# Online Appendix

*Before the Storm: Firm Policies and Varying Recession Risk*

By: Ali Kakhbod, Dmitry Livdan, A. Max Reppen, and Tarik Umar

This Appendix contains supplementary theoretical and empirical work.

1. Appendix A provides proofs.

2. Appendix B details the numerical algorithm.

3. Appendix C provides additional theoretical work.

   - Section C.1 illustrate several main mechanisms in simpler models.
   - Figure C.2 shows the transition probabilities diagram.
   - Figure C.3 shows the policy diagram for the recession regime $h$.
   - Figure C.4 shows optimal policies in $(k, c/k)$ space.
   - Figure C.5 shows optimal policies when issuance allowed in recession.
   - Figure C.6 shows optimal policies when disinvestment is allowed.
   - Section C.3 Robustness: Cyclical discount rate $r$ & issuance costs $\lambda_f$

4. Appendix D provides additional empirical work.

   - Table D.1 provides anecdotal evidence that large firms are more sensitive to changes in recession risk.
   - Table D.2 shows issuances decline in NBER recessions.
   - Table D.3 shows the correlation of our recession probability measure with other leading indicators.
   - Table D.4 shows the Compustat sample selection criteria.
   - Table D.5 repeats Table 6 using PP&E.
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   - Table D.9 shows robustness for Table 6 column (4) on dividend growth.

- Table D.10 shows robustness for Table 6 column (5) on investment growth.
- Table D.11 examines whether the most cyclical firms are different.
- Table D.12 examines whether the least cyclical firms are different.

# A Proofs

For notational convenience, in this section, we write the subscript in $V_s$ as an additional argument, e.g., $V(k,c,s) = V_s(k,c)$.

We simplify the setting of the comparison proof by making the following assumption: For each $k$ and $s$, there exists a cash level such that dividend payouts are optimal whenever $c$ is above that level, and this level is continuous in $k$. Furthermore, since the proof compactifies in $k$, we, for expositional simplification, assume that this level is a constant $\bar{C}$. We may thus write the HJB equation on the domain

$$\mathcal{O} = [0,\infty) \times [0,\bar{C}] \times \{l,m,h\}, \tag{16}$$

with the additional boundary condition

$$\partial_c V = 1 \quad \text{where } c = \bar{C}. \tag{17}$$

This is indeed satisfied by the value function, and in the numerical experiments, we verify that this is correct by solving on larger domains and observing that the dividend boundary does not move.

**Theorem 1.** *Let $u$ and $v$ be, respectively, continuous viscosity sub- and supersolutions to* (12) *in $\mathcal{O}$ with the boundary conditions* (13) *and* (17). *Assume further that $u$ and $v$ are both of linear growth in $c$ and polynomial growth in $k$, i.e., they take values in $[c, c+M+p(k)]$ for some constant $M > 0$ and polynomial $p$. Then, $u \leq v$ everywhere in $\mathcal{O}$.*

In the proof, we will use the result from Altarovici, Reppen and Soner (2017) establishing that the functions obtained from applying the issuance operator to $u$ and $v$ are continuous. Although (12) shares a lot of similarity with that in Kakhbod et al. (2024), the added economic regimes leads to issuance in the interior of the domain, which significantly increases the difficulty of the comparison proof.

*Proof.* In this proof, we drop the dependence of $\mu_s$ and $\sigma_s$ on the cycle $s$ from the notation, as this dependence does not affect the arguments.

Suppose there exists a point at which $u > v$. Fix some $\eta_k > 0$ and consider $e^{-\eta_k k}(u - v)$, which, by the growth condition is bounded and attains a maximizer. We may therefore restrict ourselves to maximizers in a compact domain on which $k$ is bounded by $k^*$, the latter depending only on $\eta_k$. Let $\hat{v}_\omega = (1-\omega)v + \omega(1+\lambda_p(s))c$, for some $\omega > 0$ small enough that $u > \hat{v}_\omega$ somewhere. From here on, we omit the $\omega$ in the notation: $\hat{v} = \hat{v}_\omega$.

Denote by $(\bar{k},\bar{c},\bar{s})$ a maximizer of $e^{-\eta_k k}(u-\hat{v})$. We may choose it so that $\{(\bar{k},c,s)\in\mathcal{O}: c>\bar{c}\}$ does not contain any other maximizer. As a consequence, by the compactness of $\mathcal{O}$ in $c$, all points above $\bar{c}$ are take strictly lower values.

Let $\delta_\eta$ be the corresponding maximum. Define $\bar{f}(k,c,s)=\|(k,c,s)-(\bar{k},\bar{c},\bar{s})\|^4$ and

$$\Phi^\epsilon(k,c,s,\ell,d,t)=e^{-\eta_k k}u(k,c,s)-e^{-\eta_k \ell}\hat{v}(\ell,d,t)\\ -\beta\bar{f}(k,c,s)-\frac{1}{2\epsilon}\Big((c-d)^2+(k-\ell)^2+(s-t)^2\Big)\quad\text{in }\mathcal{O}\times\mathcal{O}.$$

Clearly,

$$\sup_{\mathcal{O}\times\mathcal{O}}\Phi^\epsilon\geq\Phi^\epsilon(\bar{k},\bar{c},\bar{s},\bar{k},\bar{c},\bar{s})=e^{-\eta_k\bar{k}}\Big(u(\bar{k},\bar{c},\bar{s})-\hat{v}(\bar{k},\bar{c},\bar{s})\Big)=\delta_\eta.$$

In particular, $\Phi^\epsilon$ has a maximizer $(k_\epsilon,c_\epsilon,s_\epsilon,\ell_\epsilon,d_\epsilon,t_\epsilon)$ because of the growth conditions on $u$ and $v$. Moreover, the growth conditions give an upper bound for this maximizer, depending only on $\eta_k$. Therefore, $(k_\epsilon,c_\epsilon,s_\epsilon,\ell_\epsilon,d_\epsilon,t_\epsilon)$ converges along a subsequence as $\epsilon\to 0$. From here on, let us only consider $\epsilon$ along this subsequence. Because the lower bound at the maximum above is independent of $\epsilon$,

$$0<\delta_\eta\leq\liminf_{\epsilon\to 0}\Phi^\epsilon(k_\epsilon,c_\epsilon,s_\epsilon,\ell_\epsilon,d_\epsilon,t_\epsilon),$$

which implies

$$\limsup_{\epsilon\to 0}\frac{1}{2\epsilon}\Big((c_\epsilon-d_\epsilon)^2+(k_\epsilon-\ell_\epsilon)^2+(s_\epsilon-t_\epsilon)^2\Big)<\infty,$$

so $(k_\epsilon,c_\epsilon,s_\epsilon),(\ell_\epsilon,d_\epsilon,t_\epsilon)\to(\bar{k},\bar{c},\bar{s})$. Note that $\bar{k}\leq k^*$, again because of the growth condition.

Rearranging terms and letting $\epsilon\to 0$,

$$\begin{aligned}\lim_{\epsilon\to 0}\beta\bar{f}(k_\epsilon,c_\epsilon,s_\epsilon)+\lim_{\epsilon\to 0}\frac{1}{2\epsilon}\Big((c_\epsilon-d_\epsilon)^2+(k_\epsilon-\ell_\epsilon)^2+(s_\epsilon-t_\epsilon)^2\Big)\\ &\leq\limsup_{\epsilon\to 0}e^{-\eta_k k_\epsilon}u(k_\epsilon,c_\epsilon,s_\epsilon)-e^{-\eta_k\ell_\epsilon}\hat{v}(\ell_\epsilon,d_\epsilon,t_\epsilon)-\delta_\eta\\ &\leq e^{-\eta_k\bar{k}}\Big(u(\bar{k},\bar{c},\bar{s})-\hat{v}(\bar{k},\bar{c},\bar{s})\Big)-\delta_\eta\\ &\leq 0.\end{aligned}$$

That is,

$$\lim_{\epsilon\to 0}\beta\bar{f}(k_\epsilon,c_\epsilon,s_\epsilon)+\lim_{\epsilon\to 0}\frac{1}{2\epsilon}\Big((c_\epsilon-d_\epsilon)^2+(k_\epsilon-\ell_\epsilon)^2+(s_\epsilon-t_\epsilon)^2\Big)\leq 0.\tag{18}$$

If $\bar{k} = 0$, we directly obtain $u(\bar{c}, 0) \leq \bar{c} \leq v(\bar{c}, 0)$, which is a contradiction. If $\bar{c} = 0$, the situation is either similar or the issuance condition is active, in which case it can be treated similarly to the issuance condition on the interior. Hence, we resume with the case that $(\bar{k}, \bar{c}, \bar{s})$ lies in the interior, and therefore also $(k_\epsilon, c_\epsilon, s_\epsilon)$ and $(\ell_\epsilon, d_\epsilon, t_\epsilon)$ for sufficiently small $\epsilon$.

Because the maxima are attained in interior points, we proceed to use Ishii's lemma. Since the equation only has a second derivative in $c$, we abuse notation and consider the corresponding elements of the jets as only the $\partial_{cc}$-component. We obtain $(p^u, X) \in \bar{J}^{2,+}(e^{-\eta_k k_\epsilon} u(k_\epsilon, c_\epsilon, s_\epsilon))$ and $(p^v, Y) \in \bar{J}^{2,-}(e^{-\eta_k \ell_\epsilon}(1-\omega) v(\ell_\epsilon, d_\epsilon, t_\epsilon))$ (Crandall, Ishii and Lions, 1992, Theorem 3.2), satisfying

$$
\begin{aligned}
p_c &= \frac{c_\epsilon - d_\epsilon}{\epsilon} \\
p^u &= (p^u_c, p^u_k) = \left( p_c + 4\beta(c_\epsilon - \bar{c})^3, p^v_k + 4\beta(k_\epsilon - \bar{k})^3 \right), \\
p^v &= (p^v_c, p^v_k) = \left( p_c - e^{-\eta_k \ell_\epsilon} \omega (1 + \lambda_p(t_\epsilon)), \frac{k_\epsilon - \ell_\epsilon}{\epsilon} \right)
\end{aligned}
$$

and

$$
k_\epsilon^{2\alpha} X - \ell_\epsilon^{2\alpha} Y \leq k_\epsilon^{2\alpha} 12\beta(c_\epsilon - \bar{c})^2 + \frac{(k_\epsilon^\alpha - \ell_\epsilon^\alpha)^2}{\epsilon} + o(1),
$$

where $o(1)$ denotes a term that converges to 0 as $\epsilon \to 0$.

Because $u$ is a subsolution, $\tilde{u} = e^{-\eta_k k} u$ satisfies

$$
\begin{aligned}
0 \geq \min \Bigg\{ & r\tilde{u} - \sup_{i \in [0, i_{\max}]} \Bigg( \Big[ i - \delta k_\epsilon \Big] (\eta_k \tilde{u} + \partial_k \tilde{u}) \\
&\quad + \Big[ (r - \lambda_c) c_\epsilon + k_\epsilon^\alpha \mu - i - g(k_\epsilon, i) \Big] \partial_c \tilde{u} \\
&\quad + \frac{1}{2} k_\epsilon^{2\alpha} \sigma^2 \partial^2_{cc} \tilde{u} \\
&\quad + \sum_{s'} q_{s_\epsilon, s'} \tilde{u}(k_\epsilon, c_\epsilon, s') \Bigg), \\
& \tilde{u}(k_\epsilon, c_\epsilon, s_\epsilon) - \sup_{\Delta I \geq 0} \Big[ \tilde{u}(k_\epsilon, c_\epsilon + \Delta I, s_\epsilon) - e^{-\eta k_\epsilon} (\Delta I + \lambda(\Delta I, s_\epsilon)) \Big], \\
& \partial_c \tilde{u} - e^{-\eta_k k_\epsilon} \Bigg\}.
\end{aligned} \tag{19}
$$

Similarly, $\tilde{v} = e^{-\eta k}(1-\omega)v$ satisfies[15]

$$
\begin{aligned}
0 \leq \min \Bigg\{ r\tilde{v} - \sup_{i\in[0,i_{\max}]} \Bigg( & \Big[i - \delta \ell_\epsilon\Big](\eta_k \tilde{v} + \partial_k \tilde{v}) \\
& + \Big[(r-\lambda_c)d_\epsilon + \ell_\epsilon^\alpha \mu - i - g(\ell_\epsilon, i)\Big]\partial_c \tilde{v} \\
& + \frac{1}{2}\ell_\epsilon^{2\alpha}\sigma^2 \partial_{cc}^2 \tilde{v} \\
& + \sum_{s'} q_{t_\epsilon, s'} \tilde{v}(\ell_\epsilon, d_\epsilon, s') \Bigg), \\
& \hat{v}(\ell_\epsilon, d_\epsilon, t_\epsilon) - \sup_{\Delta I \geq 0} \Big[\hat{v}(\ell_\epsilon, d_\epsilon + \Delta I, t_\epsilon) - e^{-\eta \ell_\epsilon}(\Delta I + \lambda(\Delta I, t_\epsilon))\Big], \\
& \partial_c \tilde{v} - (1-\omega)e^{-\eta_k \ell_\epsilon} \Bigg\}.
\end{aligned}
\tag{20}
$$

We split into two cases, depending on which expression is smallest in Equation (19). We begin with the simple case of

$$p_c^u \leq e^{-\eta_c k_\epsilon}.$$

Subtracting the two equations (19) and (20) thus gives

$$e^{\eta_k \ell_\epsilon}\omega(1+\lambda_p(t_\epsilon)) + 4\beta(c_\epsilon - \bar{c})^3 = p_c^u - p_c^v \leq e^{-\eta_k k_\epsilon} - (1-\omega)e^{-\eta_k \ell_\epsilon}.$$

Letting $\epsilon \to 0$, and dividing out equal factors, $\lambda_p(t_\epsilon) \leq 0$, which is a contradiction.

