1-\eta}q(\gamma,h^d)^{-\epsilon}-\sigma\gamma\right)(T-\tau)}. \qquad \text{(A19)}
\end{aligned}
$$

The firm's value at $t=\tau^-$, before the realization of γ, is

$$
\begin{aligned}
V_{i,\tau^-}(\overline{\gamma},h^u,h^d) =& \mathbb{E}_{\tau^-}\left[\frac{\Lambda_\tau}{\Lambda_{\tau^-}}V_{i,\tau}(\gamma,h^u,h^d)\right] \\
=& \mathbb{E}_{\tau^-}\left[e^{\kappa(\gamma)}V_{i,\tau}(\gamma,h^u,h^d)\right] \\
=& B_{i,\tau}e^{-r_f(T-\tau)}\left[\lambda_L^Q e^{\left(A\phi_L\omega_L^{1-\eta}q_L^{-\epsilon}-\sigma\gamma_L\right)(T-\tau)}+\lambda_H^Q e^{\left(A\phi_H\omega_H^{1-\eta}q_H^{-\epsilon}-\sigma\gamma_H\right)(T-\tau)}\right]. \qquad \text{(A20)}
\end{aligned}
$$

The firm's value at $t=0$ is

$$
\begin{aligned}
V_{i,0}(\overline{\gamma},h^u,h^c) =& \mathbb{E}_0\left[\frac{\Lambda_{\tau-}}{\Lambda_0}V_{i,\tau^-}(\overline{\gamma},h^u,h^d)\right] \\
=& \mathbb{E}_0\left[\frac{\Lambda_{\tau-}}{\Lambda_0}B_{i,\tau}\right]e^{-r_f(T-\tau)}\left[\lambda_L^Q e^{\left(A\phi_L\omega_L^{1-\eta}q_L^{-\epsilon}-\sigma\gamma_L\right)(T-\tau)}+\lambda_H^Q e^{\left(A\phi_H\omega_H^{1-\eta}q_H^{-\epsilon}-\sigma\gamma_H\right)(T-\tau)}\right] \\
=& \mathbb{E}_0\left[e^{-\left(r_f+\frac{1}{2}\overline{\gamma}^2\right)\tau-\overline{\gamma}(Z_\tau-Z_0)}e^{\left(A\overline{\phi}\overline{\omega}^{1-\eta}\overline{q}^{-\epsilon}-\frac{1}{2}\sigma^2\right)\tau+\sigma(Z_\tau-Z_0)}\right] \\
& \times e^{-r_f(T-\tau)}\left[\lambda_L^Q e^{\left(A\phi_L\omega_L^{1-\eta}q_L^{-\epsilon}-\sigma\gamma_L\right)(T-\tau)}+\lambda_H^Q e^{\left(A\phi_H\omega_H^{1-\eta}q_H^{-\epsilon}-\sigma\gamma_H\right)(T-\tau)}\right] \\
=& e^{-r_fT+\left(A\overline{\phi}\overline{\omega}^{1-\eta}\overline{q}^{-\epsilon}-\sigma\overline{\gamma}\right)\tau}\left[\lambda_L^Q e^{\left(A\phi_L\omega_L^{1-\eta}q_L^{-\epsilon}-\sigma\gamma_L\right)(T-\tau)}+\lambda_H^Q e^{\left(A\phi_H\omega_H^{1-\eta}q_H^{-\epsilon}-\sigma\gamma_H\right)(T-\tau)}\right]. \qquad \text{(A21)}
\end{aligned}
$$

The exposure of industry returns to the aggregate discount rate shock at $t = \tau$ is

$$\begin{aligned}
\Psi_V(\gamma, h^u, h^d) =& \frac{1}{\gamma - \overline{\gamma}} \left[\frac{\int_0^1 V_{i,\tau}(\gamma, h^u, h^d) di}{\int_0^1 V_{i,\tau^-}(\overline{\gamma}, h^u, h^d) i} - 1 \right] \\
=& \frac{1}{\gamma - \overline{\gamma}} \left[\frac{e^{\left(A\phi(\gamma)\omega(\gamma, h^u)^{1-\eta} q(\gamma, h^d)^{-\epsilon} - \sigma\gamma\right)(T-\tau)}}{\lambda_L^Q e^{\left(A\phi_L \omega_L^{1-\eta} q_L^{-\epsilon} - \sigma\gamma_L\right)(T-\tau)} + \lambda_H^Q e^{\left(A\phi_H \omega_H^{1-\eta} q_H^{-\epsilon} - \sigma\gamma_H\right)(T-\tau)}} - 1 \right]
\end{aligned} \tag{A22}$$

We first analyze the case with $\gamma = \gamma_H$,

$$\begin{aligned}
\Psi_V(\gamma_H, h^u, h^d) =& \frac{1}{\gamma_H - \overline{\gamma}} \left[\frac{e^{\left(A\phi_H \omega_H^{1-\eta} q_H^{-\epsilon} - \sigma\gamma_H\right)(T-\tau)}}{\lambda_L^Q e^{\left(A\phi_L \omega_L^{1-\eta} q_L^{-\epsilon} - \sigma\gamma_L\right)(T-\tau)} + \lambda_H^Q e^{\left(A\phi_H \omega_H^{1-\eta} q_H^{-\epsilon} - \sigma\gamma_H\right)(T-\tau)}} - 1 \right] \\
=& \frac{1}{\gamma_H - \overline{\gamma}} \left[\frac{1}{\lambda_L^Q G(h^u, h^d) + \lambda_H^Q} - 1 \right],
\end{aligned} \tag{A23}$$

where

$$G(h^u, h^d) = \left[\frac{e^{\phi(\gamma_L)\omega(\gamma_L, h^u)^{1-\eta} q(\gamma_L, h^d)^{-\epsilon}}}{e^{\phi(\gamma_H)\omega(\gamma_H, h^u)^{1-\eta} q(\gamma_H, h^d)^{-\epsilon}}} \right]^{A(T-\tau)} e^{\sigma(\gamma_H - \gamma_L)(T-\tau)}, \tag{A24}$$

where the term $\frac{e^{\phi(\gamma_L)\omega(\gamma_L, h^u)^{1-\eta} q(\gamma_L, h^d)^{-\epsilon}}}{e^{\phi(\gamma_H)\omega(\gamma_H, h^u)^{1-\eta} q(\gamma_H, h^d)^{-\epsilon}}}$ in equation (A24) is essentially the continuously compounded version of the term $\frac{\phi(\gamma)\omega(\gamma, h^u)^{1-\eta} q(\gamma, h^d)^{-\epsilon}}{\phi(\overline{\gamma})\omega(\overline{\gamma}, h^u)^{1-\eta} q(\overline{\gamma}, h^d)^{-\epsilon}}$ in equation (A12). We thus expect the property of industry profitability exposure, $\Psi_\Theta(\gamma, h^u, h^d)$, obtained from equation (A12) also holds for industry return exposure, $\Psi_V(\gamma_H, h^u, h^d)$, obtained from equation (A23).

