Internet Appendix to "Inventory Behavior and Financial Constraints: Theory and Evidence"

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Table IA.1 Commodity Price Changes and Instrumented Sales Growth

This table reports the regression results when using quarterly gold (Panel A) and silver (Panel B) price changes to instrument sales growth to test the asymmetric response and dynamic adjustment of inventory growth to cost shocks. We obtain daily prices of gold (silver) from Bloomberg and use price on the last trading day in each month to calculate the percentage change in gold (silver) prices. We then deflate the price changes and compute the cumulative real price changes over three months. The price changes are matched to the Compustat firms based on the end date of each fiscal quarter and are multiplied by -1 to make positive (negative) price changes to reflect favorable (unfavorable) cost shocks. To instrument sales growth with gold (silver) price changes, for each industry, we regress sales growth on the gold (silver) price changes and the interaction of price changes with the FC dummy. We also control for $(CF/K)_{t-1}$, its interaction with the FC dummy, K_Growth_t and firm-fixed effect. The control variables are defined in Appendix B. Note that we use the price changes at quarter $t-2$ to instrument the sales growth at quarter t since on average it takes 2 quarters for the sales growth to react positively on the gold (silver) price changes. We only keep industries for which there is a positive correlation between sales growth and the (negative of) price changes and use the predicted sales growth to determine whether firms experience favorable or unfavorable cost shocks. We perform the same test as we did on the simulated data in Table 5 and report the results on the asymmetric response in column (1) to (4) and dynamic adjustment in column (5) to (8) The dependent variable is N_Growth. To test the asymmetric response, we create a dummy, Adv_{t-1}, to capture the extreme adverse (cost) states. It equals to 1 if the predicted sales growth is below the 20th percentile of the firm's distribution, and zero otherwise. To test the dynamic inventory adjustment, we create two dummies variables, $Fav_{t-1,t-6}$ and $Adv_{t-1,t-6}$, for extreme (cost) shocks in the previous periods. $Fav_{t-1,t-6}$ ($Adv_{t-1,t-6}$) equals to 1 if the average shock over the past 6 periods is in the top (bottom) 20th percentile of the moving-averagedistribution, and 0 otherwise. The regressions also control for $(CF/K)_{t-1}$, $(CF/K)_{t-1} \times FC_t$, K_Growth and $(N/K)_{t-1}$, and are estimated with firm-fixed effects and year-fixed effects. We use four commonly used financial constraint classifications: total assets in column (1) and (5), ratings in column (2) and (6), the Hadlock-Pierce Index in column (3) and (7), and the Whited-Wu Index in column (4) and (8). The regression model is run for each quarter to account for seasonality. The reported coefficients are the average over the four quarters. t-statistics in parentheses are calculated using the Fama-MacBeth method. Coefficients significant at the 10%, 5%, and 1% levels are marked with *, **, and ***, respectively. The original regressions on each quarter are available upon request.

