Journal of Mathematical Finance, 2025, 15(1), 35-65
https://www.scirp.org/journal/jmf
ISSN Online: 2162-2442
ISSN Print: 2162-2434

Macroeconomic Conditions, Persistent Preference Shocks, and Corporate Management

Du Du

Department of Economics and Finance, City University of Hong Kong, China
Email: dudu22@cityu.edu.hk

How to cite this paper: Du, D. (2025) Macroeconomic Conditions, Persistent Preference Shocks, and Corporate Management. *Journal of Mathematical Finance*, **15**, 35-65.
https://doi.org/10.4236/jmf.2025.151002

Received: November 1, 2024
Accepted: December 24, 2024
Published: December 27, 2024

Abstract

Macroeconomic conditions affect multiple dimensions that are related to the operation of an entrepreneurial firm. Through a multi-regime dynamic stochastic model, we show that this simple observation has a wide range of empirical implications for corporations. Notably, we show that the entrepreneur invests less, assigns a lower value to firm-held capital, and liquidates the firm earlier when the macroeconomic condition is bad, and this is particularly true when she is more risk averse. Somewhat surprisingly, a bad economic condition or a higher degree of risk aversion may encourage consumption, but this effect can be largely smoothed out once we allow for reasonable macroeconomic dynamics. The duration of economic recessions has particularly large impact on the entrepreneur's welfare and the implied business liquidation. While raising entrepreneur's risk aversion induces more conservative policies during good times, its effects during the bad times are mixed, which depend on the firm's financial status.

Keywords

Macroeconomic Conditions, Regime Switches, Persistent Preference Shocks, Duration of Contractions, Corporate Management

1. Introduction

Traditional corporate finance models implicitly assume a single-regime which, roughly speaking, implies that the environment under which a firm is operated is not subject to any structural breaks. Empirically, however, we live in a multi-regime world where big changes are common observations. The most notable structural breaks relevant for firm operations are the fluctuations of macroeconomic conditions and the induced structural changes. Indeed, mounting evidences show large economy-wide swings in production and investment opportunities, market conditions, and economic agents' risk preferences, which natually have profound impact on corporate decision-making, firm valuations, and the entrepreneur's welfare with the firm.

Despite the rapid growth in empirical research on the effects of business cycle variations on corporate policies and corporate risk management (e.g., Oxelheim [1], Dittmar and Dittmar [2], Abaidoo [3], Bezerra, Lagioia, and Pereira [4], Chang, Chen, and Dasgupta [5], Vural-Yavaş [6], Mahmood *et al.* [7]), the literature lacks theoretical analyses on the impact of business cycle variations on firms' optimal operations and the resulting valuation and welfare implications[1]. This paper aims to fill this gap by studying the optimal operations of an entrepreneurial firm that is subject to the macro-level shocks and the accompanied persistent changes of its controlling agent's risk preferences.

More specifically, we introduce the realistic business cycle variations into a dynamic stochastic framework for an entrepreneurial firm featuring consumption, asset allocation, investment-specific shocks, and costly busines liquidation. Different than the usual single-regime models (e.g., Du [9]), we account for the regime dependences of several of the model's critical parameters so that the firm-held capital becomes less productive, investment involves higher risk, equity market on average delivers negative returns, and the entrepreneur of the firm becomes more risk averse in episodes of bad economic states (or regimes). With this framework, we are trying to answer several related questions: How should a firm allocate its resources between capital investment and a risky market portfolio when it faces both a less productive capital and a negative equity risk premium during the bad times? Compared to the single-regime case, how would macroeconomic dynamics that intrinsically links different regimes together change the entrepreneur's behaviors and her welfare? How should the entrepreneur make her intertemporally optimal decisions when her degree of risk aversion also changes through the different business cycle phases? What are the overall effects of macro-level shocks when the entrepreneur, with the anticipation of regime switches, can get prepared for future shocks through liquidity and risk management policies?

Incorporating business cycle variations into the dynamic corporate finance framework proves technically challenging even if we only consider two macro regimes of expansions and contractions. This is because the entrepreneur's problem now has to be solved by two interconnected Hamilton-Jacobi-Bellman (HJB) equations: one for the current regime's value function and the other for her continuation value function which reflects the values obtained after the aggregate economy switches into the other regime. Within each regime, the entrepreneurial firm accumulates both capital stock and liquid wealth so the resulting HJBs are

[1]To our best knowledge, Bolton, Chen, and Wang (BCW) [8] provide the only theoretical study on an entrepeneurial firm that is subject to the macro-level fluctuations. Their setup, however, is very different than the one considered in this paper. In particular, they focus on the firm's external financing policies by ignoring important dimensions of firm-level activities such as consumption and asset allocation. In addition, they do not account for the changing market conditions and the persistent shocks to the entrepreneur's preferences induced by the macro-level fluctuations which are the focus of study in the present paper.

partial differential equations (PDEs), which in general are very difficult to solve. In addition, several critical parameters, e.g., the equity risk premium and degree of risk aversion, take very different values under the two macro regimes so that the involved HJBs are essentially describing two very different problems suited to the macroeconomic conditions. Consequently, it is difficult to merge them together into a solution for the linked system so that each of the two HJBs serves as the continuation value for the other HJB in an internally compatible manner. By tackling these challenges, we provide numerical solution to our model with accuracy, which lays the foundation for the subsequent quantitative analysis.

A clear differentiation of the different macroeconomic conditions and the risk aversion reveals quantitative results that cannot be seen with a single-regime setup. By temporarily ignoring the interactions between the two regimes, we show that a worse economic condition, which naturally induces a greater concern about the potential risks, implies a lower valuation of the firm-held capital and a more conservative investment, asset allocation, and liquidation policies. Somewhat surprisingly, a bad economic condition or a higher degree of risk aversion may encourage consumption. This is because a more risk averse entrepreneur who is stuck in bad times, relative to a less risk averse entrepreneur in good times, transfers resources from production and stock market positioning to consumption, which is deemed as the optimal way to maximize her utility with firm given the current hopeless situation.

More interestingly, our numerical solution to the linked system reveals various implications that are not easily expected when compared to results in the case where the two regimes are isolated from one another. First, the strong intertemporal smoothing effect yields consumption levels that are almost indistinguishable for the two macro regimes. Second, while the value-creation effect from stock trading turns negative during the contraction regime, which prompts the firm to allocate more resources from financial trading to investment, the lower capital's productivity and the higher investment risk during bad times simultaneoulsy depresses the firm's investment motives. Our numerical solution shows that the latter two effects dominate, which implies the usual countercyclical pattern of firms' capital investment. Third, as the duration of the contraction regime rises, the entrepreneur gains a higher hope for the recovery of the aggregate economy, which raises both the firm's valuation the entrepreneur's welfare. In comparison, however, the welfare gain for the entrepreneur is substantially higher than the gain of the firm's valuation. Fourth, the effects of macroeconomic condition on a firm policies crucially depend the duration of the given regime. For example, the entrepreneur in bad times substantially scales back her consumption and reduces the liquidation boundary to levels that are fairly close to their expansion-counterparts when the duration of the recession regime falls from infinity to two years. In sum, while its timing cannot be accurately forecasted, the mere anticipation about the potential regime switches would substantially change the entrepreneur's welfare and the resulting firm-level behaviors. In other words, it will be wrong to conclude that macro environment has small effect on firm operations just because the ex-post policy responses to macro-level shocks are small because any observed responses following the shock would merely be a residual response.

We further conduct comparative analysis, which generates a rich set of empirical predictions. First, raising the capital's productivity in bad times raises consumption, investment, and capital's valuation in both regimes. It simultaneously induces a more aggressive short position in the stock market during contractions, but leaves the entrepreneur's asset allocation policy during expansions largely unaffected. Second, raising the degree of investment risk during recessions has mixed effects on bad times' investment and asset allocation policies depending on the firm's financial status, but it hardly affects the firm along other dimensions. Third, a worse market condition during the bad times induces the more aggressive short selling whose proceeds are used to finance investment in current regime. Simutaneoulsy, it depresses consumptions in both regimes. Fourth, changes of the entrepreneur's risk averson substantially affects her operations of the firm and the effects are asymmetric which depend on a particular macroeconomic condition. In particular, while a lower degree of risk aversion in good times uniformly raises investment, capital's valuation, consumption and firm's position in the stock market, a similar effect is observed during bad times only when the firm is financially healthy. When the firm is instead in a bad financial status, a lower degree of risk aversion in bad times can actually raise consumption and induce a more conservative asset allocation strategy for the current regime.

Our paper is closely related to the literature on market timing (e.g., Baker and Wurgler [10], DeAngelo, DeAngelo, and Stulz [11], Huang and Ritter [12]). By attributing the changing market conditions to the alternations of business cycle phases, we complement this literature by interpreting the widely observed market timing behaviors as firm agents' adaptions to the fluctuations of macroeconomic conditions. By analyzing the impact of economic recession's duration on firms' optimal operations, our work also contributes to the literature that studies the effects of financial crisis on firms' behaviors (e.g., Campello, Graham, and Harvey [13]; Duchin, Ozbass, and Sensoy [14]). From the theoretical side, our analyses extend the modeling of macro-level fluctuations (e.g., Hackbarth, Miao, and Morellec (HMM) [15]; Chen [16]; BCW [8]) by allowing for persistent preference shocks adapted to the different business cycle phases. In contrast, HMM [15], Chen [16], and BCW [8] all assume time-invariant risk preferences so that agents in their setups behave in a preference-consistent manner which greatly simplifies the involved mechanics[2].

The rest of the paper is organized as follows. Section II sets up the model. Section III characterizes the model and Section IV presents the model's numerical solution. Section V investigates the model's quantitative implications and Section VI provides the comparative analysis with respect to the regime-dependent parameters. Section VII concludes.

[2]Financially, both HMM [15] and Chen [16] focus on corporate bond pricing and firm's capital structure decisions: A topic which is very different than the one studied in the present paper.

2. Model Setup

2.1. Macroeconomic Dynamics

We consider an entrepreneurial firm which can be in one of the two macroeconomic conditions (or regimes), which we denote by H (expansion) and L (contraction). The firm faces different (stochastic) opportunities on investment, production, and financial trading in these two regimes, which furthermore affect the risk attitudes of the entrepreneur that runs the firm. To mimick the empirically observed alternations among different phases of the business cycle, we assume that the dynamics of H and L are governed by a two-state (continuous-time) Markov chain[3]. More specifically, the macroeconomic condition switches from H to L (or from L to H) with a constant probability $\lambda^H \Delta$ (or $\lambda^L \Delta$) over a short time interval Δ. Thus, the expected duration of regime i is $\left(\lambda^i\right)^{-1}$ and the average fraction of time spent in that regime is $\lambda^{i'}\left(\lambda^H + \lambda^L\right)^{-1}$ for $i' \neq i$; $i, i' \in \{H, L\}$. In the following, we use $s(t)$ to denote the realized macroeconomic condition, which is observable to the entrepreneur.

2.2. Capital Accumulation and Production

An entrepreneurial firm obtains productivity from its capital stock K_t, which evolves according to

$$dK_t = \left(I_t - \delta_K K_t\right)dt + \sigma_K K_t dZ_t + \epsilon^{s(t)} I_t dZ_t^I, \tag{2.1}$$

where I_t is investment; $\delta_K > 0$ is the depreciation rate. Without loss of generality, we decompose the firm-level risk into two orthogonal components: the usual capital depreciation shock (e.g., Bolton, Wang, and Yang (BWY) [17]) driven by dZ_t with the implied volatility governed by σ_K, and an investment-specific shock driven by Z_t^I where the volatility parameter $\epsilon^{s(t)}$ loads on the macroeconomic conditions for $s(t) \in \{H, L\}$. The latter specification implies that output fluctuations arise from shocks to the marginal efficiency of investment (Keynes [18]), and we use the regime-dependent $\epsilon^{s(t)}$ to capture the differences in investment opportunities for the firm when it is subject to the macro-level shocks.