Formally, we rewrite equation (A24) as follows:

$$G(h^u, h^d) = e^{\frac{A(T-\tau)\phi(\gamma_L)}{\omega(\gamma_L, h^u)^{\eta-1} q(\gamma_L, h^d)^{\epsilon}} \left(1 - \frac{\phi(\gamma_H)}{\phi(\gamma_L)} \left[\frac{\omega(\gamma_H, h^u)}{\omega(\gamma_L, h^u)}\right]^{1-\eta} \left[\frac{q(\gamma_H, h^d)}{q(\gamma_L, h^d)}\right]^{-\epsilon}\right) + \sigma(\gamma_H - \gamma_L)(T-\tau)} \tag{A25}$$

Similar to our discussions for equation (A12), we focus on the empirically relevant case in which the aggregate demand channel dominates the upstream and downstream channels. Thus, $\frac{\phi(\gamma_H)}{\phi(\gamma_L)}\left[\frac{\omega(\gamma_H,h^u)}{\omega(\gamma_L,h^u)}\right]^{1-\eta}\left[\frac{q(\gamma_H,h^d)}{q(\gamma_L,h^d)}\right]^{-\epsilon} < 1$. Therefore, we have $G(h^u, h^d) > 1$, which implies $\Psi_V(\gamma_H, h^u, h^d) < 0$, indicating that industry returns are negatively exposed to the aggregate discount rate.

Further, according to Assumption A3, when the upstream (downstream) industry is more concentrated, the price ω_t (q_t) becomes less negatively exposed to the aggregate discount rate γ. Thus, similar to our discussions for equation (A12), when h^u or h^d increases, the value of $\frac{\phi(\gamma_H)}{\phi(\gamma_L)}\left[\frac{\omega(\gamma_H,h^u)}{\omega(\gamma_L,h^u)}\right]^{1-\eta}\left[\frac{q(\gamma_H,h^d)}{q(\gamma_L,h^d)}\right]^{-\epsilon}$ decreases. If $\omega(\gamma_L, h^u)^{\eta-1}q(\gamma_L, h^d)^{\epsilon}$ does not increase much with industry concentration,[6] we have $G(h^u, h^d)$ being an increasing function of h^u and h^d. Then, equation (A23) implies that $\frac{\partial}{\partial h^u}\Psi_V(\gamma_H, h^u, h^d) < 0$ and $\frac{\partial}{\partial h^d}\Psi_V(\gamma_H, h^u, h^d) < 0$.

In the case with $\gamma = \gamma_L$, the proof is similar and it is straight forward to show that $\Psi_V(\gamma_L, h^u, h^d) < 0$, $\frac{\partial}{\partial h^u}\Psi_V(\gamma_L, h^u, h^d) < 0$, and $\frac{\partial}{\partial h^d}\Psi_V(\gamma_L, h^u, h^d) < 0$.

B.3 Proof of Proposition 3

The focal industry's expected equity return over $[0, T]$ is

$$
\begin{aligned}
e^{r(h^u,h^d)T} =& \mathbb{E}_0\left[\frac{V_T(\gamma, h^u, h^d)}{V_0(\overline{\gamma}, h^u, h^d)}\right] \\
=& \frac{\mathbb{E}_0\left[\int_0^1 B_{i,T}(\gamma, h^u, h^d)i\right]}{\int_0^1 V_{i,0}(\overline{\gamma}, h^u, h^d)i}
\end{aligned}
\tag{A26}
$$

[6]This is a reasonable condition because $\omega(\gamma_L, h^u)$ and $q(\gamma_L, h^d)$ represent the prices in a boom, during which firms within the same industries already collude on high prices. Thus, a further increase in industry concentration would not has a large effect on the level of prices. For example, in Opp et al. (2014, Figure 2), profits and markups in a boom do not change at all when the number of firms in the industry increases.

Substituting equations (A18) and (A21) into the above equation, we obtain

$$r(h^u, h^d) = r_f + \frac{1}{T} \ln \left[\frac{\lambda_L W_L + \lambda_H W_H}{\lambda_L^Q e^{-\sigma[\overline{\gamma}\tau + \gamma_L(T-\tau)]} W_L + \lambda_H^Q e^{-\sigma[\overline{\gamma}\tau + \gamma_H(T-\tau)]} W_H} \right], \tag{A27}$$

where $W_L = e^{A\phi_L \omega_L^{1-\eta} q_L^{-\epsilon}(T-\tau)}$ and $W_H = e^{A\phi_H \omega_H^{1-\eta} q_H^{-\epsilon}(T-\tau)}$ represent the deterministic component of the cumulative operating profit over $[\tau, T]$ in a boom ($\gamma = \gamma_L$) and a recession ($\gamma = \gamma_H$), respectively. Similar to our discussions for equation (A12), we focus on the empirically relevant case in which the aggregate demand channel dominates the upstream and downstream channels. Thus, $W_L > W_H$.

The second term on the right hand side of (A27) captures the risk premium of the focal industry, $r(h^u, h^d) - r_f$. The risk premium is positive, because

$$\frac{\lambda_L W_L + \lambda_H W_H}{\lambda_L^Q e^{-\sigma[\overline{\gamma}\tau + \gamma_L(T-\tau)]} W_L + \lambda_H^Q e^{-\sigma[\overline{\gamma}\tau + \gamma_H(T-\tau)]} W_H} > 1,$$

which is attributed to two channels. First, the focal industry is negatively exposed to the aggregate discount rate shock, which carries a negative market price of risk. That is, $\lambda_L^Q < \lambda_L$, $\lambda_H^Q > \lambda_H$, and $W_L > W_H$. Second, the focal industry's cash flows are positively exposed to the aggregate cash-flow shocks Z_t, which carries a positive market price of risk. That is, $e^{-\sigma[\overline{\gamma}\tau + \gamma_L(T-\tau)]} < 1$ and $e^{-\sigma[\overline{\gamma}\tau + \gamma_H(T-\tau)]} < 1$.

Further, rewrite equation (A27) as follows

$$r(h^u, h^d) = r_f + \frac{1}{T} \frac{\lambda_L}{\lambda_L^Q e^{-\sigma[\overline{\gamma}\tau + \gamma_L(T-\tau)]}} \left[\frac{W_L/W_H + \lambda_H/\lambda_L}{W_L/W_H + \lambda_H/\lambda_L e^{\kappa(\gamma_H) - \kappa(\gamma_L) - \sigma(\gamma_H - \gamma_L)(T-\tau)}} \right], \tag{A28}$$

where

$$\frac{W_L}{W_H} = \left[\frac{e^{\phi(\gamma_L)\omega(\gamma_L, h^u)^{1-\eta} q(\gamma_L, h^d)^{-\epsilon}}}{e^{\phi(\gamma_H)\omega(\gamma_H, h^u)^{1-\eta} q(\gamma_H, h^d)^{-\epsilon}}} \right]^{A(T-\tau)}. \tag{A29}$$

As discussed for equation (A25), when h^u or h^d increases, the value of W_L/W_H increases. Thus, if $e^{\kappa(\gamma_H)-\kappa(\gamma_L)-\sigma(\gamma_H-\gamma_L)(T-\tau)} > 1$, we would have $r(h^u, h^d)$ being an increasing function of h^u and h^d. This requires the condition $\kappa(\gamma_H) - \kappa(\gamma_L) > \sigma(\gamma_H - \gamma_L)(T - \tau)$, which is satisfied when the aggregate discount rate carries a sufficiently large (negative) market price of risk as in the calibration used in the literature (e.g., Opp et al., 2014).

C Detailed Discussions of the Hedging Mechanism

In this section, we complement the theoretical model in Section B of the Online Appendix with a detailed discussion on the intuition of the hedging mechanism. As discussed in our theoretical model in Section B, there are three goods in the economy: i) raw materials: goods produced by upstream industries and used as inputs by the focal industry, ii) intermediate goods: goods produced by the focal industry and sold to downstream industries, and iii) consumption goods: goods produced by downstream industries and sold to final consumers.

