5 Quantitative Model Predictions

In this section, we calibrate our model at the annual frequency and evaluate its ability to replicate key moments of both macroeconomic quantities and asset prices at the aggregate level. More importantly, we investigate its performance in terms of quantitatively accounting for key features of firm characteristics and producing an asset durability premium in the cross-section. For macroeconomic quantities, we focus on a long sample of U.S. annual data from 1930 to 2017. All macroeconomic variables are real and per capita. Consumption, output and physical investment data are from the Bureau of Economic Analysis (BEA). For the purpose of cross-sectional analyses we make use of several data sources at the micro-level, which is summarized in Appendix A.

5.1 Specification of Aggregate Shocks

In this section, we formalize the specification of the exogenous aggregate shocks in this economy. First, log aggregate productivity $a \equiv \log(A)$ follows

$$a_t = a_{ss}(1-\rho_A) + \rho_A a_{t-1} + \sigma_A \varepsilon_{A,t}, \tag{31}$$

where a_{ss} denotes the steady-state value of a. Second, as in Ai, Li, and Yang (2018), we also introduce a aggregate shock to entrepreneurs' liquidation probability λ. We interpret it as a shock originating directly from the financial sector, in a spirit similar to Jermann and Quadrini (2012). We introduce this extra source of shocks mainly to improves the quantitative performance of the model. As in all standard real business cycle models, with just an aggregate productivity shock, it is hard to generate large enough variations in capital prices and the entrepreneurs' net worth so that they become consistent with the data.

Importantly, however, our general model intuition that non-durable capital is less risky than durable capital holds for both productivity and financial shocks. The shock to the entrepreneurs' liquidation probability directly affects the entrepreneurs' discount rate, as can be seen from (26), and thus allows to generate stronger asset pricing implications.[16]

Note that technically $\lambda \in (0,1)$. For parsimony, we set

$$\lambda_t = \frac{\exp(x_t)}{\exp(x_t) + \exp(-x_t)},$$

[16] Macro models with financial frictions, for instance, Gertler and Kiyotaki (2010) and Elenev et al. (2018), use a similar device for the same reason.

and x_t itself follows and autocorrelated process:

$$x_t = x_{ss}(1 - \rho_x) + \rho_x x_{t-1} + \sigma_x \varepsilon_{x,t}.$$

We assume the innovations:

$$\begin{bmatrix} \varepsilon_{A,t+1} \\ \varepsilon_{x,t+1} \end{bmatrix} \sim Normal \left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho_{A,x} \\ \rho_{A,x} & 1 \end{bmatrix} \right)$$

in which the parameter $\rho_{A,x}$ captures the correlation between these two shocks. In the benchmark calibration, we assume the correlation coefficient $\rho_{A,x} = -1$. First, a negative correlation indicates that a negative productivity shock is associated with a positive discount rate shock. This assumption is necessary to quantitatively generate a positive correlation between consumption and investment growth that is consistent with the data. If only the financial shock innovation, $\varepsilon_{x,t+1}$, is open, such an innovation will not affect the contemporaneous output. The resource constraint in equation (15) implies a contractually negative correlation between consumption and investment growth. Second, the assumption of a perfectly negative correlation is for parsimony and enables the economy to effectively narrow down to one shock.

5.2 Calibration

We calibrate our model at the quarterly frequency. Table 4 reports the list of parameters and the corresponding macroeconomic moments in our calibration procedure. We group our parameters into four blocks. In the first block, we list the parameters which can be determined by the previous literature. In particular, we set the relative risk aversion γ to be 10 and the intertemporal elasticity of substitution ψ to be 2. These are parameter values in line with the long-run risks literature, e.g., Bansal and Yaron (2004). The capital share parameter, α, is set to be 0.30, close to the number used in the standard RBC literature, e.g., Kydland and Prescott (1982) The span of control parameter ν is set to be 0.75, consistent with Atkeson and Kehoe (2005).

[Place Table 4 about here]

The parameters in the second block are determined by matching a set of first moments of quantities and prices to their empirical counterparts. We set the average economy-wide productivity growth rate $E(A_{ss})$ to match a mean growth rate of U.S. economy of 2% per year. The time discount factor β is set to match the average real risk free rate of 1% per

icant coefficient on aggregate macroeconomic shocks and confirm the procyclical exposure to aggregate fluctuations across assets. Specification 2 shows a positively significant coefficient on the interaction term between asset durability and aggregate shocks. Such a result suggests that assets with higher durability bear higher price fluctuations and thus face significantly higher exposures than those with lower durability to aggregate shocks. As a result, firms hold a basket of assets with higher durability are riskier and earn higher expected returns.

[Place Table 7 about here]

In summary, asset exposures present a positive relation with asset durability to aggregate shocks, which is perfectly consistent with our model implication.

6.2 Asset Pricing Factor Test

In this subsection, we investigate the extent to which the variation in the average returns of the durability-sorted portfolios can be explained by exposure to standard risk factors proposed by the Fama and French (2015) five-factor model, the Hou, Xue, and Zhang (2015) q-factor model, or, more importantly, the collateralizability premium documented in Ai, Li, Li, and Schlag (2019).[19]

To test the standard risk factor models, we preform time-series regressions of asset durability-sorted portfolios' excess returns on the Fama and French (2015) five-factor model (the market factor-MKT, the size factor-SMB, the value factor-HML, the profitability factor-RMW, the investment factor-CMA), and the long-short portfolio sorted on collateralizability (COL) in Panel A and on the Hou, Xue, and Zhang (2015) q-factor model (the market factor-MKT, the size factor-SMB, the investment factor-I/A, the profitability factor-ROE), and the long-short portfolio sorted on collateralizability (COL) in Panel B, respectively. Such time-series regressions enable us to estimate the betas (i.e., risk exposures) of each portfolio's excess return on various risk factors and to estimate each portfolio's risk-adjusted return (i.e., alphas in %). We annualize the excess returns and alphas in Table 8.