In the issuance case, because $\tilde{u}$ is continuous and $\lambda_f > 0$, there exist a (uniform as $\epsilon \to 0$) choice of $\underline{I}$ so that the optimization can be restricted to $I \geq \underline{I}$. We subtract the equations and pass to limits. Using the continuity of the issuance operator, $(\bar{k}, \bar{c}, \bar{s}) = (\bar{k}, \bar{c}, \bar{s})$, and the fact that $(\tilde{u} - \hat{v})(\bar{k}, \bar{c} + I, \bar{s})$ is strictly smaller than the maximum,

$$(\tilde{u} - \hat{v})(\bar{k}, \bar{c}, \bar{s}) \leq \sup_{\Delta I \geq \underline{I}} \Big[(\tilde{u} - \hat{v})(\bar{k}, \bar{c} + \Delta I, \bar{s})\Big] < (\tilde{u} - \hat{v})(\bar{k}, \bar{c}, \bar{s}),$$

which is a contradiction.

[15]For convenience, we write the issuance expression in terms of $\hat{v}$, which we can do thanks to the growth rate of $1 + \lambda_p(s)$.

This leaves the final case, so we subtract the equations and get

$$
\begin{aligned}
r(\tilde{u}-\tilde{v}) \le \sup_{i\in[0,i_{\max}]} \Bigg\{ & \Big[i-\delta_\zeta k_\epsilon\Big](\eta_k \tilde{u}(k_\epsilon,c_\epsilon,s_\epsilon)+p_k^v+4\beta(k_\epsilon-\bar{k})^3) \\
& + \Big[(r-\lambda_c)c_\epsilon + k_\epsilon^\alpha\mu - i - g(k_\epsilon,i)\Big](p_c+4\beta(c_\epsilon-\bar{c})^3)+\frac{1}{2}k_\epsilon^{2\alpha}\sigma^2 X \\
& + \sum_{s'} q_{s_\epsilon,s'}\tilde{u}(k_\epsilon,c_\epsilon,s') \\
& - \Big[i-\delta_\zeta \ell_\epsilon\Big](\eta_k\tilde{v}(\ell_\epsilon,d_\epsilon,t_\epsilon)+p_k^v) \\
& - \Big[(r-\lambda_c)d_\epsilon+\ell_\epsilon^\alpha\mu - i - g(\ell_\epsilon,i)\Big](p_c^u - e^{-\eta_k\ell_\epsilon}\omega(1+\lambda_p(t_\epsilon)) \\
& - \sum_{s'} q_{t_\epsilon,s'}\tilde{v}(\ell_\epsilon,d_\epsilon,s') \\
& - \frac{1}{2}\ell_\epsilon^{2\alpha}\sigma^2 Y \Bigg\} \\
\le \sup_{i\in[0,i_{\max}]} \Bigg\{ & i\eta_k(\tilde{u}(k_\epsilon,c_\epsilon,s_\epsilon)-\tilde{v}(\ell_\epsilon,d_\epsilon,t_\epsilon)) \\
& + \Big[i-\delta_\zeta k_\epsilon\Big]4\beta(k_\epsilon-\bar{k})^3 \\
& + \Big[(r-\lambda_c)c_\epsilon+k_\epsilon^\alpha\mu-i-g(k_\epsilon,i)\Big]4\beta(c_\epsilon-\bar{c})^3 \\
& + \Big[(r-\lambda_c)d_\epsilon+\ell_\epsilon^\alpha\mu-i-g(\ell_\epsilon,i)\Big]e^{-\eta_k\ell_\epsilon}\omega(1+\lambda_p(t_\epsilon)) \\
& - \delta_\zeta(\ell_\epsilon-k_\epsilon)p_k^u + \Big[(k_\epsilon^\alpha-\ell_\epsilon^\alpha)\mu - (g(k_\epsilon,i)-g(\ell_\epsilon,i))\Big]p_c^v \\
& + 6k_\epsilon^{2\alpha}\sigma^2\beta(c_\epsilon-\bar{c})^2 + \frac{(k_\epsilon^\alpha-\ell_\epsilon^\alpha)^2}{\epsilon}\Bigg\} + o(1),
\end{aligned}
$$

where we use that $q_{s,s} = -\sum_{s'\neq s} q_{s,s'}$ and

$$
\begin{aligned}
\sum_{s'} q_{s_\epsilon,s'}\tilde{u}(k_\epsilon,c_\epsilon,s') - \sum_{s'} q_{t_\epsilon,s'}\tilde{v}(\ell_\epsilon,d_\epsilon,s') \\
= \sum_{s'} q_{s_\epsilon,s'}e^{-\eta_k k_\epsilon}u(k_\epsilon,c_\epsilon,s') - \sum_{s'} q_{t_\epsilon,s'}e^{-\eta_k\ell_\epsilon}\hat{v}(\ell_\epsilon,d_\epsilon,s') \le o(1),
\end{aligned}
$$

the latter because $e^{-\eta_k k}(u-\hat{v})$ is maximized at the limit $(\bar{k},\bar{c},\bar{s})$.

Let $\eta_k < (r-\Delta)/i_{\max}$ for some $\Delta \in (0,r)$. Then, taking $\limsup$ as $\epsilon \to 0$, and using that $g(\cdot,i)$ and $k \mapsto k^\alpha$ are Lipschitz in the neighborhood of $(\bar{k},\bar{c},\bar{s})$, i.e.,

$$
|g(k_\epsilon,i)-g(\ell_\epsilon,i)| + \mu|k_\epsilon^\alpha - \ell_\epsilon^\alpha| \le R|k_\epsilon-\ell_\epsilon|,
$$

we get

$$\limsup_{\epsilon\to 0} \Delta(\tilde{u}(k_\epsilon, c_\epsilon, s_\epsilon) - \tilde{v}(\ell_\epsilon, d_\epsilon, t_\epsilon))$$
$$\leq \lim_{\epsilon\to 0} \Bigg[ (\delta_\zeta + R^2)\frac{(k_\epsilon - \ell_\epsilon)^2}{\epsilon} + R\frac{(c_\epsilon - d_\epsilon)}{\sqrt{\epsilon}}\frac{(k_\epsilon - \ell_\epsilon)}{\sqrt{\epsilon}}$$
$$+ R'(|c_\epsilon - \bar{c}|^2 + |c_\epsilon - \bar{c}|^3 + |k_\epsilon - \bar{k}|^3 + d_\epsilon \omega) + o(1)\Bigg] = R'\bar{c}\omega,$$

for some constant $R'$, depending on $k^*$ (i.e., $\eta_k$), $i_{\max}$, $\beta$, and the model parameters. Finally, because $\Delta > 0$, for small enough $\omega$,

$$\delta_\eta/2 \leq e^{-\eta\bar{k}}(u - (1-\omega)v)(\bar{k}, \bar{c}, \bar{s}) \leq \frac{R'}{\Delta}\bar{c}\omega,$$

which is a contradiction, because $\bar{c} \leq \bar{C}$ and $\omega$ can be chosen arbitrarily small. Hence, there cannot exist a point $(c, k)$ such that $(u - v)(c, k) > 0$.

□

The value function is bounded by the value of a firm that is permanently in an expansion, which is bounded by $M + c + k$. As a consequence, $V$ satisfies the assumptions of Theorem 1. The following results are standard consequences of the comparison of viscosity solutions.

**Corollary 2.** *The value function $V$ is the unique solution to Equation* (12) *on* (16) *with its boundary conditions.*

For computations, in addition to (13), the boundary conditions where $c = c_{\max}$ and $k_{\max}$ are given by

$$0 = \partial_c V - 1 \qquad \text{at } c = c_{\max}$$
$$0 = \min\Bigg\{ rV + \delta k \partial_k V - \Big[rc + k^\alpha \mu\Big]\partial_c V - \frac{1}{2}k^{2\alpha}\sigma^2\partial^2_{cc}V, \qquad \text{at } k = k_{\max}$$
$$\partial_c V - 1, V(k, c, s) - \sup_{\Delta I \geq 0}\Big(V(k, c + \Delta I, s) - \Delta I - \lambda(\Delta I, s)\Big)\Bigg\}$$

At the corners, the $c$-conditions are used.

Another consequence of the comparison result in Theorem 1 is the convergence of the numerical scheme (see Section B).

**Corollary 3.** *Numerical solutions converge to the value function as the discretization gets finer.*

# B Numerical Algorithm

In this section, we provide a detailed overview of the policy iteration method as described in Kushner and Dupuis (2001) (Chapters 5 and 6), which is utilized to address the model at hand. Notably, the algorithm we propose has been proven to reliably converge to the unique solution of the Hamilton-Jacobi-Bellman (HJB) equation. The foundation for this convergence – anchored in the viscosity comparison theorem – along with the proof of the uniqueness of the value function that satisfies the HJB equation, is thoroughly documented in Appendix A. It is important to underscore some subtleties in applying the policy iteration method within this framework, particularly due to the impulsive and singular control of dividend payouts and equity issuance. To effectively navigate these singularities, our approach involves refining the problem through policy iteration, applied to a model that approximates the original by discretizing the problem space and introducing a penalty for singular behavior. This methodological adaptation is critical to handling the unique challenges posed by singular controls. For a deeper discussion of the convergence of our approach and its comparison with alternative strategies, we direct readers to the works of Azimzadeh and Forsyth (2016) and Reppen, Jean-Charles and Soner (2020).

For some policy $\pi = (\pi_{\text{inv}}, \pi_{\text{div}}, \pi_{\text{iss}})$, let $\pi_{\text{inv}}$ denote the investment intensity, $\pi_{\text{div}}$ denote whether dividends are paid, and $\pi_{\text{iss}}$ the issuance amount. Let $\mathcal{C}_{\pi_{\text{inv}}}V$ be the expression in (11) with $i = \pi_{\text{inv}}$, and let $\mathcal{I}_{\pi_{\text{iss}}}V(k,c,s) = V(k, c+\pi_{\text{iss}}, s) - \pi_{\text{iss}} - \lambda(\pi_{\text{iss}}, s)$. For an optimal policy, we can then write the HJB equation (12) as

$$0 = \min\{\mathcal{C}_{\pi_{\text{inv}}}V, \mathcal{D}V, \mathcal{I}_{\pi_{\text{iss}}}V\}.$$

Next, define

$$\mathcal{M}_{\pi}V = \mathcal{C}_{\pi_{\text{inv}}}V + m1_{\pi_{\text{div}}}\mathcal{D}V + m1_{\{\pi_{\text{iss}}>0\}}\mathcal{I}_{\pi_{\text{iss}}}V,$$

for some large $m \gg 1$. The equation

$$0 = \inf_{\pi} \mathcal{M}_{\pi}V$$

is referred to as a penalized version of the problem and has a natural stochastic representation as randomized activation of the control actions.

Finally, let $\mathcal{B}$ denote the discretized domain of computation[16] and, with some abuse of

[16] We select this domain to be substantially large and impose the following boundary conditions. At $k = 0$, the adjustment cost $g$ is infinite for $i > 0$. Conversely, at $k = k_{max}$ (which is sufficiently large), the advantage of investment becomes negligible in comparison to the adjustment cost, because of diminishing

notation, $\mathcal{M}_\pi(k,c,s,k',c',s')$ the coefficient in the discretization of $\mathcal{M}_\pi$ for point $(k',c',s')$ in the equation for $(k,c,s)$. With an initial policy $\pi^0$, we iterate the following.