The gross output of the firm over the period $(t, t+dt)$ is proportional to its time- t capital stock K_t by $K_t A^{s(t)}$, where $A^{s(t)} \in \left\{A^H, A^L\right\}$ which captures the impact of macroeconomic conditions on the firm's productivity. The firm's operating profit dY_t over the same period is thus given by

$$dY_t = K_t A^{s(t)} dt - I_t dt - G\left(I_t, K_t\right)dt, \tag{2.2}$$

[3]Our analysis in this paper focuses on the special case of two macro-level regimes. It is possible to generalize our model to a setting with more than two regimes, denoted by $s_t = 1, 2, \cdots, n$, where the dynamics among the different regimes are governed by an n -state continuous-time Markov chain $\Lambda = \left[\lambda_{ij}\right]$. In this generalized setup, the entrepreneur's problem is much harder to solve since her HJB within each regime is intrinsically linked to HJBs in all the other regimes. Financially speaking, we feel that our two-regime setup is representative which already captures the main characteristics of the entrepreneur's multi-regime problem when the corporate environment changes with the macro-level shocks.

where $G(I,K)$ is the adjustment cost. Following Hayashi [19], we assume that the adjustment cost $G(I,K,s)$ is convex in I and homogeneous of degree one in I and K by

$$G(I,K) = g(i)K = \frac{\theta i^2}{2}K, \tag{2.3}$$

where $i = I/K$ which denotes the investment-capital ratio; θ determines the degree of adjustment cost.

2.3. Stochastic Opportunities on Financial Trading

Besides capital investment and the resulting productivity, the firm can also invest in a risk-free asset which pays a constant rate of interest r and the risky market portfolio. Assume that the incremental return dR_t of the market portfolio over the time period dt follows:

$$dR_t = \mu_R^{s(t)}dt + \sigma_R dB_t, \tag{2.4}$$

where B_t is the standard Brownian representing the systematic (or market) risk which is correlated with the firm-level risks of Z_t and Z_t^I by and ρ and ρ_I, respectively[4]. In (2.4), σ_R denotes the constant volatility parameter of the market portfolio return process. Suited to our setup, we allow the average return of market portfolio, $\mu_R^{s(t)}$, to load on the macroeconomic conditions, which reflects the changable market conditions that the firm is facing.

Let W and X denote the firm's liquid wealth and the amount invested in the risky asset, respectively. Their difference, $W - X$, is thus invested in the risk-free asset. Out of its liquid asset, the firm pays the investment cost and consumes. Thus, W_t evolves according to

$$dW_t = \left[r(W_t - X_t) + \eta^{s(t)}\sigma_R X_t + dY_t - C_t\right]dt + \sigma_R X_t dB_t, \tag{2.5}$$

where dY_t is given by (2.2);

$$\eta^{s(t)} \equiv \frac{\mu_R^{s(t)} - r}{\sigma_R}$$

which denotes the market Sharpe ratio[5]. Since $\mu_R^{s(t)}$ is regime-dependent, so is $\eta^{s(t)}$ which summarizes the impact of macroeconomic conditions on the firm's stochastic opportunities on finanial trading.

2.4. The Entrepreneur's Preferences

The entrepreneur of the firm is equipped with a recursive preference (e.g., Epstein and Zin [20]; Dufie and Epstein [21]) by

$$J_t = E_t\left[\int_t^\infty f(C_s, J_s)\,\mathrm{d}s\right], \tag{2.6}$$

[4]We assume that $\rho, \rho_I < 1$ so that firm-level risks cannot be fully hedged away by taking positions in the stock market.

[5]Note that W can be negative under which firm borrows against its capital stock at the risk-free rate of r.

where J denotes the entrepreneur's utility; $f(C,J)$ is known as the normalized aggregator for consumption C and it is regime dependent in our setup by

$$f^{s(t)}\left(C_t, J_t^{s(t)}\right) = \frac{\zeta}{1-1/\psi} \frac{C_t^{1-1/\psi} - \left(\left(1-\gamma^{s(t)}\right) J_t^{s(t)}\right)^{\chi^{s(t)}}}{\left(\left(1-\gamma\right) J_t^{s(t)}\right)^{\chi^{s(t)}-1}}, \tag{2.7}$$

where ζ denotes the usual subjective discount rate; $\psi > 0$ measures the elasticity of substitution (EIS); $\gamma > 0$ is the coefficient of relative risk aversion;

$$\chi^{s(t)} \equiv \frac{1-1/\psi}{1-\gamma^{s(t)}}.[6] \tag{2.8}$$

The regime-dependence of f is attributed to the entrepreneur's persistent preference shocks, which are induced by the macro-level fluctuations. Such shocks are captured by the entrepreneur's regime-dependent risk aversion, indicated by $\gamma^{s(t)}$, which captures the usual intuition that she is more risk averse when the aggregate economy is in a bad condition.

2.5. Summarizations

In summary, our setup involves two different types of shocks: 1) a small diffusive shock as captured by dZ_t, dZ_t^I, and dB_t, and 2) a large shock when the macroeconomic condition changes. While potentially all model parameters are subject to the large shock, for parsimony we only allow four parameters, ϵ, A, η, and γ, to load on the macroeconomic conditions. Since these four parameters cover the firm's investment (ϵ) and production (A), the market condition that it faces (η), as well as the entrepreneur's risk attitudes (γ), our parametric choices for regime-dependences seem representative for understanding the impact of macro level shocks on an entrepreneurial firm's operations.

3. Characterizations of the Model

In our setup, when a forward-looking entrepreneur makes her decisions in the given regime/macroeconomic condition, she has to take into account the optimal decisions to be made in the other regime. As a result, the entrepreneur's problem is characterized by two interconnected value functions suited to the expansion and the recess on regime, respectively, and each value function serves as the continuation value for the other. We highlight such interconnections in this section which allows us to fully characterize the entrepreneur's problem.

3.1. Dynamic Programming

Let $J^m(K,W)$ denote the value function for the entrepreneur when the macroeconomic condition is $m \in \{H, L\}$. By applying the principle of dynamic

[6]The widely used constant-relative-risk-averse (CRRA) utility is a special case of the Duffie-Epstein-Zin-Weil recursive utility specification with EIS set to the inverse of γ; under which χ degenerates to 1.

programming to J^m, we obtain the following Hamilton-Jacobi-Bellman (HJB) equation:

$$\begin{aligned} 0 = \max_{C,X,I} & f^m\left(C_t, J^m\right) + \left[rW_t + \eta^m \sigma_R X_t + A^m K_t - I_t - G\left(I_t, K_t\right) - C_t\right] J_W^m \\ & + \left(I - \delta_K K\right) J_K^m + \frac{\left(\epsilon^m\right)^2 I^2 + \sigma_K^2 K^2}{2} J_{KK}^m + \left(\rho_I \epsilon^m I + \rho \sigma_K K\right) \sigma_R X J_{KW}^m \\ & + \frac{\sigma_R^2 X^2}{2} J_{WW}^m + \lambda^m \left[J^{m'}\left(K,W\right) - J^m\left(K,W\right)\right], \end{aligned} \tag{3.1}$$

where J_W^m, J_K^m, J_{KK}^m, J_{KW}^m, and J_{WW}^m denote the partial derivatives of J^m; $m' \neq m$; we have used (2.1), (2.2), and (2.5)[7]. As indicated by the last term of (3.1), J^m transitions into $J^{m'}$ with the intensity λ^m when macroeconomic condition shifts from m into m'. Consequently, the two HJBs on J^m and $J^{m'}$ are intrinsically linked to one another. Intuitively, a rational entrepreneur adapts to the current macroeconomic condition while she anticipates the macro-level fluctuations would drive the corporate environment, together with her risk preferences, into a different regime at any time with certain probability.

By the first-order conditions (FOCs), the firm's optimal policies on consumption C^m, investment I^m, and asset allocation X^m during the macro regime m are determined according to:

$$\left[C^m\right]: f_C^m\left(C^m, J^m\right) = J_W^m\left(K,W\right), \tag{3.2}$$

$$\left[I^m\right]: \left[1 + G_I\left(I^m, K\right)\right] J_W^m = J_K^m + \left(\epsilon^m\right)^2 I^m J_{KK}^m + \rho_I \epsilon^m \sigma_R X^m J_{KW}^m, \tag{3.3}$$

$$\left[X^m\right]: X^m = -\frac{\mu_R - r}{\sigma_R^2} \frac{J_W^m}{J_{WW}^m} - \frac{\left(\rho \sigma_K K + \rho_I \epsilon^m I^m\right)\sigma_R}{\sigma_R^2} \frac{J_{KW}^m}{J_{WW}^m}, \tag{3.4}$$

when the aggregate economy is in state m, where f^m is given by (2.7); G is given by (2.3). Du [9] provides the financial interpretations of the above FOCs for the single-regime case which are largely applicable here except for the differences

[7]Using (2.7), (3.1) can be equivalently written as

$$\begin{aligned} \frac{\zeta}{1-1/\psi}\left(1-\gamma^m\right)J^m = \max_{C,X,I} & \frac{\zeta}{1-1/\psi} \frac{C_t^{1-1/\psi}}{\left(\left(1-\gamma\right)J^m\right)^{\chi^m - 1}} + \left[rW_t + \eta^m \sigma_R X_t + A^m K_t - I_t - G\left(I_t, K_t\right) - C_t\right] J_W^m \\ & + \left(I - \delta_K K\right) J_K^m + \frac{\left(\epsilon^m\right)^2 I^2 + \sigma_K^2 K^2}{2} J_{KK}^m + \left(\rho_I \epsilon^m I + \rho \sigma_K K\right) \sigma_R X J_{KW}^m + \frac{\sigma_R^2 X^2}{2} J_{WW}^m \\ & + \lambda^m \left[J^{m'}\left(K,W\right) - J^m\left(K,W\right)\right]. \end{aligned}$$

In the single-regime case with the CRRA preference, as considered in BWY [17], $\gamma = 1/\psi$ so that χ as defined in (2.8) degenerates to one and there is no longer the regime-dependences. The implied HJB from (3.1) thus degenerates to

$$\begin{aligned} \zeta J = \max_{C,X,I} & \zeta \frac{C_t^{1-\gamma}}{1-\gamma} + \left[rW_t + \eta \sigma_R X_t + AK_t - I_t - G\left(I_t, K_t\right) - C_t\right] J_W + \left(I - \delta_K K\right) J_K \\ & + \frac{\epsilon^2 I^2 + \sigma_K^2 K^2}{2} J_{KK} + \left(\rho_I \epsilon I + \rho \sigma_K K\right) \sigma_R X J_{KW} + \frac{\sigma_R^2 X^2}{2} J_{WW}. \end{aligned}$$

This degenerated version of (3.1) replicates Equation (11) in BWY [17] if we 1) remove terms of investment-specific shocks that are not considered by BWY [17]; 2) add a pure idiosyncratic-risk hedging position Φ_h as in BWY [17] which is not considered in the present paper; and 3) realize that $U\left(C\right) = \frac{C_t^{1-\gamma}}{1-\gamma}$ in BWY [17].

that J^m for $m \in \{H, L\}$ have to be jointly determined in an internally compatible manner.