The mechanism through which recessions (and the rise in aggregate discount rates) affect the vertical chain operates as follows:

Step 1: Direct Effect of Recession on Demand Curves

During a recession, aggregate demand typically contracts across the economy, causing a leftward shift in demand curves for all three types of goods—raw materials, intermediate goods, and consumption goods (i.e., our model's Assumption 1). This captures the broad decline in economic activity and consumer spending during recessions. Importantly, this *direct* effect represents the economy-wide impact of recessions and is assumed to be independent of industry concentration levels.[7]

[7]While Assumption 1 specifies identical leftward demand shifts across industries for simplicity, this can be relaxed without affecting our key predictions. As long as the magnitude of demand curve shifts is either independent of industry concentration or depends on it less strongly than supply curve shifts do, our cross-sectional predictions still hold.

Consequently, the absolute magnitude of this demand contraction is immaterial for our theory. Our predictions are driven instead by cross-sectional differences in exposure to aggregate discount rate shocks induced by variation in both upstream and downstream concentration.

Step 2: The Effect of Recession on Supply Curves of Raw Materials and Consumption Goods

As shown by Opp et al. (2014) and Dou et al. (2021), higher aggregate discount rates in recessions weaken tacit collusion, intensifying product market competition (i.e., our model's Assumption 2). Beyond the homogeneous demand contraction in Step 1, this intensified competition in vertically related industries shifts upstream and downstream supply curves rightward during recessions.[8] As we elaborate below, these supply shifts generate hedging effects for the focal industry, thereby lowering its aggregate risk exposure.

Upstream Hedging Effect: When aggregate discount rates rise in recessions, the present value of future collusive profits falls, making tacit collusion harder to sustain among upstream suppliers. Upstream firms respond by competing more aggressively and selling raw materials at lower prices. This effectively shifts the supply curve of raw materials to the right (equivalently, the focal industry faces a downward shift in its input price schedule). These lower input prices reduce the focal industry's marginal cost. Holding demand at its recession level (Step 1), the focal industry's profits are therefore higher than they would be absent the upstream's supply curve shift due to intensified competition.

[8] In principle, the focal industry may also face intensified competition and a rightward supply shift. Our focus, however, is on asset-pricing implications stemming from variation in upstream and downstream concentration, complementing Dou et al. (2021), who study the focal industry's own concentration. To isolate this channel, the model assumes monopolistic competition in the focal industry, rendering its competitive intensity acyclical; empirically, we control for the focal industry's concentration in our main regressions.

In other words, the reduced marginal cost of production in the focal industry partially offsets the direct demand contraction, reducing the covariance of the focal industry's cash flows with aggregate discount rate shocks and thus providing a hedge against aggregate risk. Critically, as we demonstrate in Step 3, the magnitude of this upstream hedging effect varies systematically with upstream concentration.

Downstream hedging effect: When aggregate discount rates rise, the value of future collusive profits falls, weakening tacit collusion among downstream firms. Downstream firms compete more aggressively, leading to a rightward shift of the downstream (final goods) supply curve. Holding the final goods demand curve at its recession level (Step 1), equilibrium output of final goods is therefore higher than in the pure demand shock counterfactual with no supply response. To produce this higher equilibrium output, downstream firms purchase more intermediate inputs from the focal industry, shifting the *derived demand* curve for the focal industry's intermediate goods to the right.[9]

This indirect demand boost for the focal industry's intermediate goods partially offsets the direct contraction in Step 1, raising the focal industry's profits relative to the no downstream response counterfactual and reducing the covariance of its cash flows with aggregate discount rate shocks.

Critically, as we show in Step 3, the magnitude of this downstream hedge also varies systematically with downstream concentration.

Step 3: How Concentration Affects These Hedging Effects

The hedging effects described above vary systematically with the concentration of upstream and downstream industries. This cross-sectional variation arises because the magnitude of the rightward supply shifts in those industries depends on their concentration, as the literature suggests (Opp et al., 2014; Dou et al., 2021) (i.e., our model's Assumption 3).

[9]The rightward shift in the focal industry's demand is *indirect*: it arises because downstream competition shifts their supply outward, which in turn raises their input demand. This additional demand-side force partially offsets, but need not overturn, the *direct* leftward demand shift in Step 1.

Specifically, competition intensifies more dramatically in less concentrated industries during recessions. Relative to more concentrated upstream industries, less concentrated upstream industries therefore exhibit larger rightward supply shifts for raw materials, leading to bigger reductions in the focal industry's marginal costs and thus stronger hedging (as in Step 2). In the downstream, less concentrated industries exhibit larger rightward supply shifts for final goods, which indirectly generate larger rightward shifts in the focal industry's derived demand and thus stronger hedging (as in Step 2).[10]

Taken together, this analysis shows that hedging from intensified upstream and downstream competition during recessions is stronger when vertically related industries are less concentrated, providing the theoretical foundation for our empirical predictions.

D The Estimation of the Implied Cost of Capital

We estimate the implied cost of equity capital based on stock price and analysts' per-share earnings forecasts at the end of June. We follow prior literature and outline four different methodologies to estimate the cost of capital Chen et al. (2011). We set ICC as the median of the estimates from the four models (e.g., Hail and Leuz, 2006; Chen et al., 2011). We first describe the variables used in the following four models.

P_t: The stock price of the firm's common stock at time t, which is measured as the stock price as of June of year t+1 reported by I/B/E/S.

B_t: Book value of equity at time t, which is derived from the most recent available financial statement on Compustat before the end of June of year t+1.

$FEPS_{t+i}$: Market expectation of the firm's earnings per share (EPS) in the ith year after time t.

$FROE_{t+i}$: Market expectation of the firm's earnings to book equity ratio (ROE) in the ith year after time t.

[10] The opposite holds for highly concentrated vertical industries, where competitive responses and supply shifts are attenuated.

POUT: Forecast dividend payout ratio, which is the ratio of the indicated annual dividend from I/B/E/S to $FEPS_{t+1}$. Negative $FEPS_{t+1}$ is replaced by assuming a return on assets of 6% to calculate earnings. *POUT* is winsorized to be within 0 and 1.

D.1 Gebhardt et al. (2001) Approach

$$P_t = B_t + \frac{\Sigma_{i=1}^{T-1}(FROE_{t+1} - R_{GLS}) \times B_{t+i-1}}{(1+R_{GLS})^i} + \frac{(FROE_{t+T} - R_{GLS}) \times B_{t+T-1}}{(1+R_{GLS})^{T-1} \times R_{GLS}} \tag{A30}$$

We use analysts' forecasts on EPS to proxy for the market expectations of a firm's earnings for the next three years. We thereafter compute FROE by assuming that the future ROE declines linearly to an equilibrium level from year t+4 to year T. The equilibrium level is assumed to be the Fama and French (1997) 48 industry-median ROE in the past 10 years, where ROE is defined as the ratio of income available for common shareholders to the lagged total book value of equity. Firms with negative ROEs are retained while computing the industry ROE (Botosan and Plumlee, 2005), and the industry ROE that is less than the risk-free rate is replaced with the risk-free rate (Liu et al., 2002). The risk-free rate is the yield on 10-year Treasury bonds at the end of June in each year. The future book value of equity B_{t+i} is estimated by assuming a clean surplus, i.e., $B_{t+i} = B_{t+i-1} + EPS_{t+i} - EPS_{t+i}POUT$. We assume that T = 12. We use the numerical approximation program to solve R_GLS such that the left- and right-hand sides of the equation are within a difference of 0.001.