---

**Policy iteration algorithm** (step *i*)

---

1. Compute $V^i$ such that

$$\sum_{(k',c',s')\in\mathcal{B}} \mathcal{M}_{\pi^i}(k,c,s,k',c',s')V^i(k',c',s') = 0, \quad \forall(k,c,s)\in\mathcal{B}.$$

   Halt if $V^i = V^{i-1}$.

2. For each $(k,c,s)\in\mathcal{B}$, compute $\pi^{i+1}(k,c,s)$ according to

$$\pi^{i+1}(k,c,s) \in \arg\min_{\hat{\pi}} \sum_{(k',c',s')\in\mathcal{B}} \mathcal{M}_{\hat{\pi}}(k,c,s,k',c',s')V^i(k',c',s').$$

   Set $\pi^{i+1} = \pi^i$ if possible.

3. Return to step (i).

---

Finally, it is crucial to ensure that $\mathcal{M}$ is discretized to become weakly diagonally dominant. This condition is met when the discretized operator can be interpreted as the transition matrix of a (continuous time) Markov chain. Then, Theorem 1 and Corollary 3 prove convergence (see Appendix A).

## B.1 Estimation procedure

We implement the simulated method of moments (SMM) to calibrate the parameters $\Xi$, $\alpha$, and $\theta$ in Table 3 (Gourieroux, Monfort and Renault (1993) and Gourieroux and Monfort (1996)). We denote the vector of parameters $\Phi = (\Xi, \alpha, \theta)$. The parameter $\Xi$ serves as a scaling factor for the cash-flow parameters $\mu$ and $\sigma$.

To motivate the $\Xi$ parameter, we use Compustat data to compute, for each firm, the

returns to scale and depreciation. Therefore, at both extremes, we set the boundary condition to no investment. With $k_{max}$ set, we anticipate that the firm will optimally pay out excess cash for sufficiently large cash levels. Thus, we impose $\partial_c V = 1$ at $c = c_{max}$ and $k \in [0, k_{max}]$ as the boundary conditions, for $c_{max}$ sufficiently large. We verify that the first group of terms on the right-hand side of equation (12) is positive, ensuring that $c_{max}$ is of appropriate magnitude.

average and standard deviation of

$$\frac{\text{Cash Flow}_t}{(\text{Total Assets}_{t-1} - \text{Cash}_{t-1})^{\tilde{\alpha}}}$$

across time, for different values of $\tilde{\alpha} \in [0,1]$. We denote these firm-level statistics by $\text{Mean\_CK}_i(\tilde{\alpha})$ and $\text{Std\_CK}_i(\tilde{\alpha})$, respectively. We then take their cross-sectional averages:

$$\text{Mean\_CK}(\tilde{\alpha}) = \frac{1}{N}\sum_i \text{Mean\_CK}_i(\tilde{\alpha}) \quad \text{and} \quad \text{Std\_CK}(\tilde{\alpha}) = \frac{1}{N}\sum_i \text{Std\_CK}_i(\tilde{\alpha}),$$

where $N$ is the number of firms in the sample. These quantities serve as empirical counterparts to the model-implied cash-flow terms $\mu k^{\alpha-\tilde{\alpha}}$ and $\sigma k^{\alpha-\tilde{\alpha}}$. In the data, the ratio $\frac{\text{Mean\_CK}(\tilde{\alpha})}{\text{Std\_CK}(\tilde{\alpha})}$ remains relatively stable across different values of $\tilde{\alpha}$, indicating that the empirical mean and volatility of firm cash flows scale similarly with capital $k$. This stability allows us to estimate the ratio $\mu/\sigma$ from $\text{Mean\_CK}(1)/\text{Std\_CK}(1)$. We therefore introduce the scaling parameter $\Xi$ to jointly identify $\mu$ and $\sigma$:

$$\mu = \Xi \times \text{Mean\_CK}(1) \quad \text{and} \quad \sigma = \Xi \times \text{Std\_CK}(1).$$

For each vector of parameters given, we solve first for the optimal policy functions of the firm following the numerical algorithm outlined at the beginning of Section B. Then, we determine the firm's capital by randomly sampling from a uniform distribution over the interval $[0, \overline{k}(\Phi)]$, where $\overline{k}(\Phi)$ represents the maximum capital level at which the firm continues to invest in capital for some cash level. For each such sampled initial capital level $k_0$, the firm's initial cash holdings $c_0$ start from the dividend payout boundary at $k_0$.[17] Starting from each initial state $(k_0, c_0)$, we simulate 200 independent paths starting at $s_0 = l$ and treat each as the state trajectory of one firm.[18] For each path, we discard the first four years of simulated dynamics to avoid the influence of the initial conditions (such as $s_0 = l$) and then simulate the state dynamics of the firm for an additional 10 years, using the optimal strategies of the firm. We chose a four-year burn-in period because, in our simulations, the joint distribution of the state variables (economic regime, capital,

[17] From the perspective of investors, this approach represents an optimal strategy. If investors start a firm by transfer of their own cash to the firm, they choose $c_0$ to maximize $V(k_0, c_0) - c_0 - pk_0$, where $p$ is the price of capital. The first-order condition in $c_0$ implies that $V_c(k_0, c_0) = 1$, so $c_0$ is at least higher than the dividend boundary at $k_0$. The initial cash position is selected at the dividend boundary to ensure the firm avoids disbursing a lump-sum dividend immediately following its establishment. If that were the situation, investors would have the option to invest a smaller amount of cash into the firm at the outset.

[18] To be clear: We simulate the time series of regime changes according to the calibrated transition probability matrix in Table 1. We do not use the actual time series of regime changes in the historical data.

and cash holdings) across the full sample stabilizes well within that window, and the resulting moments are insensitive to longer burn-in periods. For example, in Table B1, we show that doubling the burn-in period to eight years does not have a meaningful effect on the marginal distributions of the cash $c$ and capital $k$ states. Moreover, this also leads to a marginal for $s$ that is practically the theoretical steady state. At each point in time $t$, the post-burn-in paths thus represent the distribution $p_t(k, c, s)$ that solves the Fokker–Planck–Kolmogorov equation corresponding to the $(k, c, s)$-dynamics under the optimal policy, cf. (12), which behaves like a steady state, i.e. $\partial_t p_t \approx 0$, after the burn-in.

Table B1: Summary statistics for burn variables

| | Cash, $c$ | | Capital, $k$ | |
|---|---|---|---|---|
| Statistic | 4Y Burn | 8Y Burn | 4Y Burn | 8Y Burn |
| Mean | 2.7154 | 2.7230 | 11.7557 | 11.7873 |
| Std | 0.5003 | 0.4980 | 0.8171 | 0.7937 |
| 25% | 2.4202 | 2.4307 | 11.3024 | 11.3588 |
| Median | 2.7508 | 2.7535 | 12.0641 | 12.0902 |
| 75% | 2.9691 | 2.9717 | 12.4071 | 12.4149 |

During the simulation for each firm, and after the burn-in period, we calculate the firm-level average (1) EBITDA to total assets ratio (expected cash flow to capital ratio), (2) cash to total assets ratio, and (3) net investment (capital expenditures less depreciation) to property, plant, and equipment ratio. We also calculate (4) the standard deviation of the net investment ratio and (5) the autocorrelation of the net investment ratio. These moments are thus calculated for 200 paths for each $(k_0, c_0)$. Finally, we take cross-sectional average of these firm-level moments and denote these five model-generated moments as the (column) vector $\Psi(\Phi)$.

Let $\{X_i\}_{i\in\{i,\dots,N\}}$ be the set of vectors of firm-level data (column). $X_i$ represents the five firm-level moments for firm $i$. The cross-sectional mean of firm-level moments are

$$\Psi_D = \frac{1}{N}\sum_{i=1}^{N} X_i.$$

Define the function

$$g(\Phi, X) = X - \Psi(\Phi) \quad \text{and} \quad G(\Phi, \{X_i\}_{i=1}^{N}) = \frac{1}{N}\sum_{i=1}^{N} g(\Phi, X_i) = \Psi_D - \Psi(\Phi).$$

Denote the sample covariance of firm-level moments as

$$\Omega_D = \frac{1}{N}\sum_{i=1}^{N}(X_i - \Psi_D)(X_i - \Psi_D)'$$

Our calibrated parameters $\widehat{\Phi}$ in Table 3 are obtained by a two-step procedure. First, we obtain an initial point estimate for $\Phi$, $\widetilde{\Phi}$, as

$$\widetilde{\Phi} = \text{arg min}_{\Phi} G(\Phi, \{X_i\}_{i=1}^{N})' G(\Phi, \{X_i\}_{i=1}^{N}),$$

with the identity weight matrix. We calculate the updated weight matrix, $\widehat{W}$, via

$$\begin{aligned}\widehat{W}^{-1} =& \frac{1}{N}\sum_{n=1}^{N} g(\widetilde{\Phi}, X_i) g(\widetilde{\Phi}, X_i)' \\ =& \frac{1}{N}\sum_{n=1}^{N}\Big(X_i - \Psi_D - (\Psi(\widetilde{\Phi}) - \Psi_D)\Big)\Big(X_i - \Psi_D - (\Psi(\widetilde{\Phi}) - \Psi_D)\Big)' \\ =& \frac{1}{N}\sum_{n=1}^{N}(X_i - \Psi_D)(X_i - \Psi_D)' + (\Psi(\widetilde{\Phi}) - \Psi_D)(\Psi(\widetilde{\Phi}) - \Psi_D)' \\ =& \Omega_D + (\Psi(\widetilde{\Phi}) - \Psi_D)(\Psi(\widetilde{\Phi}) - \Psi_D)'.\end{aligned}$$

Second, we update the estimator of $\Phi$ to $\widehat{\Phi}$:

$$\widehat{\Phi} = \text{arg min}_{\Phi} G(\Phi, \{X_i\}_{i=1}^{N})' \widehat{W} G(\Phi, \{X_i\}_{i=1}^{N})'.$$

We optimize over $\Phi$ with $(\Xi, \alpha) \in [0.5, 1.5] \times [0.7, 0.9]$. Out of practical considerations, we restrict $\theta \in \{0.004, 1.5, 5.428\}$, which are the values found in Catherine et al. (2022), Whited (1992), Steri, Nikolov and Schmid (2019), respectively, and covers a wide range of magnitudes. We obtain the calibrated parameters $\widehat{\Phi}$ as an interior minimizer of the second step optimization problem, and we report them in Table 3.

The asymptotic distribution of $\widehat{\Phi}$ is given by[19]

$$\sqrt{N}(\widehat{\Phi} - \Phi_0) \sim N(0, \Omega),$$

[19] Because $\theta$ is optimized discretely, the well understood formulas used here cannot be applied to $\theta$. Instead, we apply them to $(\Xi, \alpha)$ and note that they are to be understood as the $\theta$-conditional values. In these formulas, we thus take $\Phi = (\Xi, \alpha)$.

where an estimate of the covariance matrix is given by

$$\widehat{\Omega} = \left\{ \left( \frac{\partial G}{\partial \Phi}(\widehat{\Phi}, \{X_i\}_{i=1}^N) \right)' \widehat{W} \left( \frac{\partial G}{\partial \Phi}(\widehat{\Phi}, \{X_i\}_{i=1}^N) \right) \right\}^{-1},$$

where the gradient $\frac{\partial G}{\partial \Phi}$ is approximated numerically by the difference quotient. Denote the diagonal matrix of $\widehat{\Omega}$ as $\text{diag}(\widehat{\Omega})$. Then the standard error of $\widehat{\Phi}$ is

$$\frac{1}{\sqrt{N}} \sqrt{\text{diag}(\widehat{\Omega})}.$$

Table B2: Comparative statics of the targeted moments with respect to the four estimated parameters

We simulate the model, increasing one parameter at a time, and report the change to the moments from the moments with the baseline parameterization. $\alpha$ is the curvature of the production function. $\Xi$ scales the cash flow parameters $\mu$ and $\sigma$. We perform negative perturbations to ensure that the computational domain does not need to be changed. The moments are averages of the mean EBITDA-to-total-assets ratio; the mean cash-to-total-assets ratio; the mean net investment (capital expenditures less depreciation) to property, plant, and equipment ratio; the standard deviation of the net investment ratio; and the autocorrelation of the net investment ratio.

| | | Parameters | |
|---|---|---|---|
| | | $\alpha$ | $\Xi$ |
| | Change in parameter | -0.01 | -0.05 |
| | | Change in moment | |
| Moments | Avg. firm-level mean $\text{EBITDA}_t/(\text{Total Assets}_{t-1})$ (%) | 0.48 | 0.16 |
| | Avg. firm-level mean $\text{Cash}_t/(\text{Total Assets}_t)$ (%) | -0.24 | -0.18 |
| | Avg. firm-level mean $\text{Net Investment}_t/(\text{PP\&E}_{t-1})$ (%) | -0.18 | 0.06 |
| | Avg. firm-level standard deviation $\text{Net Investment}_t/(\text{PP\&E}_{t-1})$ (%) | -2.98 | -3.7 |
| | Avg. firm-level autocorrelation of $\text{Net Investment}_t/(\text{PP\&E}_{t-1})$ (%) | 0.05 | -0.03 |

## B.2 Identification of parameters

We use an over-identified approach with two parameters and five moments. The two parameters are: the curvature of the production function $\alpha$ and a scalar $\Xi$ for the cash flow parameters $\mu$ and $\sigma$. The five data moments are firm averages of (1) the mean EBITDA-to-total-assets ratio, (2) the mean cash-to-total-assets ratio, (3) the mean net investment (capital expenditures less depreciation) to property, plant, and equipment ratio, (4) the standard deviation of the net investment ratio, and (5) the autocorrelation of the net investment ratio.