3.2. The Implied Ordinary Differential Equations (ODEs)

To actually solve the above HJBs with the stochastic controls, we conjecture (and verify later) that J^m can be written as

$$J^m(K,W) = \frac{\left(b^m P^m(K,W)\right)^{1-\gamma^m}}{1-\gamma^m} = \frac{\left(b^m K p^m(w)\right)^{1-\gamma^m}}{1-\gamma^m}, \tag{3.5}$$

where b^m is a constant for the given $m \in \{H, L\}$; $w \equiv W/K$ which denotes the firm's financial slack; $P^m(K,W) \equiv K p^m(w)$ is interpreted as the certainty-equivalent (CE) valuation of the firm by the entrepreneur for the given macroeconomic condition[8]. Under (3.5), we have the following expressions for J^m-derivatives:

$$J_W^m = \left(b^m\right)^{1-\gamma^m} \left(p^m(w)K\right)^{-\gamma^m} p^m(w), \tag{3.6}$$

$$J_K^m = \left(b^m\right)^{1-\gamma^m} \left(p^m(w)K\right)^{-\gamma^m} \left(p^m(w) - w \cdot \left(p^m\right)'(w)\right), \tag{3.7}$$

$$J_{WW}^m = \left(b^m\right)^{1-\gamma^m} \left(p^m(w)K\right)^{-\gamma^m-1} \left[p^m(w) \cdot \left(p^m\right)''(w) - \gamma^m \left(\left(p^m\right)'(w)\right)^2\right], \tag{3.8}$$

$$J_{KW}^m = \left(b^m\right)^{1-\gamma^m} \left(p^m \cdot K\right)^{-\gamma^m-1} \left[-wp^m \cdot \left(p^m\right)'' - \gamma^m \left(p^m\right)' \left(p^m - w \cdot \left(p^m\right)'\right)\right], \tag{3.9}$$

$$J_{KK}^m = \left(b^m\right)^{1-\gamma^m} \left(p^m \cdot K\right)^{-\gamma^m-1} \left[w^2 p^m \cdot \left(p^m\right)'' - \gamma^m \left(p^m - w \cdot \left(p^m\right)'\right)^2\right]. \tag{3.10}$$

Consistent with the formulation of (3.5), we treat the firm's capital K_t as the scaling factor and use lower case letters to denote the following variables: firm's liquid wealth $w_t = W_t/K_t$, the agent's CE valuation of the firm $p_t^m = P_t^m/K_t$, consumption $c_t^m = C_t^m/K_t$, investment $i_t^m = I_t^m/K_t$, and risky ass*et al.* location $x_t^m = X_t^m/K_t$. Using (3.5) to simplify (2.7), which are then substituted into (3.2), we obtain the following consumption rule after making use of (3.6):

$$c^m(w) = \zeta^\psi \left(b^m\right)^{1-\psi} \left[\left(p^m\right)'\right]^{-\psi} p^m. \tag{3.11}$$

By substituting (3.6)-(3.10) into (3.4)-(3.3) and performing necessary manipulations, the optimal investment and asset allocation policies as functions of w are given by

$$i^m(w) = \frac{p^m - (w+1)\left(p^m\right)' - \rho_I \epsilon^m \left(p^m\right)' \frac{\gamma^m p^m - wh^m}{p^m} \left[\eta^m \frac{p^m}{h^m} - \rho\sigma_K \left(\frac{\gamma^m p^m}{h^m} - w\right)\right]}{\theta\left(p^m\right)' + \left(1-\rho_I^2\right)\left(\epsilon^m\right)^2 \frac{\left(p^m\right)'}{p^m} \frac{\left(\gamma^m p^m - wh^m\right)^2}{h^m} - \gamma^m \left(\epsilon^m\right)^2 \frac{\left(p^m\right)^2 \left(p^m\right)''}{h^m \left(p^m\right)'}} \tag{3.12}$$

[8]Financially, $P^m(K,W)$ denotes the minimum dollar amount that the entrepreneur in the aggregate state m would demand to permanently give up the firm.

$$x^m\left(w;i^m\right)=\frac{\eta^m}{\sigma_R}\frac{p^m}{h^m}-\frac{\rho_I\epsilon i^m+\rho\sigma_K}{\sigma_R}\left(\frac{\gamma^m p^m}{h^m}-w\right), \tag{3.13}$$

where $m\in\{H,L\}$;

$$h^m\equiv\gamma^m p^m-\frac{p^m\left(p^m\right)''}{\left(p^m\right)'} \tag{3.14}$$

By substituting (2.7), optimal policies of (3.11)-(3.12), and the expressions of (3.6)-(3.10) into (3.1), making use of the conjectured (3.5), which applies to both J^H and J^L, and performing necessary simplifications, tedious algebra gives:

$$\begin{aligned}0=&\frac{\zeta^\psi\left(b^m\right)^{1-\psi}\left(\left(p^m\right)'\right)^{1-\psi}-\zeta\psi}{\psi-1}p^m+\left(rw+A^m\right)\left(p^m\right)'+\frac{1}{2}\frac{\left(\eta^m\right)^2p^m\left(p^m\right)'}{h^m}\\&-\delta_K\left(p^m-w\cdot\left(p^m\right)'\right)-\frac{\sigma_K^2\left(1-\rho^2\right)}{2}\frac{p^m\left(p^m\right)'}{h^m}\left(\gamma^m-\frac{wh^m}{p^m}\right)^2\\&-\rho\sigma_K\eta^m\left(p^m\right)'\left(\frac{\gamma^m p^m}{h^m}-w\right)+\frac{\gamma^m\sigma_K^2}{2}\frac{\left(p^m\right)^2\left(p^m\right)''}{h^m\left(p^m\right)'}\\&+\frac{1}{2}\frac{\left[p^m-(w+1)\left(p^m\right)'-\rho_I\epsilon^m\left(p^m\right)'\frac{\gamma^m p^m-wh^m}{p^m}\left(\eta^m\frac{p^m}{h^m}-\rho\sigma_K\left(\frac{\gamma^m p^m}{h^m}-w\right)\right)\right]^2}{\theta\left(p^m\right)'+\left(1-\rho_I^2\right)\left(\epsilon^m\right)^2\frac{\left(p^m\right)'}{p^m}\frac{\left(\gamma p^m-wh^m\right)^2}{h^m}-\gamma^m\left(\epsilon^m\right)^2\frac{\left(p^m\right)^2\left(p^m\right)''}{h^m\left(p^m\right)'}}\\&+\frac{\lambda^m p^m(w)}{1-\gamma^m}\left[\left(\frac{b^{m'}\cdot p^{m'}(w)}{b^m\cdot p^m(w)}\right)^{1-\gamma^m}-1\right]\end{aligned} \tag{3.15}$$

where $b^{m'}$ and $p^{m'}(w)$ in the last term come from the expression of $J^{m'}(K,W)$ after the switch of the macroeconomic condition; $m,m'\in\{H,L\}$ with $m\neq m'$. A simplified version of (3.15) is provided in Equation (3.17) of Du [9] for the single-regime case where macro-level fluctuations are shut down such that 1) the transition density λ is set at zero; and 2) the regime-dependences of b, p, h and the four parameters of ϵ, A, η, and γ are all shut down.

3.3. The Limiting Behavior of p^m at the Upper End

At the upper end when $w\to\infty$, the firm achieves the first-best (FB) for the given macroeconomic condition m as follows:

$$\lim_{w\to\infty}p^m(w)=p^{FB,m}=w+q^{FB,m}, \tag{3.16}$$

where $p(w)$ satisfies (3.15); $q^{FB,m}$ denotes the constant valuation of the firm-held capital under FB. Intuitively, $p(w)$ can be decomposed into $w+q(w)$ where w denotes the liquid wealth per unit of capital and $q(w)$ denotes the liquid-wealth valuation of capital. The w-dependence of q is attributed to the time-varying liquidation risk since a higher w provides the better buffer against the potential liquidation. At $w \to \infty$ that shuts down the liquidation risk, q becomes a constant within the given macroeconomic condition.

To identify $q^{FB,m}$ for $m \in \{H, L\}$, substituting (3.16) into (3.12) and (3.15), taking the limit $w \to \infty$, and simplying[9], we obtain

$$i^m = i^{FB,m} = \frac{q^{FB,m} - 1 - \rho_I \epsilon^m \eta q^{FB,m}}{\theta} \tag{3.17}$$

and

$$\begin{aligned} 0 = \max_i & \left(\frac{\zeta^{\psi} \left(b^m\right)^{1-\psi} - \psi\zeta}{\psi - 1} + r + \frac{\left(\eta^m\right)^2}{2\gamma^m} \right) \left(w + q^{FB,m} \right) \\ & + \frac{\lambda^m \cdot \left(w + q^{FB,m} \right)}{1 - \gamma^m} \left[\left(\frac{b^{m'}}{b^m} \right)^{1-\gamma^m} \left(\frac{\lim_{w\to\infty} p^{m'}(w)}{\lim_{w\to\infty} p^m(w)} \right)^{1-\gamma^m} - 1 \right] \\ & + A^m - i - \frac{1}{2}\theta i^2 - \left(r + \delta_K - i \right) q^{FB,m} - \left(\rho_I \epsilon^m i + \rho \sigma_K \right) \eta^m q^{FB,m}, \end{aligned} \tag{3.18}$$

respectively. Since (3.18) has to hold for all w, b^m has to satisfy

$$0 = \frac{\zeta^{\psi} \left(b^m\right)^{1-\psi} - \psi\zeta}{\psi - 1} + r + \frac{\left(\eta^m\right)^2}{2\gamma^m} + \frac{\lambda^m}{1-\gamma^m} \left[\left(\frac{b^{m'}}{b^m} \right)^{1-\gamma^m} - 1 \right], \tag{3.19}$$

for $m, m' \in \{H, L\}$ with $m \neq m'$, where we've used (3.16) for both H and L so that the limiting ratio in (3.18), $\lim_{w\to\infty} p^{m'}(w) \big/ \lim_{w\to\infty} p^m(w)$, is simply one. (3.18) now degenerates to

$$0 = \max_i A^m - i - \frac{1}{2}\theta i^2 - \left(r + \delta_K - i \right) q^{FB} - \left(\rho_I \epsilon^m i + \rho \sigma_K \right) \eta^m q^{FB,m}, \tag{3.20}$$

and a substitution of (3.17) into (3.20) gives the valuation of capital under FB as follows:

$$q^{FB,m} = \frac{1 + \theta i^{FB,m}}{1 - \rho_I \epsilon^m \eta^m}, \tag{3.21}$$

where[10]

$$i^{FB,m} = \frac{r + \rho\sigma_K \eta^m + \delta_K}{1 - \rho_I \epsilon^m \eta^m} - \sqrt{\left[\frac{r + \rho\sigma_K \eta^m + \delta_K}{1 - \rho_I \epsilon^m \eta^m} \right]^2 - \frac{2}{\theta} \left[A^m - \frac{r + \rho\sigma_K \eta^m + \delta_K}{1 - \rho_I \epsilon^m \eta^m} \right]}. \tag{3.22}$$

3.4. The Firm's Boundary Conditions at the Lower End

Turning to boundary conditions at the lower end, the firm gets liquidated when w becomes sufficiently negative upon which the firm-held capital stock yields a residual value of lK_t for $l \in (0,1)$. Upon liquidation during the macro regime

[9]Under $p^m(w) = w + q^{FB,m}$, h^m as defined by (3.14) degenerates to γ^m.

[10]It is easy to see that a substitution of (3.21) into (3.20) gives a quadratic equation on i. Of its too roots, we pick the one given by (3.22) so that the resulting $i^{FB,m}$ is increasing in the productivity of capital A^m.

$m \in \{H, L\}$, the entrepreneur sells the firm for $W + lK$ and becomes a Merton consumer (Merton [22]), where her value function takes the form of

$$J^{M,m}\left(W + lK\right) = \frac{\left[b^m\left(W + lK\right)\right]^{1-\gamma^m}}{1-\gamma^m}. \tag{3.23}$$

In (3.23), b^m is solved by (3.19)[11] and our quantitative analyses show that $W_t + lK_t > 0$ always holds so that the entrepreneur as a Merton consumer always starts with a positive wealth.

Let W_d^m denote the firm's liquidation boundary, quoted in terms of the firm's liquid wealth, when the macroeconomic condition is m. Since W_d is optimally chosen, we have the following value matching and smooth-pasting conditions:

$$J^m\left(K, W_d^m\right) = J^{M,m}\left(W_d^m + lK\right), \tag{3.24}$$

$$\left.\frac{\partial J^m\left(K, W\right)}{\partial W}\right|_{W=W_d^m} = \left.\frac{\partial J^{M,m}\left(W + lK\right)}{\partial W}\right|_{W=W_d^m}. \tag{3.25}$$

where $J^m\left(K, W\right)$ and $J^{M,m}\left(W\right)$ are defined by (3.5) and (3.23), respectively. Simplifying (3.24)-(3.25) by making use of (3.5), (3.23), and the scaled variables, we obtain

$$p^m\left(w_d^m\right) = w_d^m + l, \tag{3.26}$$

$$\left(p^m\right)'\left(w_d^m\right) = 1. \tag{3.27}$$

where $w_d^m \equiv W_d^m / K$.