[Place Table 8 about here]

As we show in Table 8, the risk-adjusted returns (intercepts) of the asset durability sorted high-minus-low portfolio remain large and significant, ranging from 8.14% for the Fama and

[19] The Fama and French factors are downloaded from Kenneth French's data library (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). We thank Kewei Hou, Chen Xue, and Lu Zhang for kindly sharing the Hou, Xue, and Zhang factors.

French (2015) five-factor model in Panel A to 8.54% for the Hou, Xue, and Zhang (2015) q-factor model in Panel B, and these intercepts are at least 3.38 standard errors above zero, which the t-statistics is far above 1% statistical significance level. Second, the alpha implied by the Fama-French five-factor model or by the HXZ q-factor model remain comparable to the durability spread (i.e., the return on the high-minus-low portfolio) in the univariate sorting (Table 3). Third, the return on the high-minus-low portfolio has significantly negative market betas with respect to both the Fama and French (2015) five-factor model and to the Hou, Xue, and Zhang (2015) q-factor model; however, the return on the low-minus-high portfolio has insignificantly negative betas with respect to both the Fama and French (2015) five-factor model and to the Hou, Xue, and Zhang (2015) q-factor model. Finally, the asset durability spread cannot be explained by collateralizability (COL), given that asset durability is higher associated with asset collateralizability.

In summary, results from asset pricing tests in Table 8 suggest that the cross-sectional return spread across portfolios sorted on durability cannot be explained by either the Fama and French (2015) five-factor model, the HXZ q-factor model (Hou, Xue, and Zhang (2015)), or the collaterizability prmium. Hence, common risk factors cannot explain the higher returns associated with asset durability. In the following subsection, we reassure the asset durability-return relation by running Fama-Macbeth regressions to control a bundle of firm characteristics.

6.3 Fama-Macbeth Regressions

In Section 6.3, we investigate the joint link between the firm-level asset durability and future stock returns using Fama and MacBeth (1973) regressions at firm-level as a valid cross-check the results and establish the robustness of the findings. For robustness, we also investigate the predictive ability of durability for the cross-sectional stock returns using Fama-MacBeth cross-sectional regressions (Fama and MacBeth (1973)). This analysis allows us to control for an extensive list of firm characteristics that predict stock returns and to verify whether the positive durability-return relation is driven by other known predictors at the firm level. This approach is preferable to the portfolio tests, as the latter requires the specific breaking points to sort firms into portfolios and also requires us to select the number of portfolios. Also, it is difficult to include multiple sorting variables with unique information about future stock returns by using a portfolio approach. Thus, Fama-MacBeth cross-sectional regressions provide a reaonable cross-check.

Specifically, we run a Fama-MacBeth firm-level stock return predictability regressions on lagged firm-level asset durability and a list of control variables for other characteristics. The specification of regression is as follows:

$$R_{i,t+1} - R_{f,t+1} = a_j + b \times Asset\ Durability_{i,t} + c \times Leverage_{i,t} d \times Controls_{i,t} + \varepsilon_{i,t} \quad (33)$$

Following Fama and French (1992), we take each month from July of year t to June of year t+1, and we regress monthly returns of individual stock returns (annualized by multiplying 12) on asset durability of year t-1, different sets of control variables that are known by the end of June of year t, and industry fixed effects. Control variables include the natural logarithm of market capitalization at the end of each June (Size) deflated by the CPI index, the natural logarithm of book-to-market ratio (B/M), investment rate (I/A), profitability (ROA), organization capital ratio (OC/AT), R&D intensity (R&D/AT), and industry dummies based on NAICS 3-digit industry classifications. All independent variables are normalized to a zero mean and a one standard deviation after winsorization at the 1th and 99th percentile to reduce the impact of outliers; we also adjust all independent variables for standard errors by Newey-West adjustment.

[Place Table 9 about here]

In Table 9, we report the results from cross-sectional regressions performed at a monthly frequency. The reported coefficient is the average slope from monthly regressions, and the corresponding t-statistic is the average slope divided by its time-series standard error. We annualize the slopes and standard errors in Table 9.

The results of Fama-Macbeth regression are consistent with the results of portfolio sorted on durability. To alleviate the confounding effect of levered position, we control for the firm-level leverage ratio in each specification. In Specification 1, asset durability significantly and positively predicts future stock returns with a slope coefficient of 1.46, which is 3.62 standard errors from zero. This finding assures that the asset durability-return relation is mainly driven the leverage channel. In Specification 2, we introduce firm-level collateralizability, according to Ai, Li, Li, and Schlag (2019). In Specification 2, we show that the slope of coefficient on durability remains significant and even larger in magnitude, after explicitly controlling for firm-level collateralizability. In contrast, the coefficient on collateralizability is comparable with the that on durability but with a negative sign. On top of that, Specification 3 highlights that the predictability of asset durability is not subsumed by known predictors for stock returns in the literature, when we put all control variables together to run a horse racing test.

As a whole, Table 9 suggests that the positive asset durability-return relation cannot be attributed to other known predictors and have an unique return predictive power.

6.4 Cash Flow Sensitivities of Asset Durability-Sorted Portfolios

Our theory suggests that the asset durability premium comes from different cyclicality of the prices of durable versus less durable capital. In our model, household does not directly trade stocks, therefore, diffrerences in expected returns on the firm's equity must attribute to the differences in the cash flow accuring to entrepreneurs. In this subsection, we measure the cash flow to equity holders and show empirically at the portfolio level that the equity cash flows of firms with high asset durability exhibit a higher, i.e. more positive, sensitivity with respect to two alternative proxies for aggregate macroeconomic shocks: the log difference (i.e., the growth rate) in TFP and GDP.[20]

According to Belo, Li, Lin, and Zhao (2017), we first aggregate cash flow (represented by EBIT) across the firms in a given portfolio and then normalize this sum by the total lagged sales of that portfolio, and then compute the sensitivity (i.e., loading) of the cash flow with respect to the two aggregate macroeconomic shocks.[21] The results are reported in Table 10.