Table B2 shows how each moment varies with each parameter, which helps to identify the parameters.

# C Theoretical Appendix

## C.1 Mechanism intuition from simpler models

Below, we present a sequence of models that, although not strict extensions of one another, highlight the major mechanisms in the absence of regime shocks. With $\alpha = 1$, all policies are asymptotically linear, so our focus lies on the case $\alpha < 1$.

**First best** In the absence of financing and investment frictions, the firm optimizes its net expected, discounted cash flow:[20]

$$V_1(k_0) = \sup_{\mathcal{I}^+,\mathcal{I}^-} \mathbb{E}\left[ \int_0^\infty (k_t^\alpha \mu \, \mathrm{d}t - \mathrm{d}\mathcal{I}_t^+ + \mathrm{d}\mathcal{I}_t^-) \right].$$

Here $\mathcal{I}_t^\pm$ denotes the cumulative investment and disinvestment by time $t$:

$$\mathrm{d}k_t = -\delta k_t \, \mathrm{d}t + \mathrm{d}\mathcal{I}_t^+ - \mathrm{d}\mathcal{I}_t^-,$$

with the natural investment constraint that $k_t \geq 0$. The value function is a solution to

$$0 = \min\{rV_1 + \delta k - k^\alpha \mu, |V_1' - 1|\},$$

which is given by

$$V_1(k_0) = \frac{1-\alpha}{\alpha}\frac{\delta + r}{r}k^* + k_0 = \frac{\mu}{r}(1-\alpha)(k^*)^\alpha + k_0$$

with $k^* = \left(\frac{\mu\alpha}{\delta+r}\right)^{\frac{1}{1-\alpha}}$. In fact, whether originally above or below, the firm shifts its capital to the point $k^*$. In this sense, $k^*$ represents the ideal level of capital.

This solution thus illustrates that even in the absence of frictions, the firm has a sweet spot $k^*$ in terms of its size, which can be interpreted as the point $Z$ in our complete model.

**Liquidity risk** Without frictionless financing, the firm must manage its cash flows in order to mitigate the risk of unwanted ruin. For simplicity, consider a firm that does not have access to equity issuance and whose capital level must be maintained, i.e., $i = \delta k$.

[20] We omit the liquidation value, because it is always dominated by the frictionless disinvestment.

The firm's problem is then[21]

$$V(k,c) = \sup_{D} \mathbb{E}\left[ \int_0^{\tau} e^{-rt}\,\mathrm{d}D_t \right],$$

where $\tau = \inf\{t > 0 : c_t < 0\}$ is the ruin time, $k_t \equiv k$, and

$$\mathrm{d}c_t = k^{\alpha}(\mu\,\mathrm{d}t + \sigma\,\mathrm{d}W_t) - \delta k\,\mathrm{d}t.$$

The value function $V$ can be found explicitly, and the optimal dividend payout policy is to pay dividends whenever cash levels exceed

$$\frac{\operatorname{atanh}\left(\frac{\mu(k)b(k)}{r+\mu(k)a(k)}\right)}{b(k)}, \tag{21}$$

where

$$\mu(k) = \max\{k^{\alpha}\mu - \delta k, 0\} \qquad a(k) = \frac{\mu(k)}{k^{2\alpha}\sigma^2}, \qquad b(k) = \frac{\sqrt{\mu(k)^2 + 2rk^{2\alpha}\sigma^2}}{k^{2\alpha}\sigma^2}.$$

This is the dashed line in Figure C.1 and illustrates the generally increasing need for cash buffers as capital grows.

**Investment frictions** In the preceding problem, the firm is required to maintain its capital level. We now introduce a one-off opportunity to adjust it:

$$\max_{i} V(k+i, c-i). \tag{22}$$

As we see in Figure C.1, this gives rise to a structure resembling that of the complete model. The dividend region, Region A, has a natural correspondence to the set of points where immediate dividend payouts are optimal, represented in light gray.[22] Moreover, the set of points where the optimizer in (22) is zero, naturally corresponds to and resembles the boundary between the net positive investment region B and the net negative investment region C.

[21] For simplicity, we leave out the liquidation value. With a liquidation value included, the optimal dividend payout boundary in Figure C.1 would have a more pronounced downward curve.

[22] Because the optimization is sequential—first investment then dividends—immediate dividends could occur post-investment. We thus define the region as points where either (i) there is no investment, and dividends are immediately paid out or (ii) there is investment and, post-investment, dividends are immediately paid out.

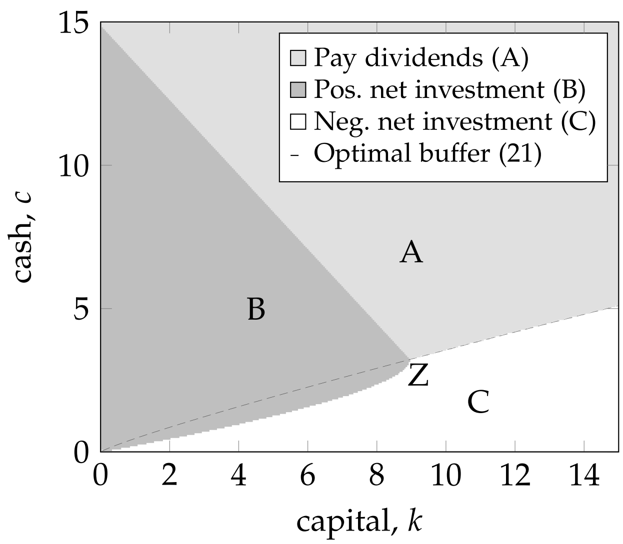



Figure C.1: Combined plot illustrating the cash buffer level (21) and the optimal policies for (22). The dashed line shows the dividend payout boundary (21) for a firm constrained to maintain its capital level and facing financing frictions. Pertaining to the optimal policies for (22), the light gray region consists of points where immediate dividend payout is optimal. The remaining space is split into the dark gray region consists of points where investment is optimal and the white region consists of points where disinvestment is optimal.

## C.2 Additional supporting figures

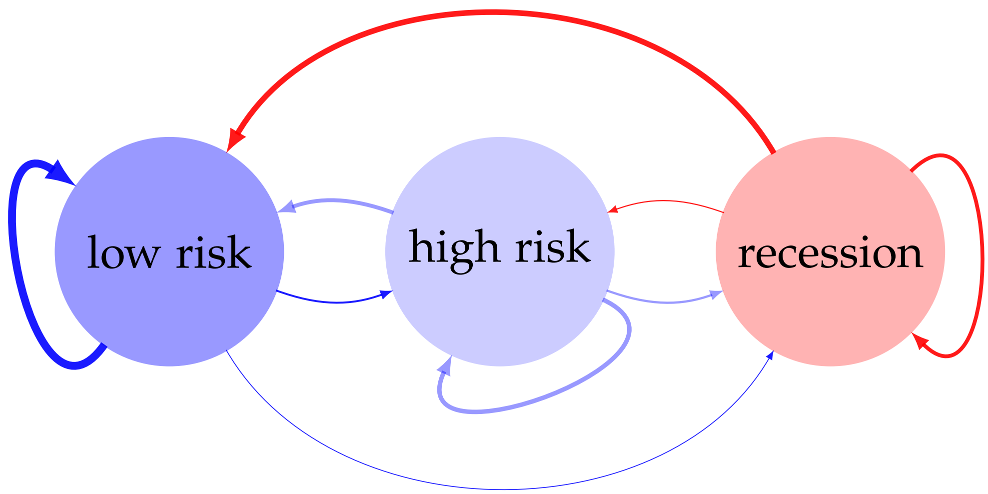



Figure C.2: **Transition probabilities diagram**

This figure shows the transition probabilities between the low-risk expansion ($l$), high-risk expansion ($m$), and recession ($h$) regimes. Thicker edges indicate higher transition probabilities (see Table 1).

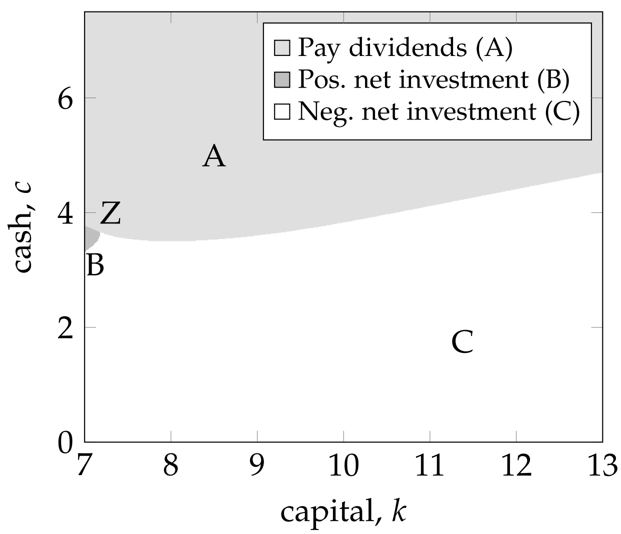
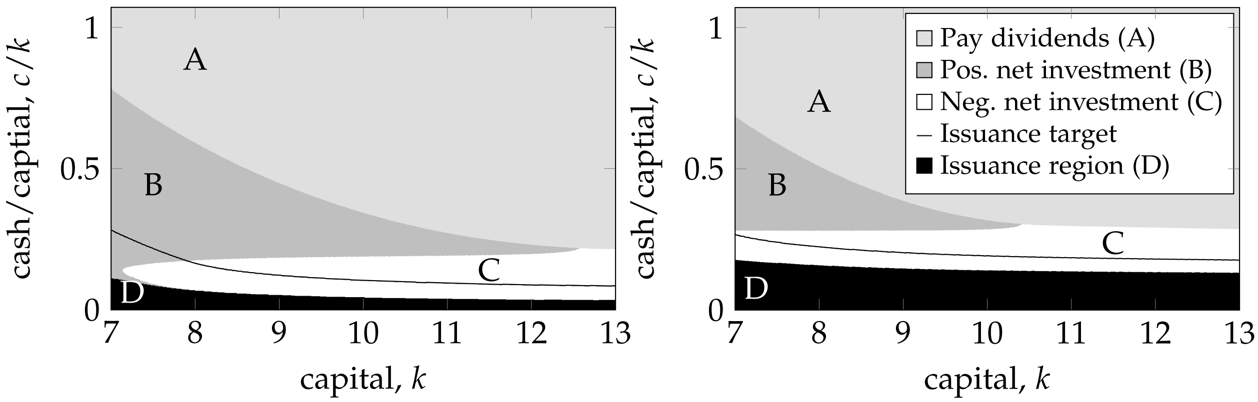