D.2 Claus and Thomas (2001) Approach

$$P_t = B_t + \frac{\Sigma_{i=1}^{5}FEPS_{t+i} - R_{CT} \times B_{t+i-1}}{(1+R_{CT})^i} + \frac{(FROE_{t+5} - R_{CT} \times B_{t+4}) \times (1+g_{lt})}{(R_{CT} - g_{lt}) \times (1+R_{CT})^5} \tag{A31}$$

We use analysts' forecast on EPS to proxy for the market expectations of firms' earnings for the next three years. The market expectations of earnings in year t+4 and year t+5 are derived from $FEPS_{t+3}$ and the long-term earnings growth rate. If the long-term earnings growth rate is missing, we derive it from $FEPS_{t+3}$ and $FEPS_{t+2}$. The long-term abnormal earnings growth rate (g_{lt}) is computed as the risk-free rate minus 3%. Other variables are defined above. We use the numerical approximation program to solve R_{CT} such that the left- and right-hand sides of the equation are within a difference of 0.001.

D.3 Ohlson and Juettner-Nauroth (2005) Approach

$$\begin{aligned} R_{OJ} = &\frac{1}{2}(g_{lt} + \frac{FEPS_{t+1} \times POUT}{P_t}) \\ &+ \sqrt{\frac{1}{4}(g_{lt} + \frac{FEPS_{t+1} \times POUT}{P_t})^2 + \frac{FEPS_{t+1}}{P_t}(g_{st} - g_{lt})} \end{aligned} \tag{A32}$$

Following Gode and Mohanram (2003), we compute the average short-term growth rate (g_{st}) as the average of the growth rate implied in $FEPS_{t+1}$ and $FEPS_{t+2}$ and the analysts' forecast long-term growth rate. We require that $FEPS_{t+2} > 0$ and $FEPS_{t+2} > 0$ to implement the calculation. Other variables are defined above.

D.4 Easton (2004) Approach

$$P_t = B_t + \frac{FEPS_{t+1}}{R_{MPEG}} + \frac{FEPS_{t+1}[g_{st} - R_{MPEG} \times (1 - POUT)]}{R^2_{MPEG}} \tag{A33}$$

Variables are defined above. We require that $FEPS_{t+2} > FEPS_{t+1} > 0$ to implement the calculation. We use the numerical approximation program to solve R_{MPEG} such that the left- and right-hand sides of the equation are within a difference of 0.001.

E Additional Analyses

Table A1: Descriptive Statistics

This table presents descriptive statistics of variables used in our main analyses. Panel A reports the summary statistics of variables used in analyses of the comovement between performance and discount rates (e.g., Table 1 of the main text). Panel B reports the summary statistics of variables used in analyses of how upstream or downstream concentration affects the sensitivity of cash flow to discount rates (e.g., Tables 2 and 3 of the main text). Panel C reports the summary statistics of variables used in the analyses of how upstream or downstream concentration affects the sensitivity of stock returns to discount rates (e.g., Table 4 of the main text).

	Mean	Std. Dev.	P25	P50	P75
Panel A: Variables used in Table 1					
Avg. ΔNet Profitability	-0.0003	0.0052	-0.0020	-0.0001	0.0012
Avg. ΔLog Sale	0.1971	0.0943	0.1435	0.2045	0.2640
ΔSmooth_EP	-0.0010	0.0070	-0.0046	-0.0025	0.0012
Panel B: Variables used in Tables 2 & 3					
Avg. ΔNet Profitability	-0.0001	0.0062	-0.0026	-0.0003	0.0025
Avg. ΔLog Sale	0.2094	0.1186	0.1435	0.2127	0.2796
ΔSmooth_EP	-0.0010	0.0070	-0.0046	-0.0025	0.0012
Focal CR4	29.3374	5.2431	25.7424	30.6880	32.7258
Panel B: Variables used in Table 4					
Accumulated excess returns	0.1448	0.1806	0.0618	0.1458	0.2280
Acc. Smooth EP Shocks	-0.0003	0.0070	-0.0041	-0.0015	0.0021
Focal CR4	28.4695	5.5520	24.4902	29.7467	32.0364

Table A2: Upstream/Downstream Concentration and CAPM Beta

This table represents the average CAPM beta in industry portfolios sorted on the one-year-lagged upstream (Panel A) and downstream (Panel B) concentration ratio. We measure the CAPM beta for each industry-quarter by regressing value-weighted industry returns on value-weighted market returns, using daily stock returns from the calendar year preceding the quarter-end. We then compute the average CAPM beta across industries in each quintile portfolio. The sample period is from 1988Q1 to 2017Q4. We exclude financial industries and industries with two or fewer firms from the analysis. Standard deviation is reported in brackets, and t-statistics is reported in square brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Sort on Supplier Concentration

	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 - 1
CAPM β	0.880	0.915	0.963	0.959	1.026	0.147***
	(0.161)	(0.155)	(0.252)	(0.279)	(0.265)	[5.271]

Panel B: Sort on Customer Concentration

	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 - 1
CAPM β	0.842	0.953	0.933	1.002	1.013	0.170***
	(0.211)	(0.204)	(0.212)	(0.237)	(0.233)	[6.030]

Table A3: Fama-MacBeth Regressions of Stock Returns on the Upstream/Downstream Concentration and Other Variables

This table reports coefficients from value-weighted Fama-MacBeth (Fama and MacBeth, 1973) cross-sectional regression. We regress industry value-weighted stock returns (in percent) from July of year t to June of year t+1 on supplier four-firm concentration ratio (*Supplier CR4*) or customer four-firm concentration ratio (*Customer CR4*), with the inclusion of different sets of control variables. The weight for the regression is set to the market equity. *Log ME* is the natural logarithm of market equity at the end of June of year t. *Log BTM* is the natural logarithm of book-to-market ratio. *ROA* is the ratio of earnings before extraordinary items and depreciation to total assets in year t-1. *Log RD* is the natural logarithm of one plus the ratio of R&D expenditure to sales in year t-1. *Log IK* is the natural logarithm of the ratio of capital expenditure to assets in year t-1. *Return_Prior* is the prior one-month returns. *Mom* is the prior three month returns (with a one-month gap between the holding period and the current month). *Constraint* is the Whited and Wu (2006) index in year t-1. *Illiquid* is the absolute value of monthly return divided by the trading volume in June of year t, multiplied by 1,000,000. *Focal CR4* is the four firm concentration ratio of focal industry. All control variables are winsorized at the 1% and 99% levels. The sample period for implied costs of capital is from July 1988 to June 2018. We exclude financial industries and industries with two or fewer firms from the analysis. The R-squared is the time-series average of the R-squared of each monthly cross-sectional regression. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Excess Return (%)	
	(1)	(2)
Supp CR4	0.023**	
	(1.974)	
Cust CR4		0.010**
		(2.153)
Log ME	0.109	0.034
	(1.247)	(0.394)
Log BTM	0.574***	0.416**
	(2.964)	(2.385)
ROA	4.561	4.674
	(1.419)	(1.301)
Log RD	1.520	0.495
	(1.261)	(0.380)
Log IK	-0.310	-0.257
	(-1.568)	(-1.358)
Return_Prior	0.486	-0.119
	(0.160)	(-0.041)
Mom	0.835	-0.162
	(0.468)	(-0.095)
Constraint	3.514	2.874
	(1.414)	(1.236)
Illiquid	-0.028	-0.083
	(-0.359)	(-1.056)
Focal CR4	0.091	0.084
	(0.224)	(0.204)
R-squared	0.841	0.841