3.5. Summarizations

In our model, J^H and J^L denote the entrepreneur's value function during the expansion and the contraction regime, respectively. Correspondingly, $J^{FB,H}$ and $J^{FB,L}$ denote the entrepreneur's value function under first-best which characterize the boundary conditions at the upper end for J^H and J^L, respectively, while $J^{M,H}$ and $J^{M,L}$ denote a Merton consumer's value function during the expansions and contractions which characterize the boundary conditions at the lower end for J^H and J^L, respectively. For a direct comparison, let J, J^{FB}, and J^M denote the entrepreneur's value function, her value function under

[11]By the principle of dynamic programming, $J^{M,m}$ satisfies the HJB of

$$0 = f^m\left(C^{M,m}, J^{M,m}\right) + \left[rW + \eta^m \sigma_R X^{M,m} - C^{M,m}\right] J_W^{M,m} + \frac{\sigma_R^2\left(X^{M,m}\right)^2}{2} J_{WW}^{M,m} + \frac{\lambda^m \cdot W}{1-\gamma^m}\left[\left(\frac{b^{m'}}{b^m}\right)^{1-\gamma^m} - 1\right],$$

where $\left(C^{M,m}, X^{M,m}\right)$ are optimal policies chosen by the Merton consumer in the macro regime m; the last term reflects the potential switches from regime m to regime m'; we've used the regime dependences of f, η, and γ. Under the conjectured solution of $J^{M,m}\left(W\right) = \left(b^m W\right)^{1-\gamma} / \left(1-\gamma\right)$ as indicated by (3.23), the implied HJB degenerates to (3.19) with $C^{M,m} = \zeta^\psi \left(b^m\right)^{1-\psi} W$ and $X^{M,m}\left(w\right) = \frac{\eta^m}{\gamma^m \sigma_R} W$.

first-best, and a Merton consumer's value function, respectively, in the single-regime case when macro-level fluctuations are shut down[12]. Table 1 summarizes the connections among J, J^H, J^L, J^{FB}, $J^{FB,H}$, $J^{FB,L}$, J^M, $J^{M,H}$, $J^{M,L}$.

As illustrated in Table 1, J^H and J^L serve as the continuation value for each other. Apart from such linkages, J^m for $m \in \{H, L\}$ is similarly characterized as its single-regime counterpart J in terms of the two boundary conditions when $w \to \infty$ and when $w \to w_d^m$. While Table 1 focuses on the interconnections among the different value functions, the involved mechanics within a given value function are provided in Du [9] which remain largely unaffected by the macro-level fluctuations.

4. The Numerical Solution

Taking into account the boundary conditions of (3.26)-(3.27) and (24) for $m \in \{H, L\}$, we can numerically solve the linked system of (23) for a plausible set of parameter values that (possibly) load on the macroeconomic conditions. Table 2 summarizes the baseline parameterizations for our model, where all parameter values are annualized.

Following BCW [9], we calibrate the macroeconomic dynamics to mimick the empirically observed alternations of business cycle phases. In particular, the transition intensity out of state H is set at $\lambda^H = 0.1$, which implies an average duration of ten years for good times. The transition intensity out of L is $\lambda^L = 0.5$, with an implied average length of a financial crisis of two years. Among the regime-dependent parameters, we set $\eta^H = 0.38$ and $\eta^L = -0.1$ so that the average the market Sharpe ratio equals 0.3[13], which is consistent with its usual calibration (e.g., BWY [17]). Wang, Wang, and Yang (WWY) [23] set the average productivity A at 0.2 whereas BWY [18] estimate it to be 0.227. Suited to our setup, we set $A^H = 0.22$ and $A^L = 0.16$ so that the implied average A lies between its previous calibrations. While both η and A are procyclical, the volatility of investment-specific shocks ϵ is countercyclical at $\epsilon^H = 0.4$ and

[12]More specificially, $J^{FB}(K,W) = \frac{\left[bKp^{FB}(w)\right]^{1-\gamma}}{1-\gamma} = \frac{\left[bK\left(w+q^{FB}\right)\right]^{1-\gamma}}{1-\gamma}$, where q^{FB} is a constant; b satisfies $0 = \frac{\zeta^{\psi} b^{1-\psi} - \psi\zeta}{\psi - 1} + r + \frac{\eta^2}{2\gamma}$ which is a degenerated version of (3.19) with transition density λ set to zero and parameters' regime-dependences shut down. For a direct comparison, $J^{FB,m}(K,W) = \frac{\left[b^m Kp^{FB,m}(w)\right]^{1-\gamma}}{1-\gamma} = \frac{\left[b^m K\left(w+q^{FB,m}\right)\right]^{1-\gamma}}{1-\gamma}$, where $q^{FB,m}$ is a constant which is determined by (3.21)-(3.22); b^m satisfies (3.19) for $m \in \{H, L\}$. A similar comparison holds for $J^M(W) = \frac{(bKw)^{1-\gamma}}{1-\gamma}$ vs. $J^{M,m}(W) = \frac{(b^m Kw)^{1-\gamma}}{1-\gamma}$, where b and b^m are defined the same way as that for $J^{FB}(K,W)$ and $J^{FB,m}(K,W)$.

[13]Using the average fraction of time spent in a given regime as its weight, the weighted average of η is thus calculated as $0.38\frac{0.5}{0.1+0.5} + (-0.1)\frac{0.1}{0.1+0.5}$ which gives 0.3.

Table 1. Connections among different value functions. This table summarizes the connections among different value. J, J^{FB}, and J^{M} in Panel A denote the entrepreneur's value function, her value function under first-best, and a Merton consumer's value function, respectively, in the single-regime case when macro-level fluctuations are shut down. Panel B&C report connections of value functions studied in the present paper with the macro-level dynamics. Specifically, J^{H} and J^{L} denote the entrepreneur's value function during the expansion and the contraction regime, respectively. $J^{FB,H}$ and $J^{FB,L}$ denote the entrepreneur's value function under first-best, which characterize the boundary conditions at the upper end for J^{H} and J^{L}, respectively, while $J^{M,H}$ and $J^{M,L}$ denote a Merton consumer's value function during the expansions and contractions, which characterize the boundary conditions at the lower end for J^{H} and J^{L}. The arrows of "$\nearrow$" and "$\searrow$" educe the entrepreneurs' limiting behaviors when the firm's financial status, as measured by w, approaches its upper and lower limit, respectively. The arrow "$\rightarrow$" educes the entrepreneurs' continuation value when a regime switch occurs before the firm's liquidation.

Panel A: single-regime benchmark		
J	$\nearrow$	J^{FB} as $w \to \infty$
	$\searrow$	J^{M} for a Merton consumer in the single-regime case as $w \to w_d$
Panel B: entrepreneur's problem during expansions		
J^{H}	$\nearrow$	$J^{FB,H}$ as $w \to \infty$
	$\rightarrow$	J^{L} as the continuation value for J^{H} when $w \in \left(w_d^H, \infty\right)$
	$\searrow$	$J^{M,H}$ for a naive Merton consumer as $w \to w_d^H$
Panel C: entrepreneur's problem during contractions		
J^{L}	$\nearrow$	$J^{FB,L}$ as $w \to \infty$, where $b^S = b^N$
	$\rightarrow$	J^{H} as the continuation value for J^{L} when $w \in \left(w_d^L, \infty\right)$
	$\searrow$	$J^{M,L}$ for a sophisticated Merton consumer as $w \to w_d^L$

$\epsilon^L = 1$ [14]. Du [9] allows ϵ to vary between 0 and 1 and our choices of ϵ^H and ϵ^L implies an average ϵ that lies in its midpoint 0.5. Finally, we set $\gamma^H = 2$ and $\gamma^L = 4$ to reflect 1) a reasonably low degree of risk aversion; and 2) that the entrepreneur is more risk aversion during the bad macroeconomic condition.

The other parameters remain the same in the two regimes. Specifically, we follow WWY [23] by setting both the risk-free rate and the entrepreneur' subjective discount rate at 4.6%. The volatility of the market portfolio return σ_R equals its usual calibration of 20% so that the average equity risk premium, which equals $\eta\sigma_R$, is 6%. Consistent with the calibration by Du [9], we set ρ and ρ_I at 0

[14]Intuitively, a higher ϵ^L implies that the firm faces higher difficulty to accumulate capital during the bad macroeconomic condition. By similarly using the average fraction of time spent in a given regime as its weight, it is easy to see that the weighted average of ϵ is 0.5.

Table 2. Baseline parameterization. This table summarizes the baseline parameterization to our model. Our model involves two regimes: H which denotes the expansion regime, and L which denotes the recession regime, and Panel A reports the calibration for λ^H and λ^L which denote the transition intensity out of H and L, respectively. We also allow four other parameters to be regime-dependent: The market Sharpe ratio η as reported in Panel B; the entrepreneur's risk aversion γ as reported in Panel C; the capital's productivity A and the volatility of investment-specific shocks ϵ that are reported in Panel D, where the superscript $m \in \{H, L\}$ denotes the particular macroeconomic regime. The other single-valued parameters are as follows. r, σ_R, ρ_K, and ρ_I in Panel B denote, respectively, the risk-free rate, the volatility of the market portfolio, the correlation between the market portfolio returns and capital depreciation shocks, and the correlation between the market portfolio returns and investment-specific shocks. ζ and ψ in Panel C denote the subjective discount rate and the elasticity of intertemporal substitution (EIS), respectively. θ, l, and δ_K in Panel D denote, respectively, the adjustment cost parameter, capital liquidation price, and the rate of capital depreciation.

Panel A: Macroeconomic dynamics						
$\lambda^H = 0.1$	$\lambda^L = 0.5$					
Panel B: Market environment						
$r = 0.046$	$\sigma_R = 0.2$	$\eta^H = 0.38$	$\eta^L = -0.1$	$\rho_K = 0$	$\rho_I = 0.3$	
Panel C: Preferences						
$\zeta = 0.046$	$\gamma^H = 2$	$\gamma^L = 4$	$\psi = 2.2$			
Panel D: Investment and production						
$A^H = 0.22$	$A^L = 0.16$	$\theta = 2$	$l = 0.9$	$\delta_K = 0.125$	$\epsilon^H = 0.4$	$\epsilon^L = 1$

and 0.3, respectively, so that the firm-level risks correlate with the stock market only through the investment-specific shocks. Motivated by its recent estimate by Kapoor and Ravi [24], we set the EIS parameter ψ to 2.2. Guided by the estimate by Whited [25], we take the adjustment cost parameter θ to be 2. As suggested by Hennessy and Whited [26], we choose the capital liquidation price l to be 0.9. At our baseline calibrations reported in **Table 2** [15], **Figure 1** plots the model's numerical solution in terms of $\left(p^m\right)'(w)\,(=P_W^m)$, which denotes the firm's marginal value of wealth conditional on the macro regime $m \in \{H, L\}$.

Due to the extra benefits of accumulating financial slack when the firm is subject to the costly liquidation, $p'(w)$ generally stays above its face value of one for one unit increase of W. Except for values of w that are close to w_d^L, $\left(p^L\right)'(w)$ (dashed line) stays above $\left(p^H\right)'(w)$ (solid line) which underscores the importance of liquid wealth in bad times. Since the entrepreneur liquidates the firm earlier when the macroeconomic condition is bad, $\left(p^L\right)'(w)$ falls below

[15] To confirm the robustness of our results to parameterizations, we allow various parameters to deviate from their baseline levels and find that model implications remain largely unaffected for marginal changes of parametric values. In Section VI, we further conduct comparative analysis with respect to regime-dependent parameters that summarize the impact of macro level shocks on an entrepreneurial firm's operations.

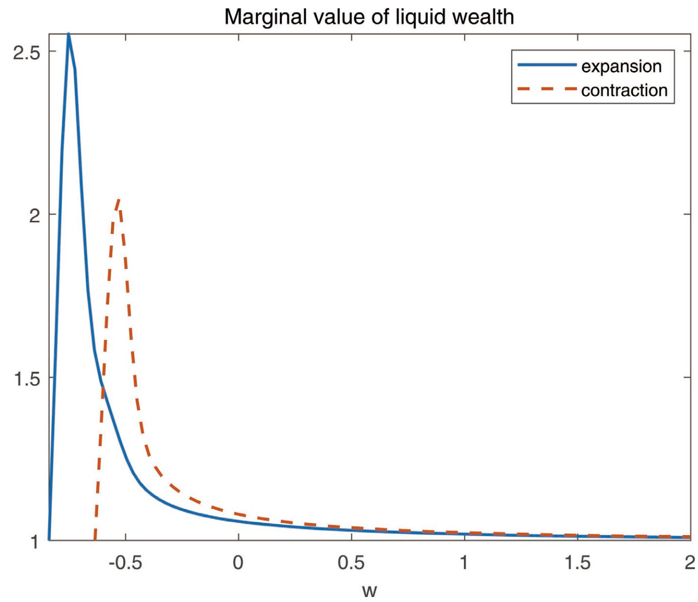

Figure 1. Marginal value of liquid wealth at the presence of macro-level fluctuations. **Figure 1** plots the numerical solutions to the entrepreneur's problems in terms of $\left(p^m\right)'(w)$ $(=P_W^m)$, which denotes the firm's marginal value of wealth conditional on the macro regime $m \in \{H, L\}$, where $w \equiv W/K$ which measures the firm's financial slack; regime H denotes economic expansions and regime L denotes economic contractions. The model's baseline paramaterizations, which may depend on a particular macroeconomic regime, are reported in **Table 2**.