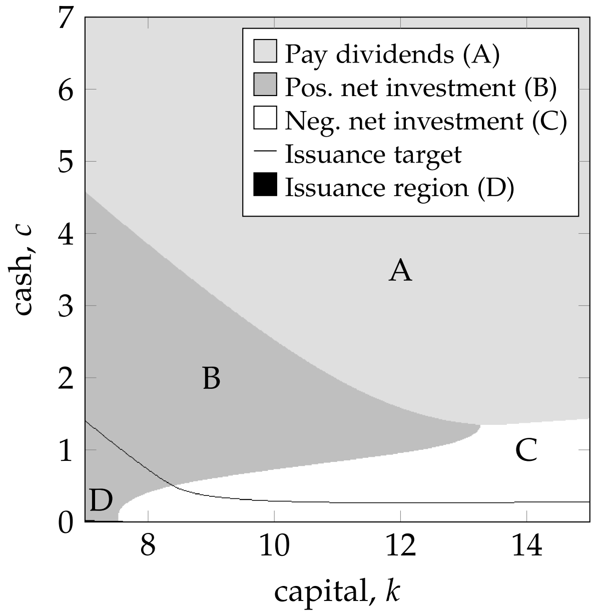

Figure C.3: **Policy diagram in the recession regime** $h$



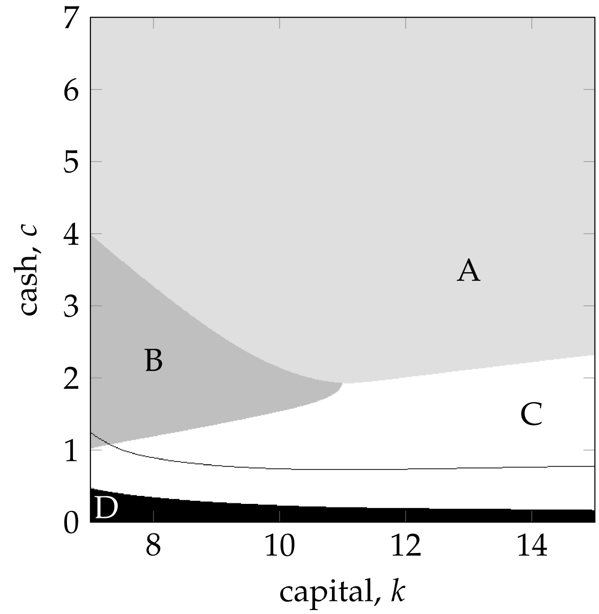

(a) **Expansion, Low Risk ($l$)** (b) **Expansion, High Risk ($m$)**

Figure C.4: **Optimal policies in ($k, c/k$) state space.**

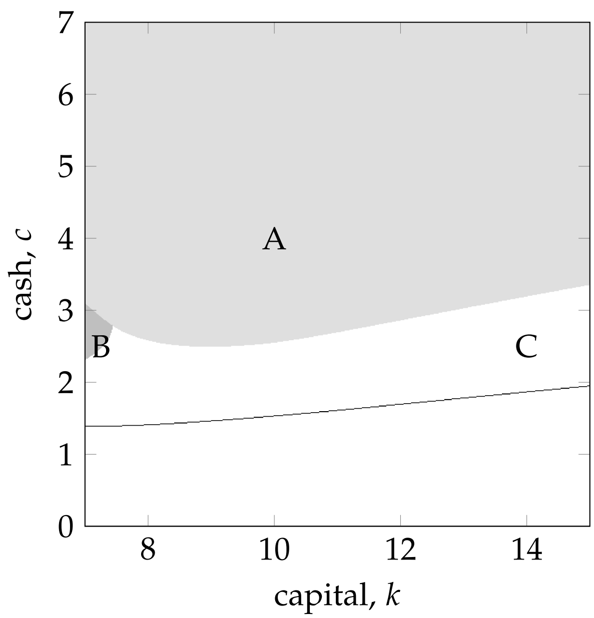
This figure shows the firm's optimal policies in the $(k, c/k)$ state space for low-risk expansion (panel a) and high-risk expansion (panel b). Parameters used are summarized in Table 2.




(a) **Expansion, Low Risk ($l$)**

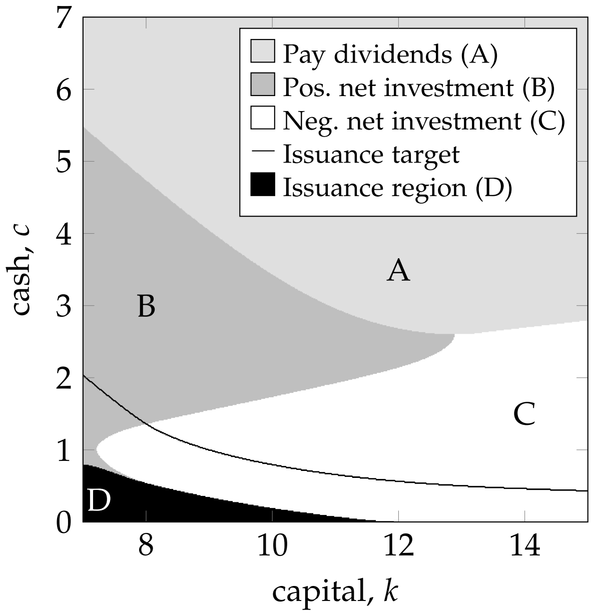



(b) **Expansion, High Risk ($m$)**

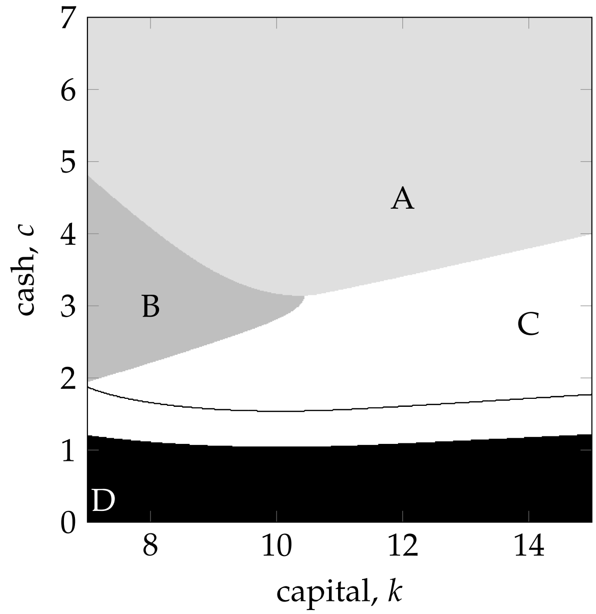



(c) **Recession ($h$)**

Figure C.5: **Optimal policies with equity issuance allowed in recession**
This figure shows the firm's optimal policies when issuance is allowed in the recession regime. Like in Bolton, Chen and Wang (2013), we increased the fixed component of issuance costs $\lambda_f$ to 0.5, or 100 times the expansion level of 0.005. The recession regime now shows an issuance target (black line) and an issuance boundary at $c = 0$. Parameters used are summarized in Table 2.



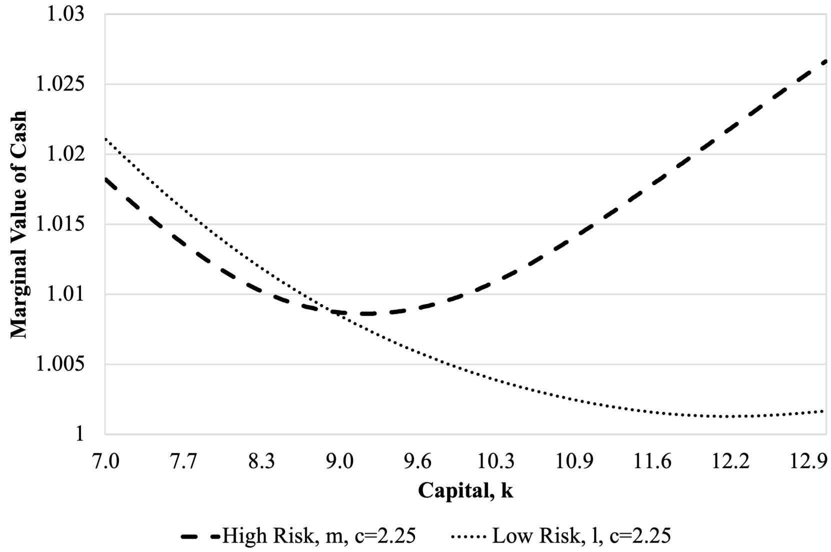

(a) **Expansion, Low Risk ($l$)**



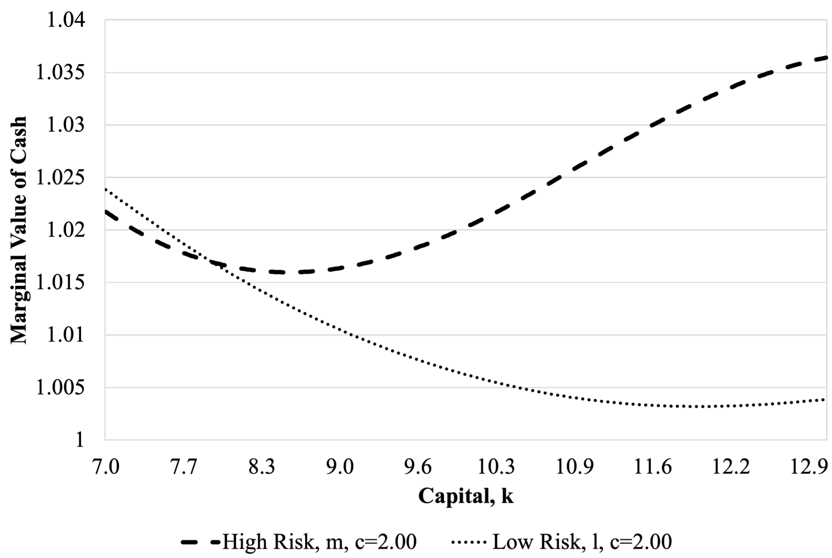

(b) **Expansion, High Risk ($m$)**

Figure C.6: **Optimal policies with disinvestment**

This figure shows the firm's optimal policies when disinvestment is permitted (investment is not irreversible) in the expansion regimes, recouping the full book value. The adjustment cost parameter for disinvestment is 0.04. The other parameters used are summarized in Table 2.




(a) Marginal Value of Cash (Y-axis) against size $k$ (X-axis) when $c = 2.25$ in low-risk expansion regime $\ell$ and high-risk expansion regime $m$.



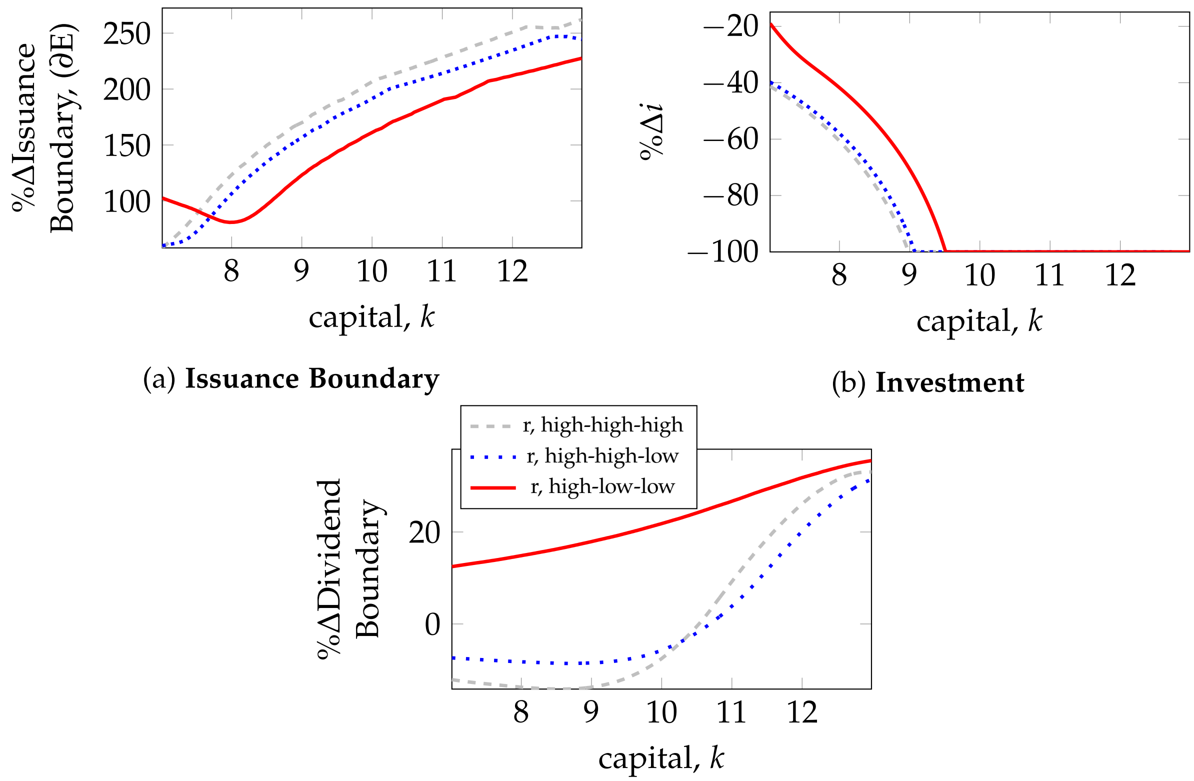

(b) Marginal Value of Cash (Y-axis) against size $k$ (X-axis) when $c = 2.00$ in low-risk expansion regime $\ell$ and high-risk expansion regime $m$.