Table A4: Fama-MacBeth Regressions of Costs of Capital on the Upstream/Downstream Concentration and Other Variables

This table reports coefficients from Fama-MacBeth (Fama and MacBeth, 1973) cross-sectional regression. We regress industry value-weighted implied cost of capital (in percent) estimated at the end of June on lagged supplier four-firm concentration ratio (*Supplier CR4*) or lagged customer four-firm concentration ratio (*Customer CR4*), with the inclusion of different sets of control variables. The weight for the regression is set to the market equity. *Log ME* is the natural logarithm of market equity at the end of June of year t. *Log BTM* is the natural logarithm of book-to-market ratio. *ROA* is the ratio of earnings before extraordinary items and depreciation to total assets in year t-1. *Log RD* is the natural logarithm of one plus the ratio of R&D expenditure to sales in year t-1. *Log IK* is the natural logarithm of the ratio of capital expenditure to assets in year t-1. *Return_Prior* is the prior one-month returns. *Mom* is the prior three month returns (with a one-month gap between the holding period and the current month). *Constraint* is the Whited and Wu (2006) index in year t-1. *Illiquid* is the absolute value of monthly return divided by the trading volume in June of year t, multiplied by 1,000,000. *Focal CR4* is the lagged four firm concentration ratio of focal industry. All industry level measures are constructed at the end of June in year t+1. All control variables are winsorized at the 1% and 99% levels. The sample period for stock returns is from 1988 to 2018. We exclude financial industries and industries with two or fewer firms from the analysis. The R-squared is the time-series average of the R-squared of each monthly cross-sectional regression. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	ICC (%)	
	(1)	(2)
Supp CR4	0.021***	
	(3.371)	
Cust CR4		0.009**
		(2.262)
Log ME	-0.462***	-0.527***
	(-6.111)	(-6.540)
Log BTM	0.504***	0.490***
	(3.875)	(3.929)
ROA	-0.023	0.096
	(-0.016)	(0.065)
Log RD	0.730	0.413
	(1.061)	(0.497)
Log IK	0.189*	0.220**
	(1.962)	(2.449)
Return_Prior	0.676	0.816
	(0.599)	(0.756)
Mom	1.530*	1.341*
	(1.999)	(1.750)
Constraint	-3.412***	-3.918***
	(-3.499)	(-3.636)
Illiquid	-0.015	-0.033
	(-0.250)	(-0.553)
Focal CR4	0.010***	0.011***
	(5.739)	(4.869)
R-squared	0.458	0.457

Table A5: The Effect of Upstream Concentration on Growth Option

This table examines the impact of upstream market structure changes on downstream firms' growth option. The unit of observation is an SIC industry-year. The dependent variable is the quarterly industry-level market-to-book ratio. *Tariff Cut* is a binary variable that equals one for the period after the major supplier industry experiences a major tariff cut, which refers to the tariff cut whose magnitude is greater than 2.5 times the median tariff cut in this industry across the whole sample period (e.g., Fresard, 2010). *Export Leniency* is a binary variable that equals one for the period after a major export destination country passes the leniency law. Both columns control for quarter fixed effects and industry fixed effects. Standard errors are clustered at the quarter level and t-statistics are reported in brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Log(MTB)	
	(1)	(2)
Tariff Cut	0.060**	
	(4.023)	
Export Leniency		0.111***
		(6.238)
Year-Quarter FE	Yes	Yes
Industry FE	Yes	Yes
Obs.	29,245	23,053
R-squared	0.437	0.453

Table A6: Controlling for Relative Bargaining Power

This table tests the robustness of our main results to the inclusion of proxies for relative bargaining power between suppliers and customers. *Supp Size* is the ratio of the average supplier industry gross production to the focal industry gross production. *Supp Diversification* is one minus the Herfindahl-Hirschman Index (HHI) of the sale from each supplier industry to the focal industry. *Cust Size* is the ratio of the average customer industry gross production to the focal industry gross production. *Cust Diversification* is one minus the Herfindahl-Hirschman Index (HHI) of the sale from the focal industry to each customer industry. Panels A5.1 and A5.2 replicate Table 2, which report the time-series regressions of the average profitability and sales growth on discount rates in industry quintile portfolios sorted on the one-year-lagged upstream concentration ratio. Panels B5.1 and B5.2 replicate Table 3, which report the time-series regressions of the average profitability and sales growth on discount rates in industry quintile portfolios sorted on the one-year-lagged downstream concentration ratio. Panels C5.1 and C5.2 replicate Table 4, which report the heterogeneous returns exposure to discount rates for portfolios sorted on upstream or downstream concentration ratio. The coefficient on *Focal CR4* is multiplied by 100. We omit the coefficients for the constant terms for brevity. We exclude financial industries and industries with two or fewer firms from the analysis. We include t-statistics in the brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A6.1: Upstream Concentration and Sensitivity of Net Profitability to Discount Rates

	Avg. ΔNet Profitability					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
ΔSmooth_EP	-0.326**	-0.208*	-0.515***	-0.345**	-0.704***	-0.326***
	(-2.603)	(-1.918)	(-3.217)	(-2.571)	(-3.672)	(-2.935)
Focal CR4	-0.006	0.019	0.022	-0.024	0.154***	0.024**
	(-0.207)	(1.184)	(1.151)	(-0.711)	(3.211)	(2.035)
Supp Size	0.000	-0.000	0.000**	0.000	-0.000	0.000
	(0.910)	(-1.029)	(2.430)	(0.792)	(-0.457)	(0.195)
Supp Diversification	-0.007	0.039	-0.034	0.079*	-0.148*	-0.045
	(-0.158)	(1.124)	(-0.515)	(1.675)	(-1.717)	(-1.246)
Obs.	120	120	120	120	120	120
R-squared	0.192	0.151	0.262	0.203	0.370	0.166

Panel A6.2: Upstream Concentration and Sensitivity of Sales Growth to Discount Rates

	Avg. ΔLog Sales					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
ΔSmooth_EP	-3.976*	-4.742***	-4.991**	-6.505***	-7.970***	-3.420***
	(-1.839)	(-2.704)	(-2.439)	(-2.791)	(-3.556)	(-2.724)
Focal CR4	-1.440**	-0.626**	0.623**	-1.469**	1.127	-0.196
	(-2.587)	(-2.181)	(1.996)	(-2.516)	(1.642)	(-0.738)
Supp Size	-0.001**	-0.001***	0.001***	0.000	0.000	0.001
	(-2.131)	(-2.937)	(2.645)	(0.227)	(0.198)	(1.468)
Supp Diversification	0.653	2.103***	-1.320	-0.996	-2.626**	-1.908***
	(0.821)	(2.980)	(-1.088)	(-0.844)	(-2.208)	(-3.184)
Obs.	120	120	120	120	120	120
R-squared	0.359	0.181	0.181	0.245	0.261	0.106

Table A6: Controlling for Relative Bargaining Power (Continued)

Panel B6.1: Downstream Concentration and Sensitivity of Net Profitability to Discount Rates