[Place Table 10 about here]

Table 10 shows the cash flow sensitivity with respect to TFP or GDP shocks. First, the cash flow sensitivities of asset durability-sorted portfolios display a increasing patter pattern from the lowest to the highest portfolios, ranging from 1.16 (1.33) to 1.78 (1.21) with respect to TFP (GDP) shocks. The loading on the highest quintile portfolio is statistically significant and larger than that of the lowest quintile portfolio. In particular, the difference in TFP (GDP) shock sensitivities between the two extreme portfolios has a t-statistic of 4.25 (2.59). Such a finding again highlights the main economic mechanism in our paper that low durability provides an insurance against aggregate shocks.

6.5 Market Price of Macroeconomic Shocks

Firms with different asset durability differ in their exposures to aggregate macroeconomic shocks and their risk premia. In this subsection, we show that aggregate macroeconomic

[20]The data on utilization adjusted total factor productivity (TFP) and GDP are from the Federal Reserve Bank of San Francisco (https://www.frbsf.org/economic-research/indicators-data/total-factor-productivity-tfp/).

[21]For robustness, we replace the normalization to total sales and report the sensitivity with respect to two aggregate macroeconomic shocks. The result is indifferent to the normalization and remains consistent with the finding in Panel A of Table 10.

shock is a source of systematic risk and that exposures to this shock drives the cross-sectional variation of the asset durability sorted portfolios. Consistent with our model, we do so by investigating a two-factor model where the market excess return is the first factor and the macroeconomic shock is the second by estimating the market price of these two factors.

We estimate the parameters of the stochastic discount factor using the generalized method of moments (GMM). The moment restrictions on the excess rate of return of any asset is priced according to the Euler equation. Specifically, the resulting moment restrictions are

$$\mathrm{E}[MR_i^e] = 0. \tag{34}$$

In our estimation, we use portfolio returns in excess of risk free rate R_i^e, so the mean of the stochastic discount factor M is not identified from the moment restrictions in equation (34).[22] As the result, we normalize $\mathrm{E}[M] = 1$. Given this normalization, we can rearrange the moment condition in the above equation as

$$\mathrm{E}[R_i^e] = -\mathrm{Cov}(M, R_i^e), \tag{35}$$

which is the empirical equivalent to our model, but with the conditional moments replaced by their unconditional counterparts. We assess the model's ability to price test assets correctly on the basis of residuals of the Euler equation (35).

The empirical equivalent of the stochastic discount factor (SDF) in our model denotes as

$$M_t = 1 - b_M \times \mathrm{MKT}_t - b_A \times \mathrm{Macro}_t, \tag{36}$$

which specifies that investors' marginal utility is driven by two aggregate shocks, MKT_t, which is spanned by the market factor in the standard capital asset pricing model (CAPM), and Macro_t, which is the aggregate macroeconomic shock. We take the log difference in wealth share and TFP to proxy for the aggregate macroeconomic shock. We compute the sum of squared errors (SSQE) and the J-statistic of the overidentifying restrictions of the model. That is, all the pricing errors are zero if our model specification is correct. Finally, we report two-setp GMM estimates of b_M and b_A using the identity matrix to weigh moment restrictions, and adjust the standard errors using the Newey-West procedure with a maximum of three lags.

[Place Table 11 about here]

[22]Given that our testing assets are portfolio returns in excess of the risk-free rate, the mean of the SDF is not identified. Without loss of generality, we take a normalization $\mathrm{E}[M] = 1$, which leads the moment condition in equation (35). Details refer to Cochrane (2005), page 256-257.

Panel A of Table 11 presents the average excess returns and risk characteristics for the five portfolios of firms sorted on their asset durability portfolios. First, the sensitivity with respect to the TFP (GDP) shock display a largely upward-sloping pattern from the lowest to the highest quintile portfolio and the long-short portfolio. These portfolios present a upward-sloping pattern of covariances with the empirical measures of the aggregate macroeconomic shock. Namely, the highest asset durability quintile faces the highest risk exposure and thus exhibits higher sensitivity than the lowest asset durability quintile with respect to aggregate macroeconomic shocks. Second, the difference in sensitivities between two extreme portfolios (i.e., the lowest and the highest portfolio) is positively significant with a t-statistic of 2.15 and 1.85, depending on whether the aggregate macroeconomic shock is measured as the TFP or GDP shock.

Panel B of Table 11 presents results using the five asset durability-sorted portfolios. The estimates of the price of risk of the aggregate macroeconomic shock are statistically significant across specifications, ranging from 0.24 to 0.70 when using the the log difference TFP or GDP. In terms of asset pricing errors, including measures of the aggregate macroeconomic shock improves upon the ability of CAPM to price the cross-section of asset durability-sorted portfolios, reducing the sum of squares to 0.1-0.39 relative to 0.78 and the mean absolute pricing errors to 1.17-2.30 relative to 2.72 when using difference measures of the aggregate macroeconomic shock. Last, the J-test is statistically insignificant and does not reject the model when we introduce the two-factor model, which implies that the average pricing error becomes smaller and even statistically insignificant. Therefore, the two-factor model is sufficient to capture the cross-sectional variations in the asset durability-sorted portfolios.

7 Conclusion

In this paper, we present a general equilibrium asset pricing model with heterogeneous firms and collateral constraints. Our model predicts that the the price of durable asset features higher cyclicality, faces more exposures to aggregate shocks, and, therefore, earns a higher expected return, since firms choose to hold a lower fraction of durable assets to relax the collateral constraint, when their constraint is more binding in recessions than in booms.

We develop a novel measure of the asset durability from firms' assets and document empirical findings consistent with our model predictions. In particular, we find that a significant return spread between firms with a high asset durability versus a low asset durability amounts to 5% per year. When we calibrate our model to the dynamics of macroeconomic quantities, we show that the credit market friction channel is a quantitatively important determinant for the cross-sectional stock returns.