Figure C.7: Marginal Value of Cash as a function of firm size $k$ across the low and high-risk expansion regimes with $c = 2.25$ or $c = 2.00$.

## C.3 Robustness: Cyclical discount rate $r$ & issuance costs $\lambda_f$

### C.3.1 Cyclical discount rate $r$

We examine how firm policies' sensitivity to recession risk changes with the risk-free rate. Initially, we kept $r$ fixed throughout the business cycle. The first scenario is that monetary policy lowers the discount rate during a recession ($h$). The second scenario is that monetary policy also lowers the discount rate when recession risk is high ($m$).




(a) **Issuance Boundary** (b) **Investment**

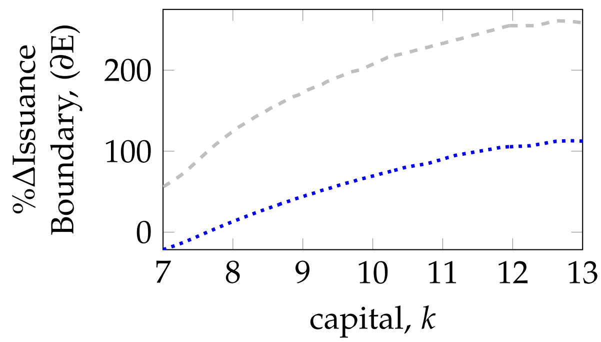
(c) **Dividend**

Figure C.8: **Lower sensitivity to risk when $r$ decreases**
The horizontal axis represents the firm's capital stock $k$, while the vertical axis shows the percentage change between low-risk ($l$) and high-risk ($h$) regimes. *high-high-high* has $r = 6\%$ across all regimes ($l, m, h$, see Table 2). *high-high-low* has $r = 6\%$ in expansion ($r_l = r_m$) and $r = 5\%$ in recession ($r_h$). *high-low-low* has $r = 6\%$ in low-risk expansion regime ($l$) and $r = 5\%$ in high-risk expansion ($r_m$) and recession ($r_h$) regimes.

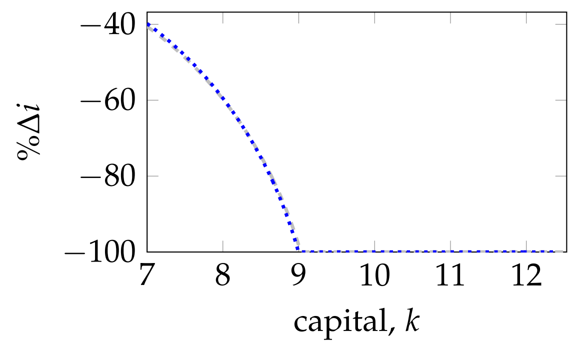
Figure C.8 shows the model's predictions remain robust across varying discount rate "r". The figure illustrates that firm policies—preemptive issuance, investment, and dividends—are less sensitive to recession risk changes when $r$ drops earlier in the business cycle. The dashed gray line represents the baseline case with a constant discount rate, comparing low-risk and high-risk expansion regimes. The blue dotted line and solid red line depict alternative scenarios. Lower $r$ leads to more forward-looking behavior, making distant recession effects more relevant today. Thus, if firms know that the Fed lowers rates when recession risk rises, firms become more forward-looking and take more preemptive actions even when recession risk is low. This behavior mitigates the impact of rising recession risk on firm decisions. However, such a policy also lowers investment when recession risk is low because firms put more weight on future recessions.

#### C.3.2 Cyclical issuance costs $\lambda_f$

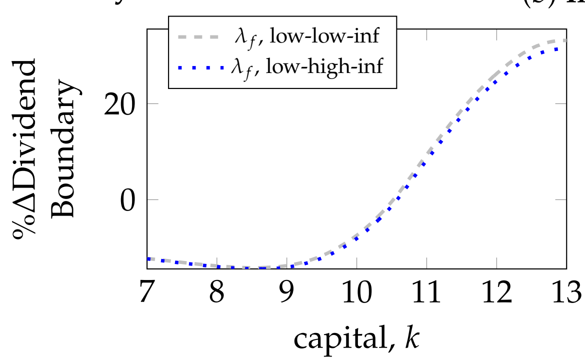
We allow investors to increase equity capital costs ($\lambda_f$) with rising recession risk. Figure C.9 shows that model predictions are stable despite cyclical issuance costs. Preemptive issuance policy sensitivity to recession risk is more affected by cyclical $\lambda_f$ than investment or payout policies. The dashed gray line is the baseline where issuance costs soar in recessions. The dotted blue line represents an alternative scenario where issuance costs increase tenfold in the high-risk regime $m$. When financing costs increase with recession risk—such as when no policy intervention occurs—firms respond by preparing more aggressively in low-risk periods, which makes them less sensitive to increases in risk later on. However, this results in future recessions exerting a stronger influence on firm investment even during low-risk periods. To mitigate the impact of recession risk on preemptive firm behavior during expansions, policymakers may aim to reduce the sensitivity of issuance costs to rising recession risk. For example, opening bond-purchase windows for large issuers once recession risk becomes acute, while providing earlier access to precautionary liquidity tools for small firms with limited cash reserves and high reinvestment needs, may help lower issuance costs and mitigate the preemptive effects of recession risk during low-risk periods. Relatedly, policymakers may want large systemic firms (e.g., financials) to be more preemptive to reduce bailout risks. Since large firms want to delay adjustment until risk is high, regulators may wish to tighten loan-to-value limits or release counter-cyclical capital buffers *earlier* for those institutions.




(a) **Issuance Boundary**




(b) **Investment**




(c) **Dividend**

Figure C.9: **Counterfactual when $\lambda_f$ increases in high-risk expansion regime**
The horizontal axis is the firm's capital stock $k$. The vertical axis shows the percentage change in the outcome variable between low-risk ($l$) and high-risk expansion ($m$) regimes. *low-low-inf* represents the benchmark model with fixed issuance costs in regimes $l$ and $m$, which increase to infinity in $h$. *low* means $\lambda_f = 0.005$ (benchmark value, see Table 2). *low-high-inf* means $\lambda_f$ increases tenfold in the high-risk regime.

# D Empirical Appendix

Table D.1: Anecdotal Support

| Source | Quote |
|---|---|
| Ann Hand (CEO, President, Chair) of Super League Gaming, Inc. (NASDAQ:SLGG) on Q1 2023 Results Conference Call May 15, 2023 5:00 PM ET | The continued uncertainty related to the federal interest rate policy, **potential recession** continuing to loom **cause large corporations to delay** finalizing 2023 advertising budgets. |
| Jordan Kaplan (President, CEO) of Douglas Emmett, Inc. (NYSE:DEI) Q1 2023 Earnings Conference Call May 3, 2023 2:00 PM ET | We continue to have strong demand from tenants under 10,000 square feet who dominate our markets, but because **larger tenants** have become more conservative in **response to recessionary concerns**, we leased less total square footage. |
| Chris Leahy (President, CEO, Chair) of CDW Corporation (CDW) Q1 2023 Results Conference Call May 3, 2023 8:30 AM ET | As the quarter progressed, IT demand weakened more than expected as a confluence of events intensified already **heightened economic concerns and recession fears**. This led to a **fairly rapid shift in customer behavior, most notably in our large commercial customers**. Projects that drove cost reduction, productivity, and financial returns were prioritized. Project justification and budget scrutiny ruled the day. And although deals were not canceled, sales cycles elongated, written sales slowed, and deal sizes compressed. |
| Scott Turicchi (CEO) of Consensus Cloud Solutions, Inc. (NASDAQ:CCSI) on Q4 2022 Results Conference Call February 22, 2023 5:00 PM ET | As you know, everybody's got their own view of the economy and whether we'll go into a recession...So, we don't see the economy being in a recession right now. Now independent of that, the **uncertainty of the economy**...has **delayed our larger customer decision-making**, which can impact and we did see it certainly impact revenue to some extent in Q3 and definitely in Q4. |
| Thomas Amato (President, CEO) of TriMas Corporation (NASDAQ:TRS) on Q3 2022 Earnings Conference Call October 27, 2022 10:00 AM ET | This effect, along with continued new cycles mentioning a **pending recession** is indeed creating a cautious planning environment, which we are most acutely seeing within products sold into personal care applications. For example, **several of our largest consumer goods customers** are faced with higher dispenser stocks than normal and have therefore **decided to take a much more conservative approach** to increasing stock in anticipation of their seasonal selling period. |
| Bob Rivers (CEO, Chair) of Eastern Bankshares, Inc. (NASDAQ:EBC) on Q2 2022 Earnings Conference Call July 29, 2022 9:00 AM ET | Despite the uncertainty brought about by COVID and the shift to remote work, the impacts of higher inflation in the **spectre of recession**, Greater Boston is considered by many among the best-performing office markets in the country, **bolstered by** high diversity industry sectors, **relatively low reliance on large tenants** and the tailwinds of strong demand for life sciences space. |

Table D.2: Issuances decline in recessions

The outcome is a firm-quarter issuance indicator equal to 100 if an issuance in a quarter exceeds a specified percentage of total assets less cash at the end of the prior quarter. The explanatory variable is one if quarter $t$ is an NBER recession. We control for a *Time Trend*, which accounts for any general increases in issuance frequency over the sample period. We cluster standard errors by quarter. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

| | $\text{Issuance}_t$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| NBER $\text{Recession}_t$ | -1.530** | -0.899** | -0.639** | -0.302* |
| | (0.629) | (0.361) | (0.266) | (0.173) |
| Time Trend | 0.016*** | 0.005** | 0.003 | 0.003** |
| | (0.003) | (0.002) | (0.002) | (0.001) |
| Constant | 3.843*** | 2.768*** | 1.864*** | 0.644*** |
| | (0.621) | (0.423) | (0.338) | (0.233) |
| Issuance Threshold $\left(\frac{\text{Issuance}_{i,t+1}}{\text{Assets-Cash}_{i,t}} > X\%\right)$ | 2% | 5% | 10% | 25% |
| % Adjusted $R^2$ | 0.10 | 0.03 | 0.02 | 0.02 |
| Observations | 411,195 | 411,195 | 411,195 | 411,195 |

Table D.3: Correlation of the recession probability measure with other leading indicators

*Recession Prob.* is the month $t$ probability of the U.S. being in a recession in one year according to the term spread, calculated as the difference between the 10-year and 3-month Treasury rates. It gives the probability of the U.S. being in a recession in one year. *VIX* is the month $t$ level of the CBOE Volatility Index. *BC* is the current state of the business cycle, which is the month $t$ probability that the U.S. is *currently* in a recession (Chauvet and Piger, 2008). *CPSB* is the 3-month commercial paper rate minus the federal funds rate. *XRI* is the month $t$ value of the Experimental Recession Index from Stock and Watson (1989). It gives the probability of the U.S. being in a recession in six months. The index includes industrial production, real personal income, real manufacturing, total employee hours, housing permits, real manufacturers' unfilled orders, exchange rates, number of people working part-time, the 10-year Treasury bond yields, the spread between the 3-month commercial paper rate and the interest rate on 3-month Treasury bills, and the spread between the 10-year Treasury bonds and the 1-year Treasury bonds. *XRI-2* is the month $t$ value of the Alternative Experimental Recession Index from Stock and Watson (1993). It gives the probability of being in a recession in six months. The index includes building permits, manufacturers' unfilled orders, exchange rates, help-wanted advertising, average weekly hours of production workers, vendor performance, and manufacturing capacity utilization rates. *S&P 500* is the month $t$ return on the S&P 500 index. *NYSE* is the month $t$ return on the NYSE index. *AI* is the Anxious Index based on the Survey of Professional Economists, which has asked economists to estimate the probability of quarter-over-quarter chain-weighted real GDP growth less than zero for the current quarter (RECESS1) and the following four quarters (RECESS2 to RECESS5). RECESS2 is known as the "Anxious Index." See Andrade and Le Bihan (2013).