$\left(p^H\right)'(w)$ when w is sufficiently negative so that it reaches the level of one earlier at the higher w_d^L as required by the boundary condition of (3.27). At the other end when w drifts away towards infinity, $\left(p^m\right)'(w)$ also approaches its face value of one since the costly liquidation is no longer a concern.

5. Quantitative Implications

5.1. Capital Valuation and Optimal Investment

The top two Panels of **Figure 2** plot the valuation of firm-held capital q^m and the optimal investiment-capital ratio i^m with respect to w, where $m \in \{H, L\}$. As plotted, capital is more valuable which induces higher investment in regime H (solid lines) than in regime L (dashed lines). The implied disrepancy, however, is only partially explained by the differences between A^H and A^L. Indeed, by shutting down both λ^H and λ^L so that the two regimes no longer interact with one another, the implied q^H and i^H rise further above (lines with square marker) while the implied q^L and i^L fall further below (lines in circle) by a large margin. These results suggest that macroeconomic dynamics play a critical role in determining the firm's optimal investment policy and its capital's valuations.

Taking into account the fact that $\eta^H > \eta^L$, the implication that $i^H > i^L$ is actually not apparent ex-ante. Indeed, when the value-creation effect from stock trading is gone (and in fact turns negative at our baseline calibration of η^L)

during recessions, the firm naturally allocate more resources from financial trading to capital investment, which could lead to a higher i^L. It turns out, however, that this resource re-allocation effect is dominated by the productivity effect of $A^H > A^L$ combined with the countercyclical investment risk of $\epsilon^H < \epsilon^L$ which suggest a lower i^L. Consequently, we obtain the procyclical investment policy as plotted in Panel B of **Figure 2**. Given the similar patterns of plots in Panel A&B, our study of q and i at the presence of business cycle variations supports the usual practices in the empirical literature on corporate investment that uses the average q to control for investment opportunities (e.g., Martin [27]; Carpenter and Guariglia [28]).

5.2. Optimal Consumption and Asset Allocation

Panel C of **Figure 2** plots the firm's optimal consumption policies. Facing the business cycle variations, the entrepreneur substantially smooth out her consumption so that the implied c^H (solid line) and c^L (dashed line) almost coincide. This is in sharp contrast to the case when business cycle variations are shut down at $\lambda^H = \lambda^L = 0$ so that the two regimes no longer interact with one another. In that case, the intertemporal smoothing-out effect is gone and the entrepreneur chooses a much higher consumption during contractions (line in circle) than during expansions (line with square marker): This way, she can maximize her utility during the contraction regime when the firm would be liquidated at a much earlier time than during the expansions.

Somewhat surprisingly, the firm's asset allocation policies are not affected by λ^H or/and λ^L much. Indeed and as plotted in Panel D of **Figure 2**, the levels of x^H are largely maintained before (solid line) and after (line with square marker) shutting down the macroeconomic dynamics for the expansion regime, and a similar observation holds for the implied $x^L s$ (dashed line vs. line in circle). Financially, the optimal x is mainly driven by the entrepreneur's myopic demand[16], which is not affected by the macro-level shocks with only occasional strikes. Given that $\eta^H > 0 > \eta^L$, the implied x^H stays positive and it rises with w at a relatively sharp angle, which is due to the relatively low degree of risk aversion during the expansion regime[17]. By a similar logic, the implied x^L is

[16]By (3.13), $x^m\left(w;i^m\right) = \frac{\eta}{\sigma_R}\frac{p^m}{h^m} - \frac{\rho_I \epsilon i^m + \rho\sigma_K}{\sigma_R}\left(\frac{\gamma p^m}{h^m} - w\right)$. To see that the first term, which denotes the entrepreneur's myopic demand, dominate the second term attributed to intertemporal hedging demand, note that $\frac{p^m}{h^m}$ rises with w while $\frac{\gamma p^m}{h^m} - w$ is insensitive to the variations of w. Thus, the myopic component dominates in general except for ws that are close to w_d^m: For such ws, the intertemporal hedging demand may dominate, especially during the contraction regime when $\left|\eta^m\right|$ is relatively small, leading to the larger discrepancies between x^L and $x^{L,0}$ at $\lambda^H = \lambda^L = 0$ which is also plotted in Panel D of **Figure 2** (dashed line vs. line in circle).

[17]By footnote 12, the myopic component of the firm's asset allocation policy $\frac{\eta}{\sigma_R}\frac{p^m}{h^m}$, which serves as the main driver of x^m, moves inversely to h^m which closely mimicks γ^m for ws that is not too negative (see its definition by (3.14)).

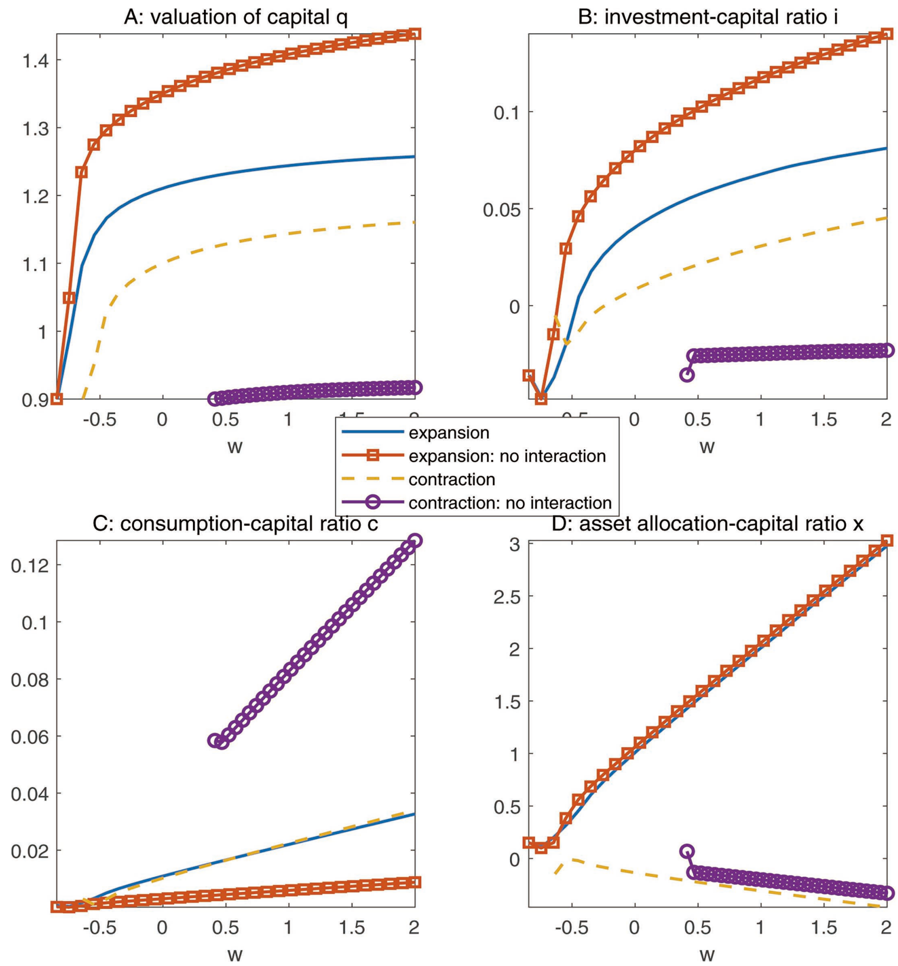

Figure 2. Optimal policies. Panel A-D plots the valuation of firm-held capital q, the investment policy i, consumption policy c, and asset-allocation policy x, respectively. In each panel, we plot implications from both the expansion regime (solid lines) and the contraction regime (dashed lines) under our baseline parameterizations. For the purpose of comparison, we also plot in each panel the implications during expansions (line in circle) and contractions (line with square marker) when macro-level dynamics are shut down at $\lambda^H = \lambda^L = 0$ so that the two regimes no longer interact with one another.

negative, whose absolute values also rise with w but at a lower rate which is attributed to the higher γ^L during the bad times.

In sum, regime-dependent implications that are plotted in Figure 2 are broadly consistent with the widely documented observations that firm agents tend to adapt their consumption, investment, and asset allocation decisions to the position of the economy in the business cycle phase (e.g., Mancke [29]; Alessandri and Bettis [30]; Navarro [31]; Navarro, Bromiley, and Sottile [32], among others).

5.3. The Recovery Effect

When the aggregate economy is in recession and there is no hope to get out of it, Figure 2 shows (lines in circle) that the firm's investment and asset allocation, as well as its capital's valuation, would be severely depressed, which is accompanied with the enhancement of the entrepreneur's consumption. Once we account for the empirically observe business cycle alternations by setting a positive λ^L, however, the entrepreneur, by anticipating the recovery of the economy from contraction into expansion, would adjust the firm-level policies and assign a higher value to capital during the bad times. We refer to such changes as the recovery effect, which is officially plotted in Panel A-D of **Figure 3** where the firm's financial status, as measured by w, is set at 0.5 which ensures an alive firm at all $\lambda^L s$.

As λ^L rises from 0 to its baseline level of 0.5, the entrepreneur in bad times becomes more optimistic in that she anticipates a sooner recovery of the aggregate economy. In response, she re-allocates more resources from consumption to investment as indicated by Panel A&B of **Figure 3**, so that she can benefit from the firm's enhanced capital accumulation and the resulting higher outputs to be realized in the future. The rising i^L as the function of λ^L (Panel B) is consistent with Rafferty's [33] finding that firm's R&D expenditures, as a type of investment, drops during initial recessionary periods but rise later periods when entrepreneurs are expecting a high probability of recovery. Simultaneously and as plotted in Panel C, the higher λ^L prompts the entrepreneur to keep adjusting w_d^L downwards so as to maintain the control of the firm for a longer term. Specifically, the firm can easily get liquidated at a very high w_d^L of 0.413 when there is no hope to leave the contraction regime at $\lambda^L = 0$, while firm's liquidation is substantially delayed at $w_d^L = -0.633$ when the contraction regime is expected to only last for two years at $\lambda^L = 0.5$.

Given that the baseline value of γ^L is greater than one, (3.5) implies that the entrepreneur's utility J^L, which measures her welfare with the firm during the bad times, is negative as indicated by plot in Panel D of **Figure 3**. As the duration of the contraction regime $1/\lambda^L$ rises from 2 to ∞, J^L decreases dramatically from −23.5 to −1144 which implies a huge welfare loss borne by the entrepreneur when bad times are expected to last longer. Intuitively, as λ^L decreases so that $1/\lambda^L$ rises, the entrepreneur gradually loses the hope for recovery which depresses her utility in a substantial way. Our numerical solutions show that this impact on welfare is mainly driven by 1) a smaller b^L at a lower λ^L [18] which implies a less efficient transfer of firm valuations into the entrepreneur's utility; 2) a higher degree of risk-adjustment in bad times when the entrepreneur is more risk averse with a higher γ^L. Indeed, in an unreported exercise we find that p^L, the entrepreneur's CE-valuation of the firm per unit of capital, only decreases from 1.60 to 1.40 when $1/\lambda^L$ rises from its baseline level to ∞. We conclude that the recovery effect has its largest impact on the entrepreneur's welfare and the implied liquidation policy[19].

[18]Mechancially, b^L decreases from 0.151 to 0.0473 as $1/\lambda^L$ rises from 2 to ∞.

[19]While not plotted, we find that the implied x^L is also increasing in λ^L which suggests that the entrepreneur also allocates more resources to the risky market portfolio when she becomes more optimistic about the macroeconomy's recovery. The magnitudes of increase, however, is small even when compared to changes of c^L and i^L.