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Table 1: **Durability and Financial Constraints**

This table shows the coefficients of regressions of asset durability on various financial constraints (controlling for industry dummies at NAICS 3-digit Code level). A detailed definition of the variables refers to Table B.3. All independent variables are normalized to zero mean and one standard deviation after winsorization at the 1th and 99th percentile of their empirical distribution. We include t-statistics in parentheses. The sample excludes utility, financial, public administrative, and public administrative industries, and starts from 1977 to 2016.

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Non-DIV	-1.75				-0.80		
[t]	14.64				10.55		
SA		-1.47				-1.42	
[t]		-20.10				-13.66	
WW			-1.08				-1.10
[t]			-13.72				-11.95
ROA				1.07	0.68	0.61	0.69
[t]				15.00	9.70	8.93	9.38
Log ME					0.11	-0.84	-0.80
[t]					1.73	-8.43	-10.23
Log B/M					0.38	-0.04	0.03
[t]					8.25	-0.64	0.58
I/K					-0.58	-0.51	-0.53
[t]					-9.03	-8.56	-8.46
Lev.					0.73	-0.41	-0.27
[t]					3.33	-1.64	-1.04
Cash/AT					0.45	0.48	0.48
[t]					4.30	4.68	4.50
Redp					-0.10	-0.08	-0.11
[t]					-0.34	-0.27	-0.34
TANT					3.83	3.88	3.84
[t]					17.00	17.33	17.05
Observations	130,059	130,059	120,135	129,924	99,292	99,292	94,299
R-squared	0.48	0.50	0.50	0.49	0.68	0.69	0.69
Controls	No	No	No	No	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2: **Summary Statistics**

This table presents summary statistics for the main outcome variables and control variables of our sample. The detailed definition of asset durability and depreciation measure refers to Section 2.1 Debt leverage is the ratio of long-term debt (DLTT) over the sum of leased capital and total assets (AT), where leased capital is defined as 10 times rental expense (XRENT). Rental leverage is the ratio of leased capital over the sum of leased capital and total assets (AT). Leased capital leverage is the sum of debt leverage and rental leverage. In Panel A, we split the whole sample into constrained and unconstrained firms at the end of every June, as classified by dividend payment dummy (DIV), according to Farre-Mensa and Ljungqvist (2016). We report pooled means of these variables value-weighted by firm market capitalization at fiscal year end. In Panel B, we report the time-series averages of the cross-sectional median of firm characteristics across five portfolios sorted on asset durability relative to their industry peers according to the NAICS 3-digit industry classifications. The detailed definition of the variables is listed in Appendix B. The sample is 1977 to 2016 and excludes financial, utility, and public administrative from the analysis.

	Panel A: Pooled Statistics		**Panel B: Firm Characteristics**				
	Const.	**Unconst.**	**Portfolios**				
Variables	**Mean**		**L**	**2**	**3**	**4**	**H**
Durability	12.66	16.54	7.69	9.99	11.45	14.24	18.00
Depreciation	0.17	0.13	0.19	0.16	0.15	0.13	0.11
Book Lev.	0.24	0.33	0.13	0.19	0.21	0.28	0.32

Table 3: **Portfolios Sorted on Asset Durability**

This table shows average excess returns for five portfolios sorted on asset durability across firms relative to their industry peers, for which we use the NAICS 3-digit industry classifications and rebalance portfolios at the end of every June. The results reflect monthly data, for which the sample is from July 1978 to December 2017 and excludes utility, financial, public administrative, and public administrative industries. We split the whole sample into financially constrained and unconstrained subsample at the end of every June, as classified by dividend payment dummy, SA index, rating dummy, and WW index. We report average excess returns over the risk-free rate E[R]-R_f, standard deviations Std, and Sharpe ratios SR across five portfolios in constrained subsamples (Panel A) and in whole sample (Panel B). Standard errors are estimated by using the Newey-West correction. We include t-statistics in parentheses and annualize portfolio returns multiplying by 12. All returns, standard deviations, and Sharpe ratios have been annualized.

	Panel A: Constrained Subsample					
	L	**2**	**3**	**4**	**H**	**H-L**
	DIV					
E[R]-R_f (%)	5.39	9.57	9.34	9.03	12.32	6.93
[t]	1.48	2.81	2.81	2.92	3.62	2.86
Std (%)	26.79	25.32	24.81	24.05	24.09	11.80
SR	0.20	0.38	0.38	0.38	0.51	0.59
	SA Index					
E[R]-R_f (%)	4.53	7.59	7.97	8.39	9.63	5.10
[t]	1.12	1.89	1.98	2.35	2.77	2.54
Std (%)	24.45	23.55	24.34	21.09	20.7	11.58
SR	0.19	0.32	0.33	0.40	0.47	0.44
	Rating					
E[R]-R_f (%)	5.65	8.76	9.40	9.35	10.10	4.45
[t]	1.42	2.18	3.06	2.84	3.52	2.12
Std (%)	24.32	23.4	19.61	19.89	18.81	11.8
SR	0.23	0.37	0.48	0.47	0.54	0.38
	WW Index					
E[R]-R_f (%)	6.09	8.24	9.13	9.59	9.65	3.56
[t]	2.13	2.78	3.68	3.78	3.85	2.23
Std (%)	25.7	24.18	23.67	21.1	20.85	11.04
SR	0.24	0.34	0.39	0.45	0.46	0.32
	Panel B: Whole Sample					
E[R]-R_f (%)	7.36	8.10	8.12	8.65	8.79	1.44
[t]	2.70	3.49	3.26	4.17	3.55	1.03
Std (%)	19.25	16.75	15.14	15.15	17.37	8.72
SR	0.38	0.48	0.54	0.57	0.51	0.17

Table 4: **Calibration**

We calibrate the model at the quarterly frequency. This table reports the parameter values and the corresponding moments (annalized) we used in the calibration procedure.