| Variables | Recession Prob. | VIX | BC | CPSB | XRI | XRI-2 | S&P 500 | NYSE | AI |
|---|---|---|---|---|---|---|---|---|---|
| Recession Prob. | 1.00 | | | | | | | | |
| VIX | -0.01 | 1.00 | | | | | | | |
| BC | 0.07 | 0.51 | 1.00 | | | | | | |
| CPSB | -0.10 | 0.29 | 0.44 | 1.00 | | | | | |
| XRI | 0.59 | 0.30 | 0.60 | -0.16 | 1.00 | | | | |
| XRI-2 | 0.35 | -0.27 | 0.73 | -0.41 | 0.66 | 1.00 | | | |
| S&P 500 | 0.03 | -0.41 | -0.14 | -0.21 | -0.07 | 0.05 | 1.00 | | |
| NYSE | 0.05 | -0.42 | -0.16 | -0.26 | -0.09 | 0.06 | 0.98 | 1.00 | |
| AI | 0.21 | 0.40 | 0.59 | 0.25 | 0.59 | 0.56 | -0.01 | -0.00 | 1.00 |

Table D.4: Quarterly Compustat Sample Selection

This table presents the criteria used to prepare the firm-quarter dataset.

| Criteria | Obs. Lost | Obs. Remaining |
|---|---|---|
| COMPUSTAT, 1961Q1 – 2022Q4 | | 1,948,319 |
| Less: | | |
| Drop quarters before Great Moderation (1985Q1) | (280,090) | 1,668,229 |
| Pre-IPO Data | (111,509) | 1,556,720 |
| Firms headquartered outside of USA | (333,211) | 1,223,509 |
| Firms incorporated outside of USA | (22,121) | 1,201,388 |
| Financials (SIC-1=6) | (393,359) | 808,029 |
| Utilities (SIC-2=49) | (50,683) | 757,346 |
| Public Administration (SIC-1=9) | (17,878) | 739,468 |
| Missing or zero assets | (29,292) | 710,176 |
| Missing cash and cash equivalents | (1,179) | 708,997 |
| Drop gvkey-quarter duplicates | (1,298) | 707,699 |
| PP&E less than $5M or missing PP&E | (247,671) | 460,028 |
| Negative cash and cash equivalents | (219) | 459,809 |
| Less than $1M in sales | (12,641) | 447,168 |
| Singleton Firms | (376) | 446,792 |
| Drop quarters in NBER recessions | (45,837) | 400,955 |
| Final sample (11,926 firms, 1985Q1-2022Q4) | | 400,955 |

Table D.5: Empirical Regression Results (Using PP&E)

This table repeats Table 6 using net PP&E to proxy for the size of the capital stock rather than total assets less cash. Column (1) reports the effect on the probability of equity issuance, defined as a binary variable equal to 100 when issuance in quarter $t+1$ exceeds 50% of firm $i$'s size (net PP&E at the end of quarter $t$). Column (2) shows the issuance amount, conditional on issuing more than 50% of the size in quarter $t+1$, standardized within the firm. Column (3) reports firm cash holdings in quarter $t$, prior to issuance in $t+1$, also conditional on such issuance and standardized within the firm. Column (4) examines the within-firm standardized percent change in payouts over the same horizon, including only firms with nonzero payouts in the prior year and some variation over time. Column (5) measures the within-firm standardized percent change in investment, comparing investment over the four future quarters ($t+1$ to $t+4$) to the four prior quarters ($t-3$ to $t$), to smooth seasonal effects. This column includes only firms with complete investment data for the full eight-quarter window. *Recession Probability*$_t$ is the quarter $t$ average log monthly probability of a recession occurring in quarter $t+4$, standardized within firm. *Size*$_{i,t}$ is the log of firm $i$'s net PP&E at the end of quarter $t$, standardized within firm. Standard errors are double-clustered by firm and quarter. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

| | Issuance Propensity (1) | Issuance Amount (2) | Cash at Issuance (3) | Dividend Growth (4) | Investment Growth (5) |
|---|---|---|---|---|---|
| Recession Probability$_t$ | 0.090*** | 0.188** | 0.059* | -0.027** | -0.037*** |
| | (0.032) | (0.074) | (0.035) | (0.013) | (0.013) |
| Recession Probability$_t$ × PP&E$_{i,t}$ | -0.038 | 0.101*** | 0.065*** | -0.013* | -0.012* |
| | (0.032) | (0.035) | (0.025) | (0.007) | (0.007) |
| PP&E$_{i,t}$ | -0.459*** | -0.459*** | 0.312*** | -0.044*** | -0.251*** |
| | (0.035) | (0.034) | (0.024) | (0.009) | (0.010) |
| Intercept | 0.618*** | 2.769*** | -0.479*** | 0.001 | -0.000 |
| | (0.046) | (0.070) | (0.037) | (0.013) | (0.011) |
| Adjusted $R^2$ | 0.31 | 8.65 | 9.84 | 0.24 | 5.31 |
| $N$ | 361,673 | 2,241 | 2,256 | 140,916 | 231,696 |

Table D.6: Robustness for equity issuance propensity results in column (1) of Table 6

This table presents the results for the issuance propensity regression reported in column (1) of Table 6, using alternative minimum issuance thresholds ranging from 2% to 50% of firm size, as well as various control specifications. *Recession Probability*$_t$ denotes the log probability in quarter $t$ of a recession occurring within one year, standardized within firm. *Size*$_{i,t}$ is the log of firm $i$'s total assets less cash holdings at the end of quarter $t$, standardized within each firm over the full sample. Business cycle controls include HP-filtered log real GDP in quarter $t$, the CRSP excess market return in quarter $t$, and the contemporaneous recession probability from Chauvet and Piger (2008). To allow for differential sensitivity to macroeconomic conditions by firm size, each control is interacted with *Size*$_{i,t}$. Standard errors are clustered at the quarter level. ** and *** indicate significance at the 5% and 1% level, respectively.

| | Issuance Propensity | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Recession Probability$_t$ | 0.255 | 0.164** | 0.139*** | 0.102*** | 0.116** |
| | (0.201) | (0.072) | (0.049) | (0.033) | (0.053) |
| Recession Probability$_t$ × Size$_{i,t}$ | -0.199 | -0.127 | -0.071 | -0.060 | -0.080** |
| | (0.163) | (0.069) | (0.048) | (0.035) | (0.037) |
| Size$_{i,t}$ | -2.475*** | -1.278*** | -0.864*** | -0.520*** | -0.531*** |
| | (0.167) | (0.071) | (0.052) | (0.038) | (0.036) |
| GDP$_t$ | | | | | -0.049 |
| | | | | | (0.073) |
| GDP$_t$ × Size$_{i,t}$ | | | | | 0.090** |
| | | | | | (0.042) |
| MKTRF$_t$ | | | | | 0.128*** |
| | | | | | (0.046) |
| MKTRF$_t$ × Size$_{i,t}$ | | | | | -0.079** |
| | | | | | (0.038) |
| Chauvet$_t$ | | | | | -0.006 |
| | | | | | (0.076) |
| Chauvet$_t$ × Size$_{i,t}$ | | | | | -0.100 |
| | | | | | (0.061) |
| Constant | 6.532*** | 2.347*** | 1.203*** | 0.619*** | 0.611*** |
| | (0.223) | (0.094) | (0.064) | (0.045) | (0.042) |
| Issuance Sample $\left(\frac{\text{Issuance}_{i,t+1}}{\text{Assets-Cash}_{i,t}} > X\%\right)$ | 2% | 10% | 25% | 50% | 50% |
| % Adjusted $R^2$ | 0.90 | 0.64 | 0.56 | 0.40 | 0.45 |
| Observations | 361,674 | 361,674 | 361,674 | 361,674 | 361,663 |

Table D.7: Robustness of issuance amount estimates in column (2) of Table 6 to alternative minimum issuance thresholds.

The sample includes firm-quarter observations in which the issuance amount, expressed as a share of the firm's total assets excluding cash, exceeds the specified thresholds, ranging from 2% to 50%. The outcome variable, Issuance Amount, is standardized within a firm based on the full sample, including quarters without issuance. $\textit{Recession Probability}_t$ is the log probability in quarter $t$ of a recession occurring within one year, standardized within the firm. $\textit{Size}_{i,t}$ denotes firm $i$'s total assets minus cash holdings at the end of quarter $t$, standardized within firm. Business cycle controls include HP-filtered log real GDP in quarter $t$, the CRSP excess market return in quarter $t$, and the contemporaneous recession probability from Chauvet and Piger (2008). Each of these controls is interacted with $\textit{Size}_{i,t}$ to capture differential sensitivities of small and large firms to macroeconomic conditions. Column (6) includes year fixed effects to exploit within-year variation in recession risk. We cluster standard errors by quarter. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

| | Issuance Amount/$\text{Size}_{i,t}$ | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Recession $\text{Probability}_t$ | -0.019 | 0.025 | 0.091 | 0.211*** | 0.172** | 0.360*** |
| | (0.034) | (0.048) | (0.062) | (0.078) | (0.077) | (0.090) |
| Recession $\text{Probability}_t \times \text{Size}_{i,t}$ | -0.001 | 0.019 | 0.054* | 0.116*** | 0.111** | 0.109** |
| | (0.019) | (0.023) | (0.029) | (0.040) | (0.043) | (0.044) |
| $\text{Size}_{i,t}$ | -0.289*** | -0.372*** | -0.433*** | -0.517*** | -0.511*** | -0.358*** |
| | (0.022) | (0.023) | (0.029) | (0.039) | (0.042) | (0.042) |
| $\text{GDP}_t$ | | | | | 0.092 | 0.180** |
| | | | | | (0.076) | (0.090) |
| $\text{GDP}_t \times \text{Size}_{i,t}$ | | | | | 0.011 | -0.022 |
| | | | | | (0.044) | (0.040) |
| $\text{MKTRF}_t$ | | | | | 0.081 | 0.064 |
| | | | | | (0.089) | (0.073) |
| $\text{MKTRF}_t \times \text{Size}_{i,t}$ | | | | | 0.019 | 0.026 |
| | | | | | (0.054) | (0.049) |
| $\text{Chauvet}_t$ | | | | | 0.054 | 0.046 |
| | | | | | (0.098) | (0.061) |
| $\text{Chauvet}_t \times \text{Size}_{i,t}$ | | | | | 0.085* | 0.060 |
| | | | | | (0.049) | (0.046) |
| Constant | 1.556*** | 2.595*** | 2.796*** | 2.682*** | 2.678*** | 2.805*** |
| | (0.034) | (0.046) | (0.062) | (0.073) | (0.077) | (0.052) |
| $\left(\frac{\text{Issuance}_{i,t+1}}{\text{Assets-Cash}_{i,t}} > X\%\right)$ | 2% | 10% | 25% | 50% | 50% | 50% |
| Year FE | No | No | No | No | No | Yes |
| % Adjusted $R^2$ | 2.47 | 4.53 | 6.69 | 10.06 | 10.28 | 22.02 |
| Observations | 23,706 | 8,523 | 4,378 | 2,241 | 2,241 | 2,241 |

Table D.8: Robustness of cash at issuance estimates in column (3) of Table 6 to alternative minimum issuance thresholds and controls.