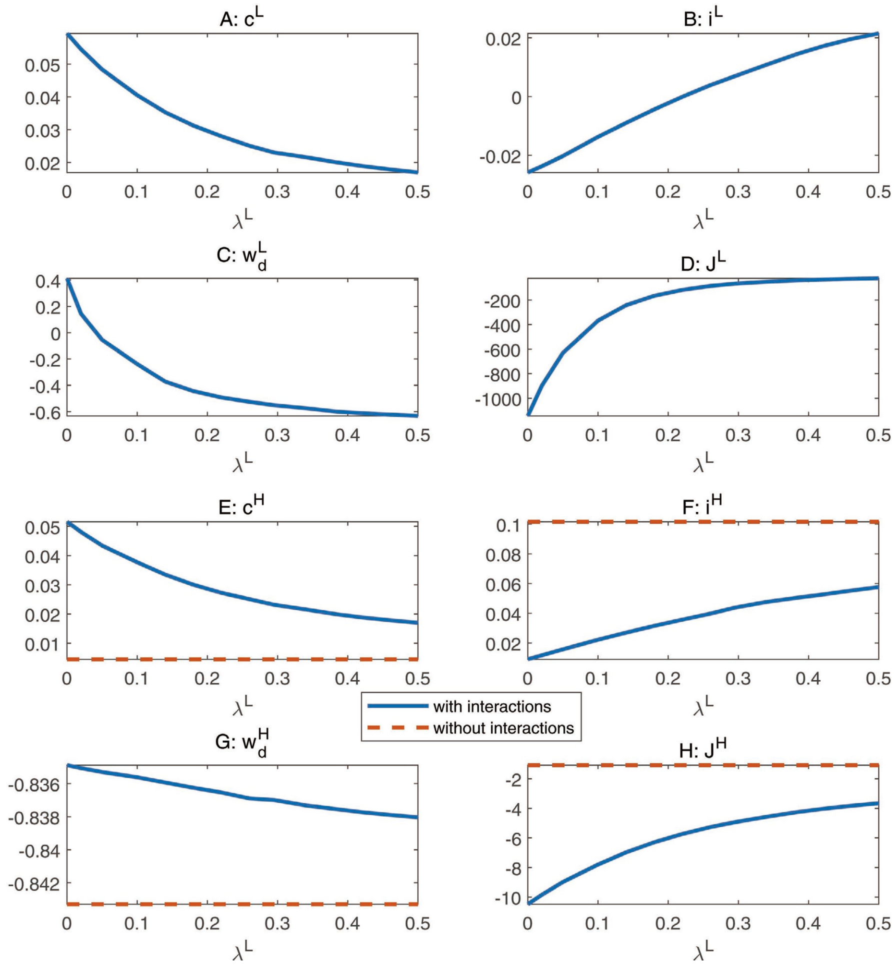

Figure 3. The recovery effect and the spillover effect. **Figure 3** plots the impact of the contraction regime's duration $1/\lambda^L$, in terms of the implied consumption c, investment i, liquidation boundary w_d, and the entrepreneur's welfare J, as we vary λ^L. More specifically, Panel A-D plot the recovery effects in terms of the implications for variables during the contraction regime, while Panel E-H plot the spillover effects in terms of the implications for variables during the expansion regime. To further gauge the spillover effect, we also plot in Panel E-H the expansion-regime implications when the macroeconomic dynamics are shut down so that the expansion and the contraction regime no longer interact with one another.

5.4. The Spillover Effect

While varying λ^L has the direct impact on variables during the contraction regime through the recovery effect, it also affects the entrepreneur's behaviors and the resulting welfare during the expansion regime. We refer to such influences as the spillover effect, which is plotted in Panel E-H of Figure 3 (solid lines) where w is once again set at 0.5. When compared to the recovery effect shown in Panel A-D, the spillover effect is qualitatively similar but quantitatively weaker. Take the implied w_d^H (Panel G) as the example. As λ^L rises, an entrepreneur in good times also delays the firm's liquidation because the potential recession, which occurs at the rate of $\lambda^H = 0.1$, feels less costly when the subsequent recovery comes sooner at the higher λ^L. While this impact of λ^L is foreseen by the entrepreneur during the expansion regime, its actual effect on w_d^H is indirect and quantitatively much weaker than that on w_d^L. Indeed, while raising λ^L from 0 to 0.5 substantially reduces w_d^L (from 0.413 to −0.633), it reduces w_d^H only marginally (from −0.835 to −0.838).

To further gauge the spillover effect, we also plot in Panel E-H the expansion-regime implications when the macroeconomic dynamics are shut down (dashed lines). Without the interactions between the two regimes, the entrepreneur's behaviors and her welfare in good times no longer react to variations of λ^L. The interesting observation is that the discrepancies between the dashed and the solid lines are the largest at $\lambda^L = 0$. Financially, setting $\lambda^L = 0$ but maintaining λ^H at its baseline level, as plotted in solid lines at their leftmost points, implies that contraction becomes an absorbing regime for firms in good times. With the anticipating of the permanent recession, the entrepreneur in good times mimicks her bad-time behaviors the most, which gives rise to the largest discrepancy mentioned above. As λ^L rises, however, the economy recovers from contraction more easily so that the entrepreneur's behaviors are more influenced by the current macroeconomic conditions. Consequently, the implied discrepancies between the solid and the dashed lines gradually shrink. As $\lambda^L \to \infty$, the spillover effect and hence the implied discrepancy vanishes because the contraction regime now exists for only an instant of time, which is no longer a concern for entrepreneur during the good times.

Our analyses on the impact of λ^L provide a new insight about the impact of the macroeconomic environment on firm operations: It will be wrong to conclude that recessions have small effect on firm's policies just because the ex-post responses to the large shock, *i.e.*, the regime switch from L to H, are small. Indeed, Panel A-C of **Figure 3** shows that the entrepreneur takes actions ahead of the realization of the shock. For example, she substantially scales back her consumption in regime L when λ^L rises from 0 to 0.5 which is a main contributor to the overall reduction in c from $c^{L,0}$ (= 0.0593) at $\lambda^L = 0$ as plotted in Panel A, to c^H (= 0.170) at $\lambda^L = 0.5$ as plotted in Panel E. The same logic also applies to the policy makings with i, x (not plotted) and w_d. In other words, the ex-ante responses of the firm in regime L already contribute to the actual behaviors observed in H so a small observed policy responses to macro-level shocks from H to L does not imply that such shocks are unimportant to the firm's optimal operations.

6. Comparative Analysis

In this section, we perform comparative analysis on various structural parameters. We focus on those that are regime-dependent because they are the most suitable for illustrating the impact of macroeconomic conditions and the resulting persistent preference shocks on capital valuation and the firm's optimal operations.

6.1. Productivity A^L

Figure 4 plots the comparatics analysis with respect to A^L which measures the capital's productivity during bad times. A higher A^L raises the valuation of capital q (Panel A&E) and capital investment i (Panel C&F) in both regime L and regime H irrespective of the firm's financial status w. This implication helps explain the findings by Zona [34] that firms respond to economic downturn of 2008-2009 with innovation investment: Such investment enhances A^L which not only benefits the firm in the short-term but also delivers the longer-term beneficial effects after the aggregate economy has recovered. While a higher A^L also encourages consumption c^L (Panel B), the implied magnitudes are much smaller which is attributed to the entrepreneur's intertemporal smoothing motives[20].

Since holding the risky market portfolio on average yields negative returns during the contraction regime, the entrepreneur chooses to take a short position in the stock market as indicated by a negative x^L (Panel D). Raising A^L from 0.15 (solid line) to 0.2 (dashed line) in general prompts the entrepreneur to take a more aggressive short position since the implied higher i^L, as discussed in last paragraph, induces a larger capital stock that is used as the collateral for taking the short positions. When w is sufficiently negative, however, a lower (solid line in Panel D) instead of a higher A^L induces the more aggressive position in the stock market. Intuitively, the entrepreneur has the incentive to gamble for resurrection when the firm is close to its liquidation and this effect is particularly strong when A^L is small. While not plotted, we find the same gambling motive also leads to a more aggressive (long) position in the stock market during the expansion regime, albeit by a much smaller magnitude.

6.2. Volatility of Investment Risk ϵ^L

The top two panels of **Figure 5** plot the impact of investment risk as measured by its volatility parameter ϵ. Once again we focus on parametric variations during the bad times which seems a bigger concern to the entrepreneur, so that $\epsilon = \epsilon^L$. Panel A of **Figure 5** confirms the intuition that lowering investment risk by reducing ϵ^L encourages investment when $i^L > 0$. When the firm is in a relatively bad financial status (as measured by w), it disinvests and a lower ϵ^L (dashed line) facilitates the disinvestment as well which makes the implied i^L even more negative[21]. In sum, a lower ϵ^L raises $\left|i^L\right|$. In other words, a higher investment risk not only depresses investment but also depresses the disinvestment.

[20]While not plotted, we find that raising A^L leaves c^H largely unaffected.

[21]Consistent with the plot in Panel B of **Figure 2**, the firm would choose a less aggressive disinvestment policy, as indicated by a lower $\left|i^L\right|$, when it is very close to liquidation. Financially, underinvestment is less of a concern when the entrepreneur is closer to liquidating the business because liquidation also has the benefit of leading the entrepreneur to exit the incomplete market that she faces which is attributed to the unhedged firm-level risks. Consequently, the entrepreneur has weaker incentives to cut investment if the distance to exiting incomplete markets is shorter. This explains why i^L may decrease in w when w is sufficiently close to w_d^L.

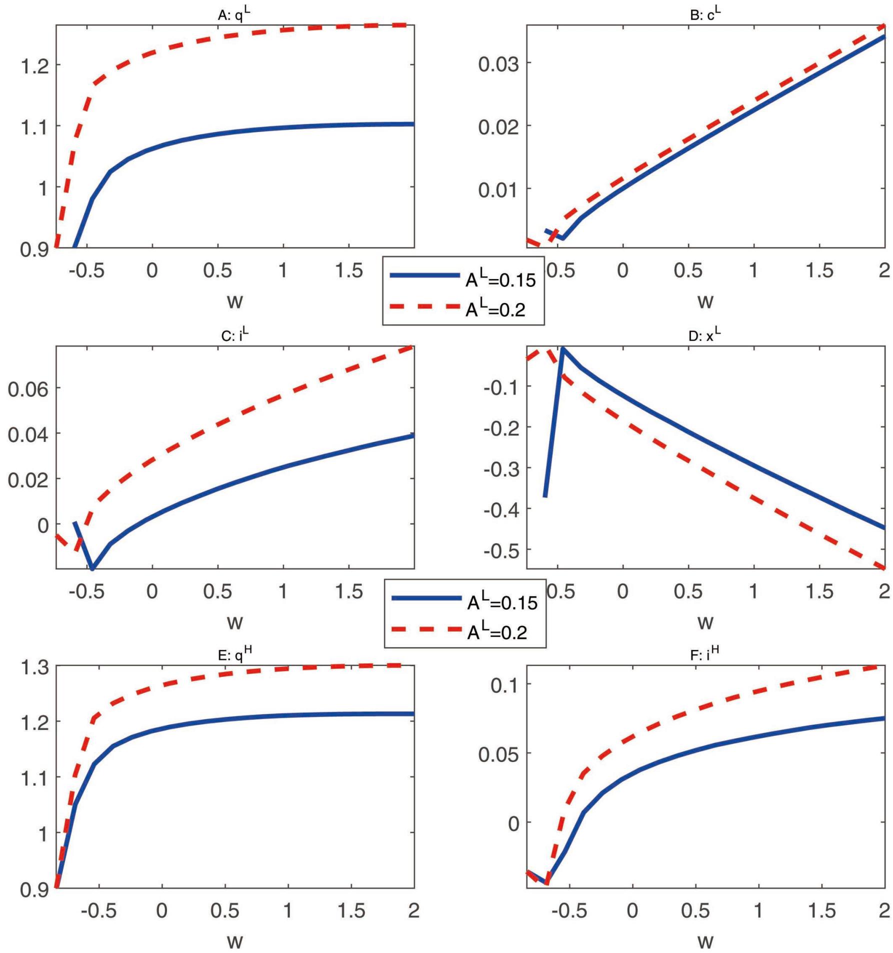

Figure 4. Comparative analysis with respect to A^L. **Figure 4** plots the comparatics analysis with respect to A^L which measures the capital's productivity during bad times. Panel A-D plot the implications on the capital's valuation q, consumption c, investment i, and asset allocation x during the contraction regime, while Panel E-F plot the implications on the capital's valuation q and the firm's investment i during the expansion regime. For each panel, we consider two scenarios of A^L: $A^L = 0.15$ and $A^L = 0.2$, and we plot the implied variables as the function of the firm's financial slack w.