Parameter	**Symbol**	**Value**
Relative risk aversion	γ	10
IES	ψ	2
Capital share	α	0.30
Span of control parameter	ν	0.75
Mean productivity growth rate	$E(\tilde{A})$	0.1248
Time discount factor	β	0.99
Durable capital dep. rate	δ_d	0.01
Non-durable capital dep. rate	δ_{nd}	0.03
Death rate of entrepreneurs	$E(\lambda)$	0.025
Collateralizability parameter	θ	0.33
Transfer to entering entrepreneurs	χ	0.89
Persistence of TFP shock	ρ_A	0.994
Persistence of λ shock	ρ_x	0.98
Vol. of λ shock	σ_x	0.05
Vol. of productivity shock	σ_A	0.00695
Inv. adj. cost parameter	ζ	25
Mean idio. productivity growth	μ_Z	0.005
Vol. of idio. productivity growth	σ_Z	0.025

Table 5: **Model Simulations and Aggregate Moments**

This table presents the moments from the model simulation. The market return R_M corresponds to the return on entrepreneurs' net worth and embodies an endogenous financial leverage. R_d^{Lev}, R_{nd}^{Lev} denotes the levered capital returns, by the average financial leverage in the economy. We simulate the economy at monthly frequency, then aggregate the monthly observations to annual frequency. The moments reported are based on the annual observations. Number in parenthesis are standard errors of the calculated moments.

Moments	**Data**	**Model**
$\sigma(\Delta y)$	3.05 (0.60)	3.32
$\sigma(\Delta c)$	2.53 (0.56)	2.88
$\sigma(\Delta i)$	10.30 (2.36)	6.15
$corr(\Delta c, \Delta i)$	0.39(0.29)	0.77
$AC1(\Delta c)$	0.49(0.15)	0.45
$E[R_M - R_f]$	5.71 (2.25)	6.82
$\sigma(R_M - R_f)$	20.89 (2.21)	16.04
$E[R_f]$	1.10 (0.16)	1.15
$\sigma(R_f)$	0.97 (0.31)	0.80
$E[R_d^{Lev} - R_f]$		5.50
$E[R_{nd}^{Lev} - R_f]$		1.50

Table 6: **Asset Durability Spread, Data, and Model Comparison**

This table compares the moments in the empirical data (Panel A) and the model simulated data (Panel B) at the portfolio level. Panel A reports the statistics computed from the sample of financially constrained firms in the data, as classified by dividend payment dummy (DIV). In Panel B, we implement model simulation and then perform the same portfolio sorts as in the data. Panel A and B show the time series average of the cross-sectional median of firm characteristics using the value from the year end, including asset durability, depreciation rate, book leverage, return on equity. We also report the value-weighted excess returns E[R]-R_f(%) (annualized by multiplying by 12, in percentage terms), for quintile portfolios sorted on asset durability. The detailed definition of the variables is listed in Appendix B. The sample is from July 1978 to December 2017 and excludes financial, utility, and public administrative industries from the analysis.

Variables	**L**	**2**	**3**	**4**	**H**	**H-L**
			Panel A: Data			
Asset Durability	7.69	9.99	11.45	14.24	18.00	
Depreciation	0.19	0.16	0.15	0.13	0.11	
Book Lev.	0.13	0.19	0.21	0.28	0.32	
ROE	0.12	0.17	0.18	0.22	0.23	
E[R]-R_f (%)	5.39	9.57	9.34	9.03	12.32	6.93
			Panel B: Model			
Asset Durability	8.33	10.05	11.12	14.28	20.08	
Depreciation	0.12	0.10	0.09	0.07	0.05	
Book Lev.	0.19	0.27	0.33	0.39	0.45	
ROE	0.06	0.08	0.09	0.11	0.13	
E[R]-R_f (%)	3.39	5.27	5.96	6.60	7.02	3.63

Table 7: **Aggregate Shocks and Price Dynamics**

This table shows the exposure of price dynamics to aggregate macroeconomic shocks. All estimates are based on the following panel regressions:

$$\Delta q_{h,t} = \beta_y \, \Delta y_t + \beta_d \, Asset\ Durability_{h,t} \times \Delta y_t + \varepsilon_{h,t},$$

in which $\Delta q_{h,t}$ denotes price dynamics of asset h, Δy_t denotes aggregate macroeconomic shocks, and Asset Durability$_h$ denotes the asset durability of asset h at year t. We control for asset fixed effects, and standard errors are clustered at the asset level. We report t-statistics in parenthesis. The sample period is from 1977 to 2017.

	(1)	**(2)**
dy	1.51	1.02
[t]	11.71	3.89
Interaction		1.06
[t]		3.28
Observations	4,830	4,760
Asset FE	Yes	Yes
Cluster SE	Yes	Yes

Table 8: **Asset Pricing Factor Tests**

This table shows asset pricing test for five portfolios sorted on asset durability across firms relative to their industry peers, where we use the NAICS 3-digit industry classifications and rebalance portfolios at the end of every June. The results reflect monthly data, for which the sample is from July 1978 to December 2017 and excludes utility, financial, and public administrative industries. We split the whole sample into financially constrained and unconstrained firms, as classified by the dividend payment dummy (DIV), and report five portfolios across the financially constrained subsample. In Panel A, we report the portfolio alphas and betas by the Fama-French five-factor model plus the long-short portfolio sorted on collateralizability (COL), including MKT, SMB, HML, RMW, CMA, and LMH. In panel B, we report portfolio alphas and betas by the HXZ q-factor model plus the long-short portfolio sorted on collateralizability, including MKT, SMB, I/A, ROE, and COL. Data on the Fama-French five-factor model are from Kenneth French's website. Data on the I/A and ROE factor are provided by Kewei Hou, Chen Xue, and Lu Zhang. Data on the long-short portfolio sorted on collateralizability refers to Ai, Li, Li, and Schlag (2019). Standard errors are estimated using Newey-West correction. We include t-statistics in parentheses and annualize the portfolio alphas by multiplying 12.