The sample consists of firm-quarter observations that immediately precede an equity issuance in quarter $t+1$ exceeding a threshold ranging from 2% to 50% of total assets less cash at the end of quarter $t$. The outcome variable, $Cash_{i,t}$, represents a firm's cash holdings at the end of quarter $t$, standardized within firm using the full sample (including quarters not preceding issuance). $Recession\ Probability_t$ is the log probability in quarter $t$ of a recession occurring within one year, standardized within the firm. $Size_{i,t}$ is the log of firm $i$'s total assets less cash holdings at the end of quarter $t$, standardized within firm. Business cycle controls include HP-filtered log real GDP in quarter $t$, the CRSP excess market return in quarter $t$, and the contemporaneous recession probability from Chauvet and Piger (2008). Each of these controls is interacted with $Size_{i,t}$ to capture differential sensitivities of small and large firms to macroeconomic conditions. Column (6) includes year fixed effects to exploit within-year variation in recession risk. We cluster standard errors by quarter. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

| | Cash at Issuance$_{i,t}$ | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Recession Probability$_t$ | -0.005 | 0.009 | 0.022 | 0.087** | 0.098** | 0.183*** |
| | (0.016) | (0.017) | (0.023) | (0.038) | (0.043) | (0.051) |
| Recession Probability$_t$ × Size$_{i,t}$ | 0.019* | 0.045*** | 0.061*** | 0.094*** | 0.093*** | 0.098*** |
| | (0.010) | (0.014) | (0.020) | (0.029) | (0.031) | (0.033) |
| Size$_{i,t}$ | 0.406*** | 0.348*** | 0.350*** | 0.356*** | 0.344*** | 0.295*** |
| | (0.009) | (0.012) | (0.018) | (0.026) | (0.026) | (0.026) |
| GDP$_t$ | | | | | -0.018 | -0.004 |
| | | | | | (0.037) | (0.049) |
| GDP$_t$ × Size$_{i,t}$ | | | | | 0.007 | 0.023 |
| | | | | | (0.028) | (0.028) |
| MKTRF$_t$ | | | | | 0.049 | 0.072* |
| | | | | | (0.051) | (0.043) |
| MKTRF$_t$ × Size$_{i,t}$ | | | | | 0.033 | 0.039 |
| | | | | | (0.033) | (0.030) |
| Chauvet$_t$ | | | | | -0.038 | -0.023 |
| | | | | | (0.036) | (0.036) |
| Chauvet$_t$ × Size$_{i,t}$ | | | | | -0.026 | -0.007 |
| | | | | | (0.030) | (0.031) |
| Constant | -0.040** | -0.274*** | -0.355*** | -0.419*** | -0.439*** | -0.484*** |
| | (0.016) | (0.018) | (0.022) | (0.037) | (0.037) | (0.030) |
| Issuance Sample $\left(\frac{\text{Issuance}_{i,t+1}}{\text{Assets-Cash}_{i,t}} > X\%\right)$ | 2% | 10% | 25% | 50% | 50% | 50% |
| Year FE | No | No | No | No | No | Yes |
| % Adjusted R$^2$ | 15.26 | 11.86 | 11.68 | 12.18 | 12.18 | 16.24 |
| Observations | 23,776 | 8,554 | 4,397 | 2,256 | 2,256 | 2,256 |

Table D.9: Robustness of payout growth estimates in column (4) of Table 6 to additional controls.

The outcome variable is the growth in dividends and share repurchases. We compare payouts over the future four quarters ($t+1$, $t+2$, $t+3$, and $t+4$) to payouts in the prior four quarters ($t-3$, $t-2$, $t-1$, and $t$). We standardize payout growth within a firm. $Recession\ Probability_t$ is the quarter $t$ average monthly probability of a recession, standardized within the firm. $Size_{i,t}$ is the log of firm $i$'s total assets less cash holdings at the end of quarter $t$, standardized within firm. Controls for the business cycle include HP filtered log real GDP in quarter $t$, the CRSP excess market return in quarter $t$, and the probability of the economy being in a recession in quarter $t$ (not $t+4$) from Chauvet and Piger (2008). We interact these controls with $Size_{i,t}$ to allow a firm, when small and large, to have different sensitivities to the business cycle. The sample only includes firms with payouts in the prior year and some variation in payouts. Column (3) includes year fixed effects to exploit within-year variation in recession risk. We double-cluster standard errors by firm and quarter. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

| | | $\left(\frac{\sum_{j=1}^{4} \text{Payouts}_{i,t+j}}{\sum_{j=-3}^{0} \text{Payouts}_{i,t+j}} - 1\right)$ | |
|---|---|---|---|
| | (1) | (2) | (3) |
| $\text{Recession Probability}_t$ | -0.026** | -0.020 | -0.038* |
| | (0.012) | (0.013) | (0.020) |
| $\text{Recession Probability}_t \times \text{Size}_{i,t}$ | -0.018** | -0.019** | -0.011 |
| | (0.007) | (0.008) | (0.007) |
| $\text{Size}_{i,t}$ | -0.039*** | -0.041*** | -0.030*** |
| | (0.009) | (0.009) | (0.006) |
| $\text{GDP}_t$ | | -0.022 | -0.004 |
| | | (0.016) | (0.023) |
| $\text{GDP}_t \times \text{Size}_{i,t}$ | | 0.012 | 0.015* |
| | | (0.008) | (0.008) |
| $\text{MKTRF}_t$ | | 0.027** | 0.022** |
| | | (0.013) | (0.011) |
| $\text{MKTRF}_t \times \text{Size}_{i,t}$ | | 0.006 | -0.002 |
| | | (0.007) | (0.005) |
| $\text{Chauvet}_t$ | | -0.004 | 0.012 |
| | | (0.032) | (0.013) |
| $\text{Chauvet}_t \times \text{Size}_{i,t}$ | | -0.007 | -0.004 |
| | | (0.014) | (0.009) |
| Constant | 0.002 | -0.002 | -0.000 |
| | (0.013) | (0.014) | (0.007) |
| Year FE | No | No | Yes |
| % Adjusted $R^2$ | 0.21 | 0.31 | 1.57 |
| Observations | 140,916 | 140,916 | 140,916 |

Table D.10: Robustness of investment growth estimates in column (5) of Table 6 to additional controls.

The outcome variable is the growth of capital expenditures on property, plant, and equipment. To account for seasonality in investment across quarters and to allow firms time to adjust investment, we compare investment in the future four quarters ($t+1$, $t+2$, $t+3$, and $t+4$) to investment in the prior four quarters ($t-3$, $t-2$, $t-1$, and $t$). We standardize these changes in investment within a firm. *Recession Probability*$_t$ is the quarter $t$ average monthly probability of a recession in twelve months, standardized within firm. *Size*$_{i,t}$ is the log of firm $i$'s total assets less cash holdings at the end of quarter $t$, standardized within firm. Controls for the business cycle include HP filtered log real GDP in quarter $t$, the CRSP excess market return in quarter $t$, and the probability of the economy being in a recession in quarter $t$ (not $t+4$) from Chauvet and Piger (2008). We interact these controls with *Size*$_{i,t}$ to allow small and large firms to have different sensitivities to the business cycle. Column (3) includes year fixed effects to exploit within-year variation in recession risk. We double-cluster standard errors by firm and quarter. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

| | | $\left(\frac{\sum_{j=1}^{4}\text{CAPX}_{t+j}}{\sum_{j=-3}^{0}\text{CAPX}_{t+j}}-1\right)$ | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Recession Probability$_t$ | -0.039*** | -0.037*** | -0.049*** |
| | (0.013) | (0.013) | (0.011) |
| Recession Probability$_t$ × Size$_{i,t}$ | -0.016** | -0.018** | -0.015*** |
| | (0.007) | (0.008) | (0.005) |
| Size$_{i,t}$ | -0.159*** | -0.160*** | -0.173*** |
| | (0.009) | (0.009) | (0.005) |
| GDP$_t$ | | 0.001 | -0.005 |
| | | (0.017) | (0.014) |
| GDP$_t$ × Size$_{i,t}$ | | 0.002 | -0.003 |
| | | (0.011) | (0.007) |
| MKTRF$_t$ | | 0.002 | 0.007 |
| | | (0.014) | (0.005) |
| MKTRF$_t$ × Size$_{i,t}$ | | 0.012 | 0.005* |
| | | (0.008) | (0.003) |
| Chauvet$_t$ | | -0.044* | -0.005 |
| | | (0.026) | (0.012) |
| Chauvet$_t$ × Size$_{i,t}$ | | 0.000 | 0.009 |
| | | (0.015) | (0.012) |
| Constant | 0.000 | -0.007 | -0.002 |
| | (0.011) | (0.013) | (0.004) |
| Year FE | No | No | Yes |
| % Adjusted $R^2$ | 2.30 | 2.34 | 3.64 |
| Observations | 231,696 | 231,696 | 231,696 |

Table D.11: Repeating Table 6: Are the Most Cyclical Firms Different?

We identify the 10% of firms in the sample that are the most cyclical. $\mathbb{1}$(Most Cyclical) is an indicator equal to one for these firms and zero otherwise. Cyclicality is measured by the correlation between HP-filtered log industry sales (by SIC-3) and HP-filtered log real GDP.

| | Issuance Propensity (1) | Issuance Amount (2) | Cash at Issuance (3) | Payout Growth (4) | Investment Growth (5) |
|---|---|---|---|---|---|
| Recession Probability$_t$ | 0.112*** | 0.203** | 0.084** | -0.037*** | -0.024* |
| | (0.036) | (0.080) | (0.039) | (0.012) | (0.013) |
| Recession Probability$_t$ $\times$ Size$_{i,t}$ | -0.077** | 0.105** | 0.087*** | -0.017** | -0.018** |
| | (0.038) | (0.042) | (0.029) | (0.007) | (0.008) |
| Recession Probability$_t$ $\times$ $\mathbb{1}$(Most Cyclical) | -0.101*** | 0.164 | 0.047 | -0.028* | -0.019 |
| | (0.034) | (0.201) | (0.140) | (0.015) | (0.017) |
| Recession Probability$_t$ $\times$ Size$_{i,t}$ $\times$ $\mathbb{1}$(Most Cyclical) | 0.186*** | 0.084 | 0.074 | 0.006 | -0.004 |
| | (0.060) | (0.106) | (0.114) | (0.014) | (0.017) |
| Size$_{i,t}$ | -0.533*** | -0.506*** | 0.360*** | -0.158*** | -0.043*** |
| | (0.041) | (0.041) | (0.025) | (0.009) | (0.010) |
| $\mathbb{1}$(Most Cyclical) | -0.367*** | 0.455* | 0.190 | -0.001 | -0.004 |
| | (0.059) | (0.247) | (0.155) | (0.007) | (0.006) |
| $\mathbb{1}$(Most Cyclical) $\times$ Size$_{i,t}$ | 0.148** | -0.002 | 0.037 | -0.013 | 0.042*** |
| | (0.068) | (0.136) | (0.138) | (0.013) | (0.014) |
| Intercept | 0.653*** | 2.669*** | -0.424*** | 0.000 | 0.002 |
| | (0.051) | (0.076) | (0.037) | (0.011) | (0.012) |
| Adjusted $R^2$ | 0.42 | 10.34 | 12.18 | 2.30 | 0.23 |
| $N$ | 361,668 | 2,241 | 2,256 | 231,696 | 140,916 |

Table D.12: Repeating Table 6: Are the Least Cyclical Firms Different?

We identify the 10% of the sample that is the least cyclical. $\mathbb{1}$(Least Cyclical) is an indicator equal to one for such firms and zero otherwise. Specifically, we find the correlation of HP-filtered log aggregate industry sales by SIC-3 and correlate this with HP-filtered log GDP.

| | Issuance Propensity (1) | Issuance Amount (2) | Cash at Issuance (3) | Payout Growth (4) | Investment Growth (5) |
|---|---|---|---|---|---|
| Recession Probability$_t$ | 0.102$^{***}$ | 0.232$^{***}$ | 0.082$^{**}$ | -0.042$^{***}$ | -0.030$^{**}$ |
| | (0.034) | (0.078) | (0.038) | (0.013) | (0.013) |
| Recession Probability$_t$ × Size$_{i,t}$ | -0.053 | 0.120$^{***}$ | 0.092$^{***}$ | -0.018$^{***}$ | -0.024$^{***}$ |
| | (0.037) | (0.041) | (0.029) | (0.007) | (0.009) |
| Recession Probability$_t$ × $\mathbb{1}$(Least Cyclical) | 0.000 | -0.182 | 0.036 | 0.023 | 0.030$^{*}$ |
| | (0.038) | (0.151) | (0.099) | (0.015) | (0.016) |
| Recession Probability$_t$ × Size$_{i,t}$ × $\mathbb{1}$(Least Cyclical) | -0.063 | -0.019 | 0.013 | 0.015 | 0.049$^{***}$ |
| | (0.053) | (0.118) | (0.076) | (0.014) | (0.014) |
| Size$_{i,t}$ | -0.525$^{***}$ | -0.528$^{***}$ | 0.364$^{***}$ | -0.159$^{***}$ | -0.037$^{***}$ |
| | (0.040) | (0.041) | (0.026) | (0.009) | (0.010) |
| $\mathbb{1}$(Least Cyclical) | -0.057 | 0.302$^{**}$ | -0.111 | -0.001 | -0.001 |
| | (0.054) | (0.136) | (0.097) | (0.007) | (0.007) |
| $\mathbb{1}$(Least Cyclical) × Size$_{i,t}$ | 0.043 | 0.087 | -0.067 | 0.005 | -0.012 |
| | (0.055) | (0.116) | (0.075) | (0.013) | (0.014) |
| Intercept | 0.626$^{***}$ | 2.648$^{***}$ | -0.407$^{***}$ | 0.000 | 0.002 |
| | (0.048) | (0.072) | (0.037) | (0.011) | (0.013) |
| Adjusted $R^2$ | 0.40 | 10.24 | 12.09 | 2.30 | 0.24 |
| $N$ | 361,668 | 2,241 | 2,256 | 231,696 | 140,916 |