	Avg. ΔNet Profitability					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	$5-1$
ΔSmooth_EP	-0.349***	-0.301**	-0.236**	-0.477***	-0.576***	-0.222***
	(-2.961)	(-2.257)	(-2.618)	(-3.749)	(-3.675)	(-2.665)
Focal CR4	0.002	-0.040	0.047***	-0.012	0.002	-0.002
	(0.051)	(-1.512)	(3.801)	(-0.809)	(0.048)	(-0.130)
Cust Size	0.000	0.000	-0.000	0.000***	0.000***	0.000***
	(0.335)	(1.604)	(-0.666)	(3.414)	(3.249)	(2.998)
Cust Diversification	0.013	0.099***	0.007	-0.019	-0.018	0.004
	(0.879)	(2.664)	(0.462)	(-0.812)	(-0.795)	(0.177)
Obs.	120	120	120	120	120	120
R-squared	0.201	0.160	0.214	0.302	0.315	0.109

Panel B6.2: Downstream Concentration and Sensitivity of Sales Growth to Discount Rates

	Avg. ΔLog Sales					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	$5-1$
ΔSmooth_EP	-3.534	-3.483**	-4.654**	-5.370**	-7.763***	-3.815**
	(-1.599)	(-2.091)	(-2.545)	(-2.335)	(-4.403)	(-2.233)
Focal CR4	-1.433*	-1.072*	-0.693**	0.470	1.554***	-0.721*
	(-1.690)	(-1.918)	(-2.167)	(1.566)	(3.324)	(-1.979)
Cust Size	-0.000	-0.001	-0.002	-0.000	-0.000	0.001**
	(-0.145)	(-1.236)	(-1.259)	(-0.915)	(-1.166)	(2.527)
Cust Diversification	1.167***	-0.027	-1.440***	-0.489	-0.960***	2.387***
	(3.327)	(-0.044)	(-4.166)	(-1.313)	(-3.247)	(4.660)
Obs.	120	120	120	120	120	120
R-squared	0.186	0.364	0.304	0.201	0.378	0.221

Table A6: Controlling for Relative Bargaining Power (Continued)

Panel C6.1: Upstream Concentration and Sensitivity of Return to Discount Rates

	Accumulated excess returns					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
Acc. Smooth EP Shocks	-15.955***	-18.958***	-18.261***	-18.951***	-21.588***	-5.131***
	(-11.932)	(-5.929)	(-13.682)	(-8.476)	(-8.567)	(-2.814)
Focal CR4	0.733	0.377	0.367	0.175	-1.034	1.086**
	(1.362)	(1.346)	(1.446)	(0.214)	(-0.926)	(2.411)
Supp Size	-0.001	-0.001**	0.000	0.001	0.000	-0.001**
	(-1.070)	(-2.075)	(1.145)	(1.334)	(0.197)	(-2.146)
Supp Diversification	1.725**	3.001	-0.320	3.964***	3.581	1.099
	(2.055)	(1.521)	(-0.376)	(2.993)	(1.494)	(0.567)
Obs.	360	360	360	360	360	360
R-squared	0.643	0.537	0.656	0.640	0.520	0.065

Panel C6.2: Downstream Concentration and Sensitivity of Return to Discount Rates

	Accumulated excess returns					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
Acc. Smooth EP Shocks	-14.887***	-15.582***	-17.593***	-14.438***	-25.887***	-8.818***
	(-11.850)	(-14.344)	(-13.469)	(-8.664)	(-7.221)	(-3.443)
Focal CR4	0.234	-0.448	0.414	-0.650	1.074	0.679
	(0.582)	(-1.176)	(1.085)	(-1.633)	(1.243)	(1.644)
Cust Size	0.000	0.002***	0.000	-0.000	-0.001	-0.000
	(0.642)	(4.414)	(0.281)	(-0.103)	(-0.388)	(-0.399)
Cust Diversification	-0.028	0.328	0.578**	-1.566**	1.204	-1.396**
	(-0.123)	(0.573)	(2.056)	(-2.553)	(1.229)	(-2.444)
Obs.	360	360	360	360	360	360
R-squared	0.643	0.702	0.726	0.405	0.557	0.197

Table A7: Using the Risk Aversion Index to Proxy for the Discount Rate

This table tests the robustness of our main results using the risk aversion index (Bekaert et al., 2022) to proxy for the discount rate. Panels A6.1 and A6.2 replicate Table 2, which report the time-series regressions of the average profitability and sales growth on discount rates in industry quintile portfolios sorted on the one-year-lagged upstream concentration ratio. Panels B6.1 and B6.2 replicate Table 3, which report the time-series regressions of the average profitability and sales growth on discount rates in industry quintile portfolios sorted on the one-year-lagged downstream concentration ratio. Panels C6.1 and C6.2 replicate Table 4, which report the heterogeneous returns exposure to discount rates for portfolios sorted on upstream or downstream concentration ratio. The coefficient on *Focal CR4* is multiplied by 100. We omit the coefficients for the constant terms for brevity. We exclude financial industries and industries with two or fewer firms from the analysis. We include t-statistics in the brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A7.1: Upstream Concentration and Sensitivity of Net Profitability to Discount Rates

	Avg. ΔNet Profitability					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	$5-1$
ΔRisk Aversion	-0.004***	-0.004***	-0.006***	-0.004***	-0.007***	-0.003***
	(-5.231)	(-7.030)	(-5.571)	(-5.484)	(-5.832)	(-4.170)
Focal CR4	0.009	0.040***	0.006	-0.028	0.055***	0.018*
	(0.636)	(4.182)	(0.415)	(-1.062)	(2.911)	(1.697)
Obs.	120	120	120	120	120	120
R-squared	0.391	0.392	0.481	0.305	0.504	0.215

Panel A7.2: Upstream Concentration and Sensitivity of Sales Growth to Discount Rates

	Avg. ΔLog Sales					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	$5-1$
ΔRisk Aversion	-0.016	-0.019	-0.025	-0.022	-0.041**	-0.030***
	(-0.950)	(-0.880)	(-1.347)	(-0.841)	(-2.034)	(-3.010)
Focal CR4	-2.358***	0.180	0.546**	-1.526**	-0.021	-0.180
	(-6.378)	(0.952)	(1.986)	(-2.552)	(-0.063)	(-0.793)
Obs.	120	120	120	120	120	120
R-squared	0.273	0.023	0.074	0.091	0.068	0.052

Table A7: Using the Risk Aversion Index to Proxy for the Discount Rate (Continued)

Panel B7.1: Downstream Concentration and Sensitivity of Net Profitability to Discount Rates

	Avg. ΔNet Profitability					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
ΔRisk Aversion	-0.004***	-0.005***	-0.003***	-0.005***	-0.006***	-0.002***
	(-7.841)	(-5.360)	(-8.482)	(-5.880)	(-6.239)	(-2.621)
Focal CR4	0.009	0.001	0.038***	-0.013	0.028	0.003
	(0.820)	(0.061)	(4.097)	(-1.287)	(1.149)	(0.277)
Obs.	120	120	120	120	120	120
R-squared	0.369	0.416	0.439	0.408	0.476	0.087

Panel B7.2: Downstream Concentration and Sensitivity of Sales Growth to Discount Rates