	L	**2**	**3**	**4**	**H**	**H-L**
			Panel A: FF5 + LMH			
$\alpha_{\text{FF5+COL}}$	-4.13	2.51	1.55	0.43	4.02	8.14
[t]	-2.06	1.44	0.94	0.29	2.52	3.38
MKT	1.28	1.14	1.15	1.13	1.17	-0.11
[t]	24.57	32.69	29.01	36.65	33.10	-2.22
SMB	0.51	0.46	0.36	0.46	0.43	-0.08
[t]	5.97	6.35	6.22	8.25	7.54	-0.91
HML	-0.24	-0.35	-0.33	-0.46	-0.38	-0.15
[t]	-2.45	-4.77	-4.35	-6.83	-4.92	-1.69
RMW	-0.10	-0.24	-0.11	0.02	-0.06	0.04
[t]	-0.78	-2.19	-1.53	0.34	-0.78	0.25
CMA	-0.44	-0.42	-0.51	-0.31	-0.25	0.19
[t]	-3.21	-4.18	-4.58	-3.27	-2.88	1.47
COL	0.10	0.13	0.13	0.09	0.03	-0.07
[t]	2.67	3.50	3.69	2.88	0.83	-1.67
			Panel B: HXZ + LMH			
$\alpha_{\text{HXZ+COL}}$	-4.71	1.65	1.60	-0.30	3.82	8.54
[t]	-2.36	0.86	0.79	-0.17	2.26	3.48
MKT	1.31	1.18	1.17	1.15	1.18	-0.13
[t]	19.40	28.08	26.40	28.47	30.62	-2.20
SMB	0.42	0.37	0.26	0.37	0.37	-0.06
[t]	3.30	3.96	4.37	5.74	7.01	-0.42
I/A	-0.62	-0.77	-0.88	-0.80	-0.69	-0.08
[t]	-5.18	-8.05	-9.03	-9.30	-8.59	-0.64
ROE	-0.03	-0.08	-0.04	0.12	0.01	0.04
[t]	-0.34	-0.98	-0.55	1.92	0.17	0.62
COL	0.17	0.24	0.21	0.18	0.11	-0.06
[t]	3.36	6.21	6.36	6.13	3.83	-1.15

Table 9: **Fama-Macbeth Regressions**

This table reports the of Fama-Macbeth regressions of individual stock excess returns on their asset durability and other firm characteristics. The sample is from July 1978 to December 2017 and excludes financial, utility, and public administrative industries from the analysis. We split the whole sample into financially constrained and unconstrained firms, as classified by the dividend payment dummy, and then report the result of regression in the financially constrained subsample. For each month from July of year t to June of year t+1, we regress monthly excess returns of individual stock on durability with different sets of variables that are known by the end of June of year t, and control for industry fixed effects based on NAIC 3-digit industry classifications. We present the time-series average and heteroscedasticity-robust t-statistics of the slopes (i.e., coefficients) estimated from the monthly cross-sectional regressions for different model specifications. All independent variables are normalized to zero mean and one standard deviation after winsorization at the 1th and 99th percentile of their empirical distribution. We include t-statistics in parentheses and annualize individual stock excess returns by multiplying 12. Standard errors are estimated using Newey-West correction.

Variables	**(1)**	**(2)**	**(3)**
Asset Durability	2.13	3.62	1.46
[t]	3.44	5.24	2.86
Book Lev.	-1.89	-0.57	-0.99
[t]	-4.17	-1.09	-2.28
Collateralizability		-3.07	
[t]		-3.87	
Log ME			-0.75
[t]			-0.67
Log B/M			4.82
[t]			8.73
ROA			6.36
[t]			8.98
I/K			-1.13
[t]			-2.78
OC/AT			1.03
[t]			2.29
R&D/AT			5.71
[t]			7.05
Observations	846,277	632,464	806,449
Controls	No	No	Yes
Industry FE	Yes	Yes	Yes

Table 10: **Cash Flow Sensitivity**

This table shows the cash flow sensitivity of the asset durability-sorted portfolios to the TFP and GDP shock. Panel A and B report sensitivities from empirical data and model simulated data, respectively. The portfolio-level normalized cash flow is constructed by aggregating cash flow (EBIT) within each quintile portfolio, and then normalized by the lagged aggregate sales (SALE) of the given portfolio. We regress portfolio-level normalized cash flow on TFP and wealth share shock, respectively, and then report estimated coefficients on normalized cash flow. Standard errors are estimated by Newey-West correction, and t-statistics are included in parentheses. All regressions are conducted at the annual frequency. The sample includes annual data from 1979 to 2017.

	L	**2**	**3**	**4**	**H**	**H-L**
TFP	1.16	1.29	1.63	1.58	1.78	0.62
[t]	14.95	8.88	17.82	10.30	9.06	4.25
GDP	1.33	2.01	2.10	2.08	2.54	1.21
[t]	3.76	5.79	4.49	4.72	4.60	5.59

Table 11: **Estimating the Market Price of Risk**

This table shows results the GMM estimates of the stochastic discount factor's parameters. In Panel A, we use the asset durability-sorted portfolios as test portfolios and report risk exposures with respect to the measures of aggregate macroeconomic shock. We use two sets of proxies for the aggregate macroeconomic shock (Macro): the the log difference in TFP and GDP. In Panel B, we present GMM estimates of the parameters of the stochastic discount factor $M = 1 - b_M \text{MKT} - b_A \times \text{Macro}$, using the leased capital ratio sorted portfolios. We do the normalization such that $E[M] = 1$ (See, e.g., Cochrane (2005)). We report HAC t-statistics computed errors using the Newey-West procedure adjusted for three lags. As a measure of fit, we report the sum of squared errors (SSQE), mean absolute pricing errors (MAPE), and the J-statistic of the overidentifying restrictions of the model. The sample includes annual data from 1979 to 2017.