Consistent with the plot in Panel D of **Figure 4**, the implied x^L plotted in Panel B of **Figure 5** is negative, whose absolute value rises with w, indicating a more aggressive stock market position when the firm has acheived a higher degree of financial slack. Varying ϵ^L also affects x^L because it is intrinsically linked to i^L through the intertemporal hedging component $-\frac{\rho_I \epsilon^L i^L}{\sigma_R}\left(\frac{\gamma p^L}{h^L} - w\right)$, where $\frac{\gamma p^L}{h^L} - w$ can be roughly interpreted as a risk-adjusted version of the capital's valuation during bad times. Given a positive ρ_I (see **Table 2**), this component and hence x^L itself is turned more negative when we raise ϵ^L from 0.1 (dashed line) to 1 (solid line) at $i^L > 0$. Naturally, the opposite holds when the firm starts to disinvest at relatively low *w*s. In that case, raising ϵ^L may actually raise x^L

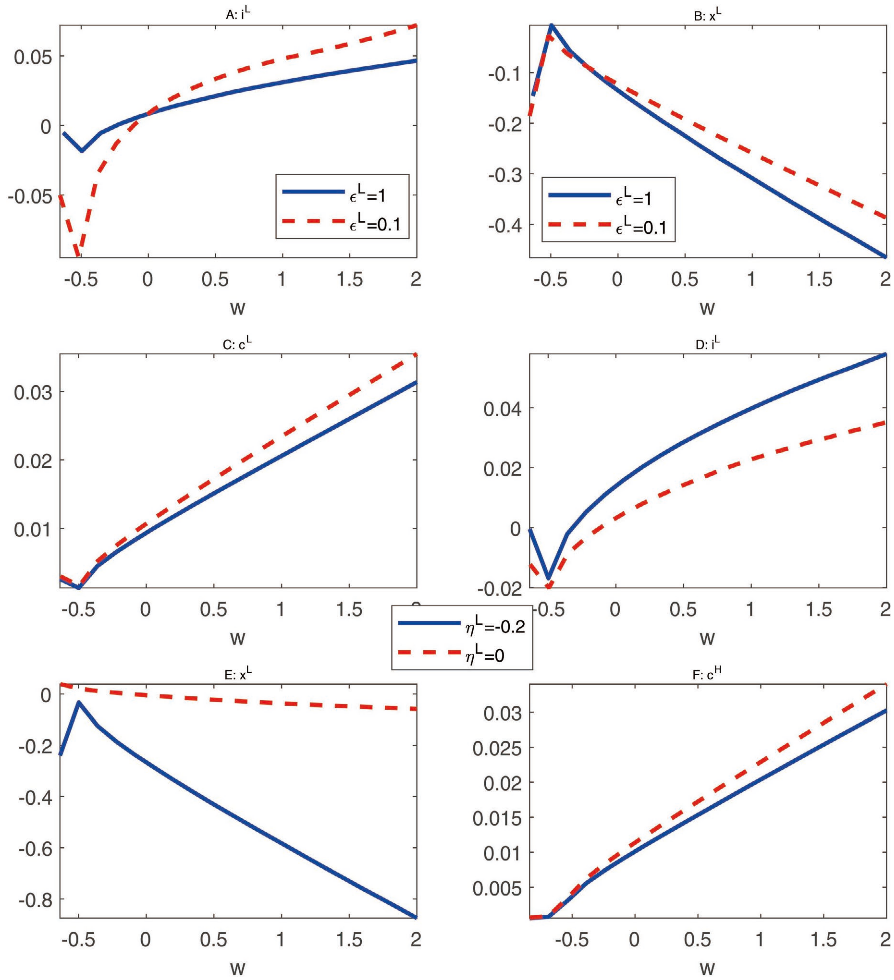

Figure 5. Comparative analysis with respect to ϵ^L and η^L. ϵ^L and η^L denote the volatility of investment-specific shocks and the market Sharpe ratio, respectively, during the contraction regime. Panel A-B consider two scenarios of ϵ^L: $\epsilon^L = 1$ and $\epsilon^L = 0.1$, and plot the implied consumption and asset allocation policies during the contraction regime, where w denotes the firm's financial slack. Panel C-F consider two scenarios of η^L: $\eta^L = -0.2$ and $\eta^L = 0$, and plot the implied consumption, investment, and asset allocation policies during the contraction regime as the function of w in Panel C-E. Panel F further plots the implied consumption policy during the expansion regime.

by making it less negative as also plotted in Panel B. Financially speaking, our model predicts that a higher investment risk induces a more (less) aggressive asset allocation policy when the firm's financial slack is high (low), and this prediction is clearly testable. Our numerical results further show that ϵ^L has little impact on other variables and we omit their plots for brevity.

6.3. Market Sharpe ratio η^L

Panel C-F of **Figure 5** plot the impact of η^L which denotes the market Sharpe ratio during the bad times. When η^L is reduced from 0 (dashed lines) to −0.2 (solid lines), the firm's position in the stock market (Panel E) changes from near

0 [22] to negative and this effect is very pronounced when the firm is in a healthy financial status as indicated by relatively large w s. Taking the proceeds from its short position, the firm simultaneoulsy raises its investment at $\eta^L = -0.2$ (Panel D). The same logic seems to suggest that the entrepreneur's consumption will also get raised. However, our numerical solution shows that the opposite holds as plotted in Panel C, which is consistent with the usual intuition that a worse market condition as measured by a lower η^L tends to depress consumption. Since the entrepreneur is forward-looking, a lower η^L simulatenously depresses her consumption in the expansion regime as plotted in Panel F.

While not plotted, we find that varying η^L has little effects on other variables. In particular, it has little impact on x^H which is worth some more comments. Financially, the firm's asset allocation policy is mainly driven by its myopic component (see discussions in footnote 12). For x^H, this component is determined by η^H which apparently cannot exert its influence until the occurrence the macro-level shock from L to H. In other words, the impact of η^m on firm's asset allocation policy is myopic and contingent on regime $m \in \{H, L\}$ which is in sharp contrast to the persistent impact of A^m (see plots in **Figure 4** with A^L as the example).

6.4. Degree of Risk Aversion γ^H and γ^L

We now examine the impact of the entrepreneur's persistent preference shocks which are captured by her regime-dependent risk aversion γ^m suited to the macroeconomic condition m for $m \in \{H, L\}$. Panel A-D of **Figure 6** plot the implied q^H, c^H, i^H, and x^H as the function of w under two scenarios of γ^H: $\gamma^H = 2$ (solid lines) and $\gamma^H = 4$ (dashed lines). Reducing γ^H from 4 to 2 implies less degree of discounting which naturally raises the capital's valuation q^H (Panel A). In terms of the firm's optimal policies, the lower degree of risk aversion enables the entrepreneur to bear more of the investment and the market risks. Consequently, she transfers resources from consumption (Panel B) to investment (Panel C) and asset allocation (Panel D) for obtaining a higher productivity and a higher expected return to be realized in the future[23]. In unreported exercises, we find that reducing γ^H has a similar impact on q^L, c^L, and i^L with comparable magnitudes, which tells the persistent influences of the entrepreneur's preference shocks[24].

[22]The fact that the implied x^L is close to 0 irrespective of w confirms the critical importance of the myopic demand component, as determined by η, on firm's asset allocation policy (see more discussions in footnote 12).

[23]While Panel B of **Figure 6** shows a lower c^H when the entrepreneur has a lower degree of risk aversion, this result holds only for the given w. In unreported simulation exercises, we have confirmed that reducing the degree of risk aversion substantially accelerates the accumulation of financial slack which on average enhances the entrepreneur's consumption.

[24]As discussed in last subsection, x^m is mainly determined by the entrepreneur's myopic demand which only loads on γ^m for $m \in \{H, L\}$. Consequently, varying γ^H has little impact on the implied x^L.

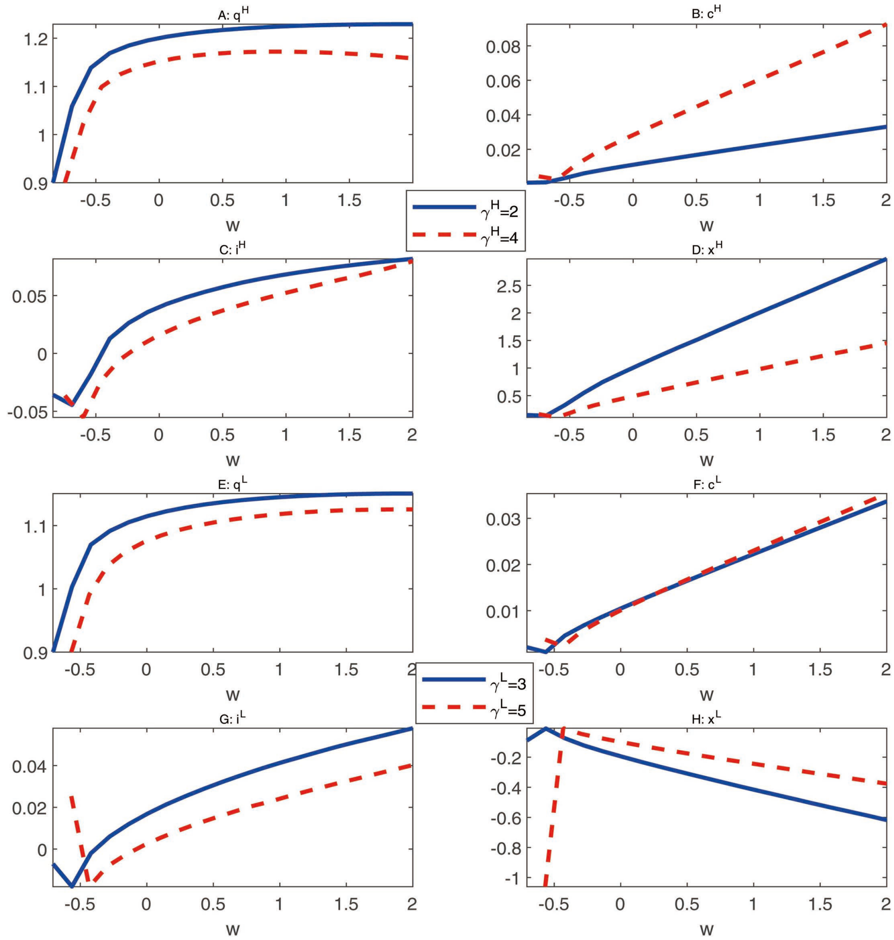

Figure 6. Comparative analysis with respect to γ^H and γ^L. γ^H and γ^L denote the entrepreneur's risk aversion during expansions and during contractions, respectively. Panel A-D consider two scenarios of γ^H: $\gamma^H = 2$ and $\gamma^H = 4$, and plot the implied capital's valuation, consumption, investment, and asset allocation during the expansion regime, where w denotes the firm's financial slack. Panel E-H consider two scenarios of γ^L: $\gamma^L = 3$ and $\gamma^L = 5$, and plot the implied capital's valuation, consumption, investment, and asset allocation during the contraction regime as the function of w.

Turning to the impact of γ^L, Panel E-H of Figure 6 plot the implied q^L, c^L, i^L, and x^L for $\gamma^L = 3$ and $\gamma^L = 5$. As illustrated in Panel E, reducing γ^L from 5 (dashed lines) to 3 (solid lines) raises the capital's valuation q^L which simultaneously delays the firm's liquidation. Empirically, small firm are subject to higher risks (Beaver and Ross [35]), so it seems reasonable that entrepreneurs of smaller business have higher appetites for risks, *i.e.*, a lower γ. Interpreted this way, the implication from Panel E helps explain the findings by Latham [36] that smaller firms tend to be more resistant to recessionary pressures.

In general, a lower γ^L prompts the entrepreneur to invest more (or divest less; Panel G) and take a more aggressive (short) position in the stock market (Panel H). The differences is that when w is sufficiently close to w_d^L, it is a higher (dashed lines) instead of a lower (solid lines) degree of risk aversion that encourages investment which is financed by proceeds from a more aggressive short position in the stock market. This is because the entrepreneur is subject to the unhedgeable business risk (see footnote 4) and abandoning the firm through liquidation provides the benefit of risk diversification. Realizing this benefit, the entrepreneur has weaker incentives to delay liquidation by cutting investment when she is more risk averse. Since the unhedgeable business risk is more costly during bad times as indicated by a higher w_d^L than w_d^H, the implied diversification effect is stronger which may convert a negative i^L serving to delay liquidation, into a positive i^L so as to obtain a larger liquidation payment[25]. These mixed results on i^L support Ghemawat [37] who makes a strong case that managers during economic downturns face a heightened tension on the financial risk of investing against the competitive risk of not investing. Our numerical solution further suggests that such a positive i^L at very negative ws is financially supported by proceeds of a rather aggressive short position in the stock market[26].