	Avg. ΔLog Sales					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
ΔRisk Aversion	-0.005	-0.011	-0.028	-0.039*	-0.042**	-0.037**
	(-0.226)	(-0.761)	(-1.179)	(-1.767)	(-2.611)	(-2.013)
Focal CR4	-0.660**	-1.721***	-1.144***	0.628**	1.327**	0.315
	(-2.298)	(-7.908)	(-3.555)	(2.570)	(2.540)	(1.167)
Obs.	120	120	120	120	120	120
R-squared	0.045	0.296	0.107	0.139	0.134	0.066

Panel C7.1: Upstream Concentration and Sensitivity of Return to Discount Rates

	Accumulated excess returns					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
Acc. Risk Aversion Shock	-0.053***	-0.059***	-0.066***	-0.070***	-0.066***	-0.013**
	(-6.586)	(-4.432)	(-7.206)	(-7.586)	(-7.151)	(-2.033)
Focal CR4	0.946*	0.991***	0.352	-0.050	0.195	0.562
	(1.901)	(2.599)	(0.916)	(-0.078)	(0.215)	(1.392)
Obs.	360	360	360	360	360	360
R-squared	0.298	0.232	0.329	0.302	0.200	0.021

Panel C7.2: Downstream Concentration and Sensitivity of Return to Discount Rates

	Accumulated excess returns					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
Acc. Risk Aversion Shock	-0.057***	-0.046***	-0.065***	-0.063***	-0.079***	-0.026**
	(-8.109)	(-4.945)	(-7.288)	(-8.731)	(-5.615)	(-2.563)
Focal CR4	0.706*	0.792	0.825*	-0.458	0.633	0.323
	(1.962)	(1.452)	(1.794)	(-1.006)	(0.532)	(0.887)
Obs.	360	360	360	360	360	360
R-squared	0.330	0.265	0.427	0.230	0.215	0.051

Table A8: Using the Economic Uncertainty Index to Proxy for the Discount Rate

This table tests the robustness of our main results using the economic uncertainty index (Jurado et al., 2015) to proxy for the discount rate. Panels A7.1A7.2 replicate Table 2, which report the time-series regressions of the average profitability and sales growth on discount rates in industry quintile portfolios sorted on the one-year-lagged upstream concentration ratio. Panels B7.1 and B7.2 replicate Table 3, which report the time-series regressions of the average profitability and sales growth on discount rates in industry quintile portfolios sorted on the one-year-lagged downstream concentration ratio. Panels C7.1 and C7.2 replicate Table 4, which report the heterogeneous returns exposure to discount rates for portfolios sorted on upstream or downstream concentration ratio. The coefficient on *Focal CR4* is multiplied by 100. We omit the coefficients for the constant terms for brevity. We exclude financial industries and industries with two or fewer firms from the analysis. We include t-statistics in the brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A8.1: Upstream Concentration and Sensitivity of Net Profitability to Discount Rates

	Avg. ΔNet Profitability					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	$5-1$
ΔUncertainty	-0.031***	-0.027***	-0.050***	-0.038***	-0.047***	-0.017**
	(-4.683)	(-6.912)	(-5.739)	(-6.675)	(-4.136)	(-2.346)
Focal CR4	0.006	0.030***	0.012	-0.004	0.063***	0.016
	(0.499)	(3.315)	(1.030)	(-0.158)	(2.620)	(1.503)
Obs.	120	120	120	120	120	120
R-squared	0.314	0.334	0.448	0.358	0.375	0.089

Panel A8.2: Upstream Concentration and Sensitivity of Sales Growth to Discount Rates

	Avg. ΔLog Sales					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	$5-1$
ΔUncertainty	-0.207	-0.098	-0.264*	-0.150	-0.315*	-0.169
	(-1.501)	(-0.513)	(-1.924)	(-0.730)	(-1.904)	(-1.650)
Focal CR4	-2.326***	0.118	0.557**	-1.435**	0.044	-0.144
	(-6.464)	(0.571)	(2.174)	(-2.348)	(0.118)	(-0.637)
Obs.	120	120	120	120	120	120
R-squared	0.287	0.008	0.086	0.085	0.051	0.023

Table A8: Using the Economic Uncertainty Index to Proxy for the Discount Rate (Continued)

Panel B8.1: Downstream Concentration and Sensitivity of Net Profitability to Discount Rates

	Avg. ΔNet Profitability					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
ΔUncertainty	-0.039***	-0.044***	-0.028***	-0.046***	-0.055***	-0.015**
	(-7.069)	(-5.343)	(-5.505)	(-5.012)	(-5.343)	(-1.982)
Focal CR4	0.009	-0.004	0.038***	-0.009	0.031	0.003
	(0.875)	(-0.420)	(4.208)	(-1.066)	(1.123)	(0.249)
Obs.	120	120	120	120	120	120
R-squared	0.403	0.436	0.363	0.378	0.439	0.054

Panel B8.2: Downstream Concentration and Sensitivity of Sales Growth to Discount Rates

	Avg. ΔLog Sales					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
ΔUncertainty	-0.079	-0.127	-0.186	-0.378**	-0.385***	-0.294*
	(-0.454)	(-1.025)	(-1.086)	(-2.152)	(-2.669)	(-1.663)
Focal CR4	-0.662**	-1.736***	-1.131***	0.662***	1.353***	0.315
	(-2.293)	(-7.957)	(-3.534)	(2.793)	(2.637)	(1.195)
Obs.	120	120	120	120	120	120
R-squared	0.047	0.300	0.092	0.150	0.134	0.054

Panel C8.1: Upstream Concentration and Sensitivity of Return to Discount Rates

	Accumulated excess returns					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
Acc. Uncertainty Shock	-0.921***	-1.068***	-1.632***	-1.745***	-1.299***	-0.430***
	(-4.271)	(-4.259)	(-8.251)	(-5.702)	(-5.256)	(-2.716)
Focal CR4	1.091***	1.006***	0.366	-1.179***	0.897*	0.543**
	(3.772)	(5.641)	(1.525)	(-3.260)	(1.853)	(2.190)
Obs.	360	360	360	360	360	360
R-squared	0.148	0.152	0.291	0.293	0.122	0.031

Panel C8.2: Downstream Concentration and Sensitivity of Return to Discount Rates

	Accumulated excess returns					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
Acc. Uncertainty Shock	-1.074***	-0.865***	-1.471***	-0.772***	-1.555***	-0.469**
	(-6.049)	(-3.813)	(-6.562)	(-2.665)	(-5.397)	(-2.170)
Focal CR4	0.350*	1.009***	1.194***	-0.486**	1.054*	0.465**
	(1.712)	(3.259)	(4.364)	(-2.250)	(1.757)	(2.345)
Obs.	360	360	360	360	360	360
R-squared	0.187	0.152	0.337	0.057	0.132	0.036

Table A9: Relative Concentration Ratio

This table tests the robustness of our main results using the relative concentration ratio between supplier/customer industry and focal industry. The relative concentration ratio between supplier (customer) industry and focal industry is defined as the ranking of upstream concentration ratio divided by the ranking of the focal industry concentration ratio. Panels A8.1 and A8.2 replicate Table 2, which report the time-series regressions of the average profitability and sales growth on discount rates in industry quintile portfolios sorted on the one-year-lagged upstream concentration ratio. Panels B8.1 and B8.2 replicate Table 3, which report the time-series regressions of the average profitability and sales growth on discount rates in industry quintile portfolios sorted on the one-year-lagged downstream concentration ratio. Panels C8.1 and C8.2 replicate Table 4, which report the heterogeneous returns exposure to discount rates for portfolios sorted on upstream or downstream concentration ratio. The coefficient on *Focal CR4* is multiplied by 100. We omit the coefficients for the constant terms for brevity. We exclude financial industries and industries with two or fewer firms from the analysis. We include t-statistics in the brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A9.1: Upstream Concentration and Sensitivity of Net Profitability to Discount Rates