Panel A: Portfolio Risk Exposures

	L	**2**	**3**	**4**	**H**	**H-L**
TFP	0.36	1.92	1.37	1.48	2.33	1.89
[t]	0.75	1.93	1.34	1.73	2.16	2.15
GDP	-0.09	2.97	1.63	1.48	3.32	3.37
[t]	-0.03	0.83	0.51	0.37	0.75	1.85

Panel B: Price of Risks

Parameters	**CAPM**	**TFP**	**GDP**
b_M	0.02	0.01	0.01
[t]	3.66	1.84	1.17
b_A		0.24	0.70
[t]		7.78	4.95
SSEQ (%)	0.78	0.10	0.39
MAPE (%)	2.72	1.17	2.30
J-test	6.69	3.13	3.40
p	0.24	0.53	0.49

Appendix A: Data Construction

This section describes how we (i) construct firm samples for empirical analysis and (ii) construct firm characteristics to control for fundamentals.

A.1. Asset Prices and Accounting Data

Our sample consists of firms in the intersection of Compustat and CRSP (Center for Research in Security Prices). We obtain accounting data from Compustat and stock returns data from CRSP. Our sample firms include those with positive durability data and non-missing SIC codes and those with domestic common shares (SHRCD = 10 and 11) trading on NYSE, AMEX, and NASDAQ, except utility firms that have four-digit standard industrial classification (SIC) codes between 4900 and 4999, finance firms that have SIC codes between 6000 and 6999 (finance, insurance, trusts, and real estate sectors), and public administrative firms that have SIC codes between 9000 and 9999. We follow Campello and Giambona (2013) by excluding firm-year observations for which the value of total assets or sales is less than $ 1 million. Following Fama and French (1993), we further drop closed-end funds, trusts, American Depository Receipts, Real Estate Investment Trusts, and units of beneficial interest. To mitigate backfilling bias, firms in our sample must be listed on Compustat for two years before including them in our sample. Macroeconomic data are from the Federal Reserve Economic Data (FRED) maintained by Federal Reserve in St. Louis.

Appendix B: Additional Empirical Evidence

In this section, we provide additional empirical evidence on the relation of the asset durability and other firm characteristics and document the summary statistics of the asset durability across industries.

B.1. More Detailed Firm Characteristics

Table B.1 documents how differences in asset durability among firms are related to other firm characteristics. We report average durability and these characteristics across five portfolios sorted on the firm-level asset durability among financially constrained firms

[Place Table B.1 about here]

Generally speaking, our sample contains $1,821$ firms. Five portfolios sorted on asset durability from the lowest to the highest quintile are evenly distributed, with the average number of firms ranging from 301 to 417. The cross-sectional variations in durability are large, ranging from 7.69 to 18 across five portfolios sorted on durability. Size does not vary a lot but presents a hump-shaped pattern across five portfolios. Moreover, a firm with a lower asset durability has a lower book-to-market ratio (B/M) and a higher investment rate (I/K) and Tobin's q to reflect more investment opportunities. We also notice that low durability firms are less profitable, as measure of return on assets (ROA), and lower capacity to borrow, as measure by book leverage, and more financially constrained (SA and WW index). These characteristics suggest an endogenous choice for less durable assets when a firm becomes more financially constrained with low tangibility but faces a positive investment opportunity. In addition, intangibilities, as measured by organization capital ratio (OC/AT) and R&D intensity, across five portfolios suggest that a lease-intensive firm holds a relatively higher share of R&D and organization capital. Finally, there is a negative relationship between asset durability and collateralizability.

B.2. Summary Statistics across Industries

In Table B.2, we report the average of asset durability and depreciation with respect to tangible and intangible assets in each industry according to the BEA industry classifications. Asset durability (depreciation) in some industries are higher (lower), such as the educational services and the accommodation industry. There are comparatively large cross-industry variations in asset durability (depreciation), ranging from 10.84 to 49.49 . Therefore, to make sure our results are not driven by any particular industry, we control for industry effects as detailed later.

[Place Table B.2 about here]

Table B.1: **Firm Characteristics**

This table reports time-series averages of the cross-sectional median of firm characteristics in five portfolios sorted on asset durability, relative to their industry peers, where we use the NAICS 3-digit classifications and rebalance portfolios at the end of every June. The sample is from 1977 to 2016 and excludes financial, utility, and public administrative industries from the analysis. We split the whole sample into financially constrained and unconstrained firms at the end of every June, as classified by dividend payment dummy (DIV) according to Farre-Mensa and Ljungqvist (2016), and report five portfolios across the financially constrained subsample. The detailed definition of the variables is listed in B.3.

Variables	**L**	**2**	**3**	**4**	**H**
Asset Durability	7.69	9.99	11.45	14.24	18.00
Depreciation	0.19	0.16	0.15	0.13	0.11
Log ME	4.88	5.13	5.16	5.22	5.07
B/M	0.48	0.51	0.53	0.60	0.67
I/K	0.37	0.30	0.28	0.24	0.22
q	1.65	1.54	1.48	1.37	1.27
ROA	0.07	0.09	0.10	0.11	0.11
ROE	0.12	0.17	0.18	0.22	0.23
OC/AT	0.36	0.25	0.21	0.17	0.13
R&D/AT	0.03	0.03	0.03	0.00	0.00
Collateralizability	0.21	0.25	0.27	0.37	0.51
Book Lev.	0.13	0.19	0.21	0.28	0.32
Short-term Lev.	0.02	0.02	0.02	0.03	0.03
Long-term Lev.	0.04	0.09	0.11	0.17	0.21
TANT	0.08	0.13	0.17	0.25	0.34
SA	-2.47	-2.68	-2.80	-2.91	-2.92
WW	-0.16	-0.18	-0.19	-0.20	-0.20
Number of Firms	365	345	301	393	417

Table B.2: **Asset Durability and Depreciation across BEA Industries**

This table reports summary statistics of the average asset durability and depreciation with respect to tangible and intangible assets across industries. Industries are based on BEA industry classifications. The sample period is 1977 to 2016.