Panel A. Evidence from Gold Price Changes

	Asymmetric Response				Dynamic Adjustment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	N_Growth_t	N_Growth_t	N_Growth_t	N_Growth_t	N_Growth_t	N_Growth_t	N_Growth_t	N_Growth_t
FC Classification	Total Asset	Rating	HP Index	WW Index	Total Asset	Rating	HP Index	WW Index
$S\_\widehat{Growth}_t^+$	0.102***	0.089**	0.134***	0.066***	0.092**	0.079**	0.130**	0.060**
	(4.52)	(5.06)	(8.14)	(5.76)	(4.06)	(4.31)	(8.81)	(4.83)
$S\_\widehat{Growth}_t^+ \times FC_t$	-0.089**	-0.070**	-0.139***	-0.081***	-0.069*	-0.053**	-0.130***	-0.064***
	(-3.68)	(-4.2)	(-9.39)	(-8.55)	(-2.72)	(-3.17)	(-10.92)	(-7.47)
$S\_\widehat{Growth}_t^-$	-0.013	-0.065	0.007	-0.002	-0.015	-0.067	0.004	-0.002
	(0.37)	(-1.58)	(0.22)	(-0.07)	(-0.43)	(-1.61)	(0.12)	(-0.07)
$S\_\widehat{Growth}_t^- \times FC_t$	-0.018	0.036	-0.026	-0.028	-0.018	0.034	-0.024	-0.027
	(-0.50)	(0.81)	(-0.69)	(-0.87)	(-0.52)	(0.77)	(-0.66)	(-0.89)
Adv_{t-1}	-0.0001	-0.0009	0.0004	-0.0000				
	(-0.2)	(-0.99)	(0.56)	(-0.06)				
$Adv_{t-1} \times FC_t$	-0.0009	-0.0004	-0.003***	-0.0016				
	(-1.23)	(-0.67)	(-5.05)	(-1.69)				
$Fav_{t-1,t-6}$					0.0003	0.0017	0.0006	-0.0001
					(0.34)	(1.63)	(0.74)	(-0.19)
$Fav_{t-1,t-6} \times FC_t$					0.0006	0.0005	0.003*	0.0021
					(0.67)	(0.73)	(2.58)	(2.17)
$Adv_{t-1,t-6}$					-0.0009	-0.0014	-0.0007	-0.0002
					(-0.76)	(-1.48)	(-0.73)	(-1.71)
$Adv_{t-1,t-6} \times FC_t$					-0.0018	-0.0001	-0.0039	-0.002
					(-1.55)	(-0.18)	(-2.09)	(-1.79)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes.	Yes
Observations	26,190	40,637	26,396	20,809	26,357	40,706	26,553	21,163
$Adj.R^2$	0.45	0.461	0.456	0.458	0.453	0.462	0.458	0.461

Panel B. Evidence from Silver Price Changes

	Asymmetric Response				Dynamic Adjustment			
	(1) N_Growth_t	(2) N_Growth_t	(3) N_Growth_t	(4) N_Growth_t	(5) N_Growth_t	(6) N_Growth_t	(7) N_Growth_t	(8) N_Growth_t
FC Classification	Total Asset	Rating	HP Index	WW Index	Total Asset	Rating	HP Index	WW Index
$S\_\widehat{Growth}_t^+$	0.067**	0.077***	0.104**	0.050**	0.046**	0.053***	0.085**	0.041**
	(4.47)	(6.69)	(3.8)	(4.77)	(3.33)	(5.00)	(4.50)	(3.75)
$S\_\widehat{Growth}_t^+ \times FC_t$	-0.059**	-0.064**	-0.115**	-0.057***	-0.029*	-0.034*	-0.091**	-0.020*
	(-4.16)	(-4.18)	(-4.58)	(-5.53)	(-3.43)	(-2.45)	(-6.16)	(-1.33)
$S\_\widehat{Growth}_t^-$	-0.012	-0.049	-0.003	-0.008	-0.021	-0.054	-0.015	-0.009
	(-0.83)	(-1.69)	(-0.22)	(-0.65)	(-2.18)	(-2.04)	(-1.11)	(-1.08)
$S\_\widehat{Growth}_t^- \times FC_t$	0.007	0.032	0.002	-0.005	0.014	0.036	0.017	-0.006
	(0.58)	(1.22)	(0.15)	(-0.29)	(0.96)	(1.65)	(1.81)	(-0.27)
Adv_{t-1}	-0.0003	-0.0006	0.0003	0.0003				
	(-0.32)	(-0.51)	(0.39)	(0.45)				
$Adv_{t-1} \times FC_t$	-0.0008	-0.0009	-0.0025**	-0.0019*				
	(-0.66)	(-1.36)	(-4.28)	(-2.52)				
$Fav_{t-1,t-6}$					0.0005	0.0025**	0.0006	0.0000
					(1.08)	(3.27)	(0.90)	(-0.01)
$Fav_{t-1,t-6} \times FC_t$					0.0006	0.0005	0.0029**	0.0012*
					(0.60)	(0.81)	(4.21)	(2.44)
$Adv_{t-1,t-6}$					-0.0006	-0.0009	-0.0004	-0.0005
					(-0.65)	(-0.99)	(-0.40)	(-1.52)
$Adv_{t-1,t-6} \times FC_t$					-0.0037**	-0.0014	-0.0047**	-0.0022
					(-2.40)	(-1.01)	(-3.68)	(-1.73)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes.	Yes
Observations	26,190	40,637	26,396	20,809	28,321	41,516	28,170	22,742
$Adj.R^2$	0.450	0.461	0.456	0.458	0.428	0.451	0.431	0.445