	Avg. ΔNet Profitability					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
ΔSmooth_EP	-0.296**	-0.309***	-0.531***	-0.308**	-0.493***	-0.197**
	(-2.031)	(-2.723)	(-3.325)	(-2.097)	(-3.965)	(-2.309)
Obs.	120	120	120	120	120	120
R-squared	0.105	0.157	0.231	0.147	0.245	0.056

Panel A9.2: Upstream Concentration and Sensitivity of Sales Growth to Discount Rates

	Avg. ΔLog Sales					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
ΔSmooth_EP	-2.956	-4.876**	-7.625***	-5.153**	-6.370***	-3.414**
	(-1.335)	(-2.093)	(-4.130)	(-2.113)	(-3.142)	(-2.203)
Obs.	120	120	120	120	120	120
R-squared	0.031	0.076	0.179	0.128	0.133	0.042

Table A9: Relative Concentration Ratio (Continued)

Panel B9.1: Downstream Concentration and Sensitivity of Net Profitability to Discount Rates

	Avg. ΔNet Profitability					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
ΔSmooth_EP	-0.227**	-0.538***	-0.358***	-0.328**	-0.378***	-0.151**
	(-2.091)	(-2.954)	(-3.264)	(-2.097)	(-3.632)	(-2.378)
Obs.	120	120	120	120	120	120
R-squared	0.087	0.245	0.181	0.153	0.207	0.044

Panel B9.2: Downstream Concentration and Sensitivity of Sales Growth to Discount Rates

	Avg. ΔLog Sales					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
ΔSmooth_EP	-1.811	-5.945**	-6.843***	-5.375**	-7.110***	-5.298***
	(-0.981)	(-2.027)	(-3.267)	(-2.569)	(-3.561)	(-4.843)
Obs.	120	120	120	120	120	120
R-squared	0.012	0.118	0.152	0.130	0.137	0.084

Panel C9.1: Upstream Concentration and Sensitivity of Return to Discount Rates

	Accumulated excess returns					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
Acc. Smooth EP Shocks	-16.260***	-19.981***	-18.082***	-17.578***	-20.102***	-3.842*
	(-9.018)	(-7.472)	(-14.243)	(-13.572)	(-11.908)	(-1.894)
Obs.	360	360	360	360	360	360
R-squared	0.618	0.513	0.638	0.640	0.534	0.053

Panel C9.2: Downstream Concentration and Sensitivity of Return to Discount Rates

	Accumulated excess returns					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	5 − 1
Acc. Smooth EP Shocks	-14.657***	-15.767***	-21.416***	-16.926***	-22.356***	-7.699***
	(-13.655)	(-8.856)	(-9.680)	(-13.170)	(-10.618)	(-4.841)
Obs.	360	360	360	360	360	360
R-squared	0.661	0.504	0.547	0.633	0.680	0.180

Table A10: Value-Weighted Measures of Operating Performance

This table tests the robustness of our main results using the value-weighted measures of operating performance. Panels A10.1 and A10.2 replicate Table 2, which report the time-series regressions of the wegiht-average profitability and sales growth on discount rates in industry quintile portfolios sorted on the one-year-lagged upstream concentration ratio. The weight is either industry input or COGS as indicated on the top of the panel. Panels B10.1 and B10.2 replicate Table 3, which report the time-series regressions of the weight-average profitability and sales growth on discount rates in industry quintile portfolios sorted on the one-year-lagged downstream concentration ratio. The weight is either sales or COGS as indicated on the top of the panel. We omit the results of the second to fourth portfolios for brevity. The coefficient on *Focal CR4* is multiplied by 100. We omit the coefficients for the constant terms for brevity. We exclude financial industries and industries with two or fewer firms from the analysis. We include t-statistics in the brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A10.1: Supplier Concentration and Sensitivity of Net Profitability to Discount Rates

	Avg. ΔNet Profitability					
	Weight: IO Input			Weight: COGS		
	Q1 (low)	Q5 (high)	$5-1$	Q1 (low)	Q5 (high)	$5-1$
ΔSmooth_EP	-0.399***	-0.537***	-0.139*	-0.470***	-0.647***	-0.194**
	(-3.754)	(-4.143)	(-1.817)	(-3.910)	(-4.442)	(-2.044)
Focal CR4	0.021	0.038	0.009	0.020*	0.062***	-0.005
	(1.248)	(1.542)	(0.765)	(1.949)	(3.597)	(-0.370)
Obs.	120	120	120	120	120	120
R-squared	0.232	0.237	0.029	0.306	0.268	0.036

Panel A10.2: Supplier Concentration and Sensitivity of Sales Growth to Discount Rates

	Avg. ΔLog Sales					
	Weight: IO Input			Weight: COGS		
	Q1 (low)	Q5 (high)	$5-1$	Q1 (low)	Q5 (high)	$5-1$
ΔSmooth_EP	-4.286**	-7.343***	-2.368*	-3.721	-7.280***	-2.158
	(-2.379)	(-3.332)	(-1.781)	(-1.481)	(-3.158)	(-1.063)
Focal CR4	-2.320***	0.469	-0.164	-1.588***	0.246	-0.203
	(-5.839)	(1.294)	(-0.838)	(-5.590)	(0.509)	(-0.798)
Obs.	120	120	120	120	120	120
R-squared	0.222	0.178	0.023	0.266	0.104	0.012

Table A10: Value-Weighted Measures of Operating Performance (Continued)

Panel A10.3: Customer Concentration and Sensitivity of Net Profitability to Discount Rates

	Avg. ΔNet Profitability					
	Weight: Sales			Weight: COGS		
	Q1 (low)	Q5 (high)	5 − 1	Q1 (low)	Q5 (high)	5 − 1
ΔSmooth_EP	-0.250***	-0.637***	-0.443**	-0.293***	-0.717***	-0.491*
	(-3.150)	(-2.738)	(-2.085)	(-2.994)	(-2.792)	(-1.946)
Focal CR4	0.017**	-0.008	-0.010	0.022*	-0.007	-0.012
	(2.015)	(-0.592)	(-1.080)	(1.881)	(-0.521)	(-1.004)
Obs.	120	120	120	120	120	120
R-squared	0.113	0.176	0.098	0.107	0.185	0.092

Panel A10.4: Customer Concentration and Sensitivity of Sales Growth to Discount Rates

	Avg. ΔLog Sales					
	Weight: Sales			Weight: COGS		
	Q1 (low)	Q5 (high)	5 − 1	Q1 (low)	Q5 (high)	5 − 1
ΔSmooth_EP	-1.698	-7.788***	-5.417***	-1.067	-9.024***	-7.423***
	(-0.803)	(-3.813)	(-2.670)	(-0.580)	(-4.011)	(-4.383)
Focal CR4	-0.174	0.398**	0.185	-0.089	0.158	0.177
	(-0.962)	(2.338)	(1.530)	(-0.492)	(0.874)	(1.588)
Obs.	120	120	120	120	120	120
R-squared	0.015	0.215	0.089	0.005	0.149	0.106