BEA Industries	**Tangible**		**Intangible**	
Industry Name	**Durability**	**Depreciation**	**Durability**	**Depreciation**
Farms	27.92	0.07	2.58	0.40
Forestry, fishing, and related activities	24.43	0.09	2.38	0.43
Oil and gas extraction	14.98	0.07	4.33	0.23
Mining, except oil and gas	20.56	0.07	4.50	0.23
Support activities for mining	13.67	0.09	3.40	0.30
Utilities	40.49	0.03	3.38	0.31
Construction	20.13	0.10	3.95	0.26
Wood products	22.67	0.07	4.61	0.23
Nonmetallic mineral products	20.65	0.07	5.90	0.17
Primary metals	21.28	0.07	5.73	0.17
Fabricated metal products	19.36	0.08	5.68	0.18
Machinery	20.94	0.07	5.68	0.18
Computer and electronic products	22.97	0.07	3.44	0.29
Electrical equipment, appliances, and components	23.98	0.06	5.89	0.17
Motor vehicles, bodies and trailers, and parts	17.97	0.08	3.19	0.31
Other transportation equipment	24.09	0.06	4.47	0.22
Furniture and related products	23.05	0.06	5.37	0.19
Miscellaneous manufacturing	22.33	0.07	5.86	0.17
Food, beverage, and tobacco products	21.90	0.07	5.55	0.18
Textile mills and textile product mills	22.65	0.06	5.46	0.18
Apparel and leather and allied products	26.52	0.06	5.73	0.17
Paper products	18.12	0.08	5.38	0.19
Printing and related support activities	19.06	0.08	5.02	0.21
Petroleum and coal products	21.09	0.07	5.86	0.17
Chemical products	22.25	0.07	8.09	0.12
Plastics and rubber products	18.44	0.08	5.72	0.18
Wholesale trade	24.93	0.08	4.13	0.25
Retail trade	33.63	0.05	4.05	0.26
Air transportation	19.23	0.07	3.28	0.31
Railroad transportation	44.31	0.03	4.30	0.25
Water transportation	18.99	0.06	4.08	0.26
Truck transportation	11.49	0.14	4.19	0.26
Transit and ground passenger transportation	35.17	0.05	3.50	0.30
Pipeline transportation	39.5	0.03	3.12	0.32
Other transportation and support activities	30.07	0.06	3.50	0.31
Warehousing and storage	37.45	0.04	3.88	0.28
Publishing industries (including software)	23.51	0.07	6.39	0.16
Motion picture and sound recording industries	29.43	0.05	7.86	0.13
Broadcasting and telecommunications	34.89	0.04	5.42	0.19
Information and data processing services	22.86	0.10	4.50	0.23
Federal Reserve banks	34.66	0.05	3.25	0.31
Credit intermediation and related activities	26.75	0.07	2.99	0.34
Securities, commodity contracts, and investments	35.37	0.04	3.12	0.32
Insurance carriers and related activities	33.83	0.05	3.10	0.33
Funds, trusts, and other financial vehicles	40.54	0.03	3.02	0.33
Real estate	40.04	0.03	2.89	0.35
Rental and leasing services and lessors of intangible assets	10.84	0.12	2.87	0.35
Legal services	31.14	0.06	2.57	0.40
Computer systems design and related services	31.76	0.07	2.83	0.35
Miscellaneous professional, scientific, and technical services	26.62	0.07	5.41	0.19
Management of companies and enterprises	35.71	0.04	3.23	0.31
Administrative and support services	29.09	0.07	2.79	0.36
Waste management and remediation services	48.14	0.05	3.91	0.26
Educational services	49.49	0.03	4.80	0.21
Ambulatory health care services	34.39	0.06	4.86	0.21
Hospitals	45.77	0.04	4.39	0.24
Nursing and residential care facilities	39.67	0.04	5.05	0.20
Social assistance	37.26	0.04	3.18	0.32
Performing arts, spectator sports, museums, and related activities	36.87	0.04	6.10	0.16
Amusements, gambling, and recreation industries	30.35	0.05	3.95	0.26
Accommodation	48.59	0.03	4.07	0.25
Food services and drinking places	27.15	0.07	4.16	0.24
Other services, except government	43.02	0.04	5.24	0.19

Table B.3: **Definition of Variables**

Variables	**Definition**	**Sources**
Durability	Details refer to Section 2.1	BEA; Compustat
Depreciation	Details refer to Section 2.1	BEA; Compustat
ME (real)	Market capitalization deflated by CPI at the end of June in year t.	CRSP
B/M	The ratio of book equity of fiscal year ending in year t-1 to market equity at the end of year t-1.	Compustat
Tobin's q	The sum of market capitalization at the end of year and book value of preferred shares deducting inventories over total assets (AT).	CRSP; Compustat
I/K	The ratio of investment (CAPX) to purchased capital (PPENT).	Compustat
ROA	The ratio of operating income before depreciation (OIBDP) over total assets (AT).	Compustat
ROE	The ratio of operating income before depreciation (OIBDP) over book equity.	Compustat
OC/AT	Following Peters and Taylor (2017).	Compustat
R&D Intensity	Following Peters and Taylor (2017).	Compustat
Tangibility	The ratio of purchased capital (PPENT) to total assets (AT).	Compustat
Book Lev.	The sum of long-term liability (DLTT) and current liability (DLCT) divided by total assets (AT).	Compustat
Short-term Lev.	Current liability (DLCT) divided by total assets (AT).	Compustat
Long-term Lev.	Long-term liability (DLTT) divided by total assets (AT).	Compustat
DIV	Following Farre-Mensa and Ljungqvist (2016).	Compustat
SA Index	Following Hadlock and Pierce (2010).	Compustat
Credit Rating	The entire list of credit ratings is as follows: AA+, AA, and AA- = 6, A+, A, and A- = 5, BBB+, BBB, BBB- = 4, BB+, BB, BB- = 3, B+, B, and B- = 2, rating below B- or missing is 0.	Compustat
WW Index	Following Whited and Wu (2006).	Compustat