Table IA.2 The (Non-)Response of Sales Growth To Credit Shocks

This table reports the (non-)response of sales growth to the shock on firms' financial constraints status. The sample consists of all the unrated firms and firms with a below-investment-grade debt rating (BB+ or lower) in the quarterly *Compustat* database during the period 1986 to 1993. Panel A reports the impact of the credit shock on the response of sales growth of the below-investment-grade firms vis-a-vis that of matched unrated firms. Panel B explores geographic variation as another source of variation and reports the impact of the credit shock on the response of sales growth of firms located in the Northeast region of the United States vis-a-vis that of firms located elsewhere. The control firms in both tests are matched with the treated firms on industry and size. We use the 1994 location information obtained from Bill McDonald's website, which is based on headers for 10-K forms in 1994 to 2010. The event quarter is 1990Q1. Therefore, the *Before* window is from 1986Q1 to 1989Q4, and the *After* window is from1990Q2 to 1990Q4 (1990Q2 to 1993Q4) for the short-run (long-run) window. We require each firm contain at least one observation in both the before and after period. We control for the trend before the shock *Preshock*, which is a dummy that equals to 1 if the observation is in the three quarters before the shock (1989Q1 to 1989Q3). We partition firms into favorable and unfavorable shock states based on the industry annual input price change for the three years before the credit shock as well as the three years after. The dependent variable is S_Growth_t. All the other variables are defined in Appendix B. The regression model is estimated with firm-fixed effect. t-statistics are reported in parentheses. Coefficients significant at the 10%, 5%, and 1% levels are marked with *, **, and ***, respectively. The standard errors are reported in the parentheses. For the differences, *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels based on one-tail distribution.

Panel A: The Impact on Below-Investment-Grade Firms

	Favorable Cost Shocks		Unfavorable Cost Shocks	
	short-run	long-run	short-run	long-run
	(1)	(2)	(3)	(4)
	S_Growth_t	S_Growth_t	S_Growth_t	S_Growth_t
$After_t$	0.00264	-0.00680	-0.00205	0.000857
	(0.23)	(-1.27)	(-0.17)	(0.17)
$After_t \times BelowInvestment$	-0.00966	0.00443	-0.00541	-0.00751
	(-0.63)	(0.50)	(-0.40)	(-1.20)
$Preshock_t$	-0.00584	-0.00570	0.00155	-0.00121
	(-1.33)	(-1.50)	(0.22)	(-0.18)
$Preshock_t \times BelowInvestment$	0.00795	0.00990	-0.00277	-0.000971
	(1.13)	(1.47)	(-0.32)	(-0.12)
$log(K)_t$	-0.0110	-0.00945	-0.0112	-0.0103
	(-0.49)	(-0.81)	(-0.73)	(-1.00)
$Constant$	0.0869	0.0756	0.0765	0.0718
	(0.58)	(0.96)	(0.74)	(1.03)
$Observations$	1367	2255	511	864
$Adj.R^2$	0.033	0.017	0.058	0.037

Panel B: Geographic Variation in the Response to Credit Shocks

	Favorable Cost Shocks		Unfavorable Cost Shocks	
	short-run	long-run	short-run	long-run
	(1)	(2)	(3)	(4)
	S_Growth_t	S_Growth_t	S_Growth_t	S_Growth_t
$After_t$	-0.00300	-0.0118**	-0.00333	-0.00172
	(-0.36)	(-2.39)	(-0.57)	(-0.48)
$After_t \times Northeast$	-0.00783	-0.000647	-0.00317	-0.00651
	(-0.66)	(-0.09)	(-0.39)	(-1.31)
$Preshock_t$	-0.00544	-0.00633	-0.0142***	-0.0143***
	(-0.74)	(-0.90)	(-2.73)	(-2.82)
$Preshock_t \times Northeast$	-0.00378	-0.000701	0.00525	0.00453
	(-0.36)	(-0.07)	(0.72)	(0.63)
$log(K)_t$	-0.0113	-0.0149***	-0.0353***	-0.0269***
	(-1.46)	(-3.06)	(-5.83)	(-7.24)
$Constant$	0.0816**	0.101***	0.181***	0.141***
	(2.04)	(4.00)	(6.35)	(8.04)
$Observations$	5,613	9,306	6,345	10,673
$Adj.R^2$	0.004	0.001	0.001	0.000