7. Conclusion and Suggestions

Empirically, firms have become increasingly aware of the structural changes in risks and opportunities they face when the macroeconomic condition changes, and they appear to adapt to the current economic conditions for their operations while anticipating that a potential regime switch, which captures the business cycle variations, would occur with certain probability at some future time. This paper develops a theoretical framework to study the impact of such structural changes on the optimal operations of an entrepreneurial firm. Our analyses confirm the intuition that when the firm-generated cash flows and the entrepreneur's risk aversion depend on current economic conditions, there will be a benefit for firms to adapt their consumption, investment, asset allocation, and business exit decisions to the position of the economy in the business cycle phase. We then demonstrate that this simple intuiton has a wide range of empirical implications for corporations.

More concretely, we show that a more risk-averse entrepreneur invests less, assigns a lower value to firm-held capital, takes a less aggressive position in the stock market, and liquidates the firm earlier, and this is particularly true when the economy is in recession. These implications lend support to the government's stimulus policies which not only prop up corporations' capital valuations and delay their liquidations but, more importantly, boost up entrepreneurs' confidences and hence reduce their degree of risk aversions. By effectively boosting up firm agents' appetites to take on risks, our model shows that firm-level activities in capital investment and asset allocations are both enhanced which serves to more efficiently stimulate the entire economy. Our analyses further show that the duration of

[25]Recall that the firm's liquidation payment is given by $l \cdot K$. A positive i^L helps with the capital accumulation which serves to enhance the firm's final payment from its liquidation.

[26]Such proceeds also help finance the entrepreneur's consumption which explains the mixed results about the impact of γ^L on c^L (Panel F of Figure 6).

economic recessions significantly affects the firm's investment, consumption, and asset allocation policies, and it has particularly large impact on the entrepreneur's welfare and the implied business liquidation. These results provide the direct rationale for the government to stimulate the economy during bad times so as to significantly relieve business liquidations and enhance economic participants' welfares by shortening the durations of economic downturns.

While our paper focuses on the theoretical study of macro-level dynamics and its implications, we outline in the following a suggested procedure that empirically test the impact of different business cycle phases on firms' optimal operations. First, collect data from COMPUSTAT, excludes utilities (Standard Industrial Classification (SIC) codes 4900-4999) and financial firms (SIC codes 6000-6999), and then calculate the time series of corporate policies, such as the investment-capital ratio and cash-capital ratio, for nonfinancial firms[27]. Second, merge the time series of corporate-level variables with the "US Business Cycle Expansions and Contractions" reported at NBER's website to obtain various corporate-related quantities during the different business cycle phases. Simultaneoulsy, identify a wide array of factors that are related to corporate policy-making as the controls. Third, run the controlled regression from the obtained quantities onto the proxies for contractions and expansions to identify the impact of macroeconomic conditions. The model's prediction on policy implications that load on the different economic regimes (see **Figure 2**) will be validated if the regression coefficients are significant both statistically and economically[28].

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Oxelheim, L. (2003) Macroeconomic Variables and Corporate Performance. *Financial Analysts Journal*, **59**, 36-50. https://doi.org/10.2469/faj.v59.n4.2544

[2] Dittmar, A. and Dittmar, R. (2008) The Timing of Financing Decisions: An Examination of the Correlation in Financing Waves. *Journal of Financial Economics*, **90**, 59-83. https://doi.org/10.1016/j.jfineco.2007.11.007

[3] Abaidoo, R. (2019) Corporate Performance Volatility and Adverse Macroeconomic Conditions: A Causal Interaction Perspective. *Journal of Financial Economic Policy*, **11**, 533-547. https://doi.org/10.1108/jfep-11-2018-0158

[27]To be consistent with the data on US business cycles, we will require firms to be incorporated in the United States and have positive assets and positive net PPE (property, plant, and equipment). In addition, because our model does not allow for lumpy investment, mergers and acquisitions, or dramatic changes in profitability, we will need to eliminate firm-years for which total assets or sales grew by more than 100% from the previous year.

[28]As suggested by our comparative analysis, more detailed empirical procedures can be conducted if we can further obtain data on the capital's productivity, investment risk, equity risk premium, and the entrepreneur's risk aversion. Regressing corporate-related quantities from COMPUSTAT onto these variables with the given economic regime as the control would more precisely identify their respective impacts on firm-level policies that would be used to test/validate the implications plotted in **Figures 4-6**.

[4] Bezerra, E.S., Lagioia, U.C.T. and Pereira, M.D.L. (2019) Financial, Macroeconomic and Corporative Management Indicators to Predict the Insolvency of B3 Companies. *Contabilidade*, *Gestão e Governança*, **22**, 405-422. https://doi.org/10.21714/1984-3925_2019v22n3a6

[5] Chang, X., Chen, Y. and Dasgupta, S. (2019) Macroeconomic Conditions, Financial Constraints, and Firms' Financing Decisions. *Journal of Banking & Finance*, **101**, 242-255. https://doi.org/10.1016/j.jbankfin.2018.10.016

[6] Vural-Yavaş, Ç. (2020) Corporate Risk-Taking in Developed Countries: The Influence of Economic Policy Uncertainty and Macroeconomic Conditions. *Journal of Multinational Financial Management*, **54**, Article ID: 100616. https://doi.org/10.1016/j.mulfin.2020.100616

[7] Mahmood, Y., Rashid, A., Rizwan, F. and Ahmad, M. (2019) The Role of Macroeconomic and Institutional Factors in Creating Corporate Financial Flexibility. *Management Decision*, **59**, 732-746. https://doi.org/10.1108/md-12-2018-1332

[8] Bolton, P., Chen, H. and Wang, N. (2013) Market Timing, Investment, and Risk Management. *Journal of Financial Economics*, **109**, 40-62. https://doi.org/10.1016/j.jfineco.2013.02.006

[9] Du, D. (2024) Investment Risk, Financial Slack, and Value of Capital: A Theoretical Examination. *Journal of Mathematical Finance*, **14**, 365-387. https://doi.org/10.4236/jmf.2024.144021

[10] Baker, M. and Wurgler, J. (2002) Market Timing and Capital Structure. *The Journal of Finance*, **57**, 1-32. https://doi.org/10.1111/1540-6261.00414

[11] DeAngelo, H., DeAngelo, L. and Stulz, R.M. (2010) Seasoned Equity Offerings, Market Timing, and the Corporate Lifecycle. *Journal of Financial Economics*, **95**, 275-295. https://doi.org/10.1016/j.jfineco.2009.11.002

[12] Huang, R. and Ritter, J.R. (2009) Testing Theories of Capital Structure and Estimating the Speed of Adjustment. *Journal of Financial and Quantitative Analysis*, **44**, 237-271. https://doi.org/10.1017/s0022109009090152

[13] Campello, M., Graham, J.R. and Harvey, C.R. (2010) The Real Effects of Financial Constraints: Evidence from a Financial Crisis. *Journal of Financial Economics*, **97**, 470-487. https://doi.org/10.1016/j.jfineco.2010.02.009

[14] Duchin, R., Ozbas, O. and Sensoy, B.A. (2010) Costly External Finance, Corporate Investment, and the Subprime Mortgage Credit Crisis. *Journal of Financial Economics*, **97**, 418-435. https://doi.org/10.1016/j.jfineco.2009.12.008

[15] Hackbarth, D., Miao, J. and Morellec, E. (2006) Capital Structure, Credit Risk, and Macroeconomic Conditions. *Journal of Financial Economics*, **82**, 519-550. https://doi.org/10.1016/j.jfineco.2005.10.003

[16] Chen, H. (2010) Macroeconomic Conditions and the Puzzles of Credit Spreads and Capital Structure. *The Journal of Finance*, **65**, 2171-2212. https://doi.org/10.1111/j.1540-6261.2010.01613.x

[17] Bolton, P., Wang, N. and Yang, J. (2019) Optimal Contracting, Corporate Finance, and Valuation with Inalienable Human Capital. *The Journal of Finance*, **74**, 1363-1429. https://doi.org/10.1111/jofi.12761

[18] Keynes, J.M. (1936) The General Theory of Employment, Interest and Money. Macmillan.

[19] Hayashi, F. (1982) Tobin's Marginal Q and Average Q: A Neoclassical Interpretation. *Econometrica*, **50**, 213-224. https://doi.org/10.2307/1912538

[20] Epstein, L.G. and Zin, S.E. (1989) Substitution, Risk Aversion, and the Temporal

Behavior of Consumption and Asset Returns: A Theoretical Framework. *Econometrica*, **57**, 937-969. https://doi.org/10.2307/1913778

[21] Duffie, D. and Epstein, L.G. (1992) Stochastic Differential Utility. *Econometrica*, **60**, 353-394. https://doi.org/10.2307/2951600

[22] Merton, R.C. (1971) Optimum Consumption and Portfolio Rules in a Continuous-Time Model. *Journal of Economic Theory*, **3**, 373-413. https://doi.org/10.1016/0022-0531(71)90038-x

[23] Wang, C., Wang, N. and Yang, J. (2012) A Unified Model of Entrepreneurship Dynamics. *Journal of Financial Economics*, **106**, 1-23. https://doi.org/10.1016/j.jfineco.2012.05.002

[24] Kapoor, M. and Ravi, S. (2017) Elasticity of Intertemporal Substitution in Consumption in the Presence of Inertia: Empirical Evidence from a Natural Experiment. *Management Science*, **63**, 4188-4200. https://doi.org/10.1287/mnsc.2016.2564

[25] Whited, T.M. (1992) Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data. *The Journal of Finance*, **47**, 1425-1460. https://doi.org/10.1111/j.1540-6261.1992.tb04664.x

[26] Hennessy, C.A. and Whited, T.M. (2007) How Costly Is External Financing? Evidence from a Structural Estimation. *The Journal of Finance*, **62**, 1705-1745. https://doi.org/10.1111/j.1540-6261.2007.01255.x

[27] Martin, K.J. (1996) The Method of Payment in Corporate Acquisitions, Investment Opportunities, and Management Ownership. *The Journal of Finance*, **51**, 1227-1246. https://doi.org/10.1111/j.1540-6261.1996.tb04068.x

[28] Carpenter, R.E. and Guariglia, A. (2008) Cash Flow, Investment, and Investment Opportunities: New Tests Using UK Panel Data. *Journal of Banking & Finance*, **32**, 1894-1906. https://doi.org/10.1016/j.jbankfin.2007.12.014

[29] Mancke, R.B. (1974) Causes of Interfirm Profitability Differences: A New Interpretation of the Evidence. *The Quarterly Journal of Economics*, **88**, 181-193. https://doi.org/10.2307/1883068

[30] Alessandri, T.M. and Bettis, R.A. (2003) Surviving the Bulls and the Bears: Robust Strategies and Shareholder Wealth. *Long Range Planning*, **36**, 13-35. https://doi.org/10.1016/s0024-6301(02)00207-8

[31] Navarro, P. (2005) The Well-Timed Strategy: Managing the Business Cycle. *California Management Review*, **48**, 71-91. https://doi.org/10.2307/41166328

[32] Navarro, P., Bromiley, P. and Sottile, P. (2010) Business Cycle Management and Firm Performance: Tying the Empirical Knot. *Journal of Strategy and Management*, **3**, 50-71. https://doi.org/10.1108/17554251011019413

[33] Rafferty, M. (2003) Do Business Cycles Alter the Composition of Research and Development Expenditures? *Contemporary Economic Policy*, **21**, 394-405. https://doi.org/10.1093/cep/byg020

[34] Zona, F. (2012) Corporate Investing as a Response to Economic Downturn: Prospect Theory, the Behavioural Agency Model and the Role of Financial Slack. *British Journal of Management*, **23**, 42-57. https://doi.org/10.1111/j.1467-8551.2012.00818.x

[35] Beaver, G. and Ross, C. (1999) Recessionary Consequences on Small Business Management and Business Development: The Abandonment of Strategy? *Strategic Change*, **8**, 251-261. https://doi.org/10.1002/(sici)1099-1697(199908)8:5<251::aid-jsc446>3.0.co;2-n

[36] Latham, S. (2009) Contrasting Strategic Response to Economic Recession in Start-Up

versus Established Software Firms. *Journal of Small Business Management*, **47**, 180-201. https://doi.org/10.1111/j.1540-627x.2009.00267.x

[37] Ghemawat, P. (2009) The Risk of Not Investing in a Recession. *Sloan Management Review*, **50**, 51-58.