Table IA.3 Allowing Different Exposure to Cost Shocks in the Simulated Data

This table reports the regression results of the asymmetric response on the simulated data when constrained firms are exposed more or less to cost shocks than unconstrained firms. The volatility of cost shock for unconstrained firms are kept at the baseline value, and that for the constrained firms are varying across columns. All variables are defined in Appendix B. The dependent variable is N_Growth. $CostShock_t^+ \times FC$ and $CostShock_t^- \times FC$ are the interactions of $CostShock_t^+$ and $CostShock_t^-$ with the FC dummy. All results obtained use the same realization of shocks. t-statistics are reported in parentheses. Coefficients significant at the 10%, 5%, and 1% levels are marked with *, **, and ***, respectively.

	(1) N_Growth_t	(2) N_Growth_t.	(3) N_Growth_t	(4) N_Growth_t	(5) N_Growth_t	(6) N_Growth_t	(7) N_Growth_t
σ_Z of unconstrained	baseline	baseline	baseline	baseline	baseline	baseline	baseline
σ_Z of constrained	0.5*baseline	0.75*baseline	0.875*baseline	baseline	1.125*baseline	1.25*baseline	1.5*baseline
N_t/K_t of unconstrained	0.150	0.150	0.150	0.150	0.150	0.150	0.150
N_t/K_t of constrained	0.193	0.200	0.210	0.225	0.247	0.278	0.378
FC	0.00256***	0.00383***	0.00521***	0.00717***	0.00987***	0.0136***	0.0258***
	(23.94)	(26.96)	(31.56)	(36.94)	(42.48)	(47.64)	(55.06)
$CostShock_t^+$	0.00624***	0.00726***	0.00785***	0.00849***	0.00922***	0.0100***	0.0120***
	(59.43)	(60.80)	(61.19)	(60.97)	(59.82)	(57.52)	(49.24)
$CostShock_t^+ \times FC$	-0.000973***	-0.00231***	-0.00307***	-0.00389***	-0.00481***	-0.00585***	-0.00860***
	(-8.70)	(-17.91)	(-21.83)	(-25.10)	(-27.67)	(-29.51)	(-30.94)
$CostShock_t^-$	0.00783***	0.00861***	0.00918***	0.00987***	0.0107***	0.0116***	0.0140***
	(79.51)	(75.54)	(74.42)	(73.52)	(72.60)	(71.49)	(67.88)
$CostShock_t^- \times FC$	0.00122***	0.00245***	0.00340***	0.00472***	0.00656***	0.00912***	0.0179***
	(7.20)	(11.70)	(14.62)	(17.82)	(21.04)	(24.00)	(28.06)
$Cost_{t-1}$	0.00291***	0.00319***	0.00339***	0.00363***	0.00391***	0.00423***	0.00499***
	(51.44)	(40.45)	(36.83)	(33.87)	(30.96)	(27.84)	(21.05)
N_{t-1}/K_{t-2}	-0.0563***	-0.0377***	-0.0333***	-0.0308***	-0.0298***	-0.0297***	-0.0318***
	(-32.69)	(-32.14)	(-36.21)	(-41.98)	(-48.31)	(-53.75)	(-59.72)
$Constant$	0.0209***	0.0178***	0.0171***	0.0166***	0.0164***	0.0164***	0.0167***
	(63.67)	(65.47)	(61.49)	(56.39)	(51.47)	(46.86)	(37.79)
Observations	430800	430800	430800	430800	430800	430800	430800
$Adj.R^2$	0.190	0.158	0.141	0.124	0.108	0.094	0.073

Table IA.4 Allowing Firms to Hedge in the Actual Data

This table reports the regression results on the asymmetric response of inventory growth to cost shocks using the real data when firms are allowed to hedge cost shocks. Observations are at annual frequency. Our baseline regression as in Table 6 is performed on subsamples of firms that may have higher tendency to hedge using Purchase Obligations (PO). Almeida, Hankins and Williams (2017) show that a firm's usage of PO to hedge input price variations depends on its supplier's bargaining power and settlement risk. Following their paper, we use supplier industry HHI to measure supplier bargaining power and supplier Z-score to measure settlement risk. For each customer industry, we identify the supplier industries from the IO table and calculate industry HHI and industry-median z-score for each supplier industry (IO 71 industries). We then use the percentage of inputs from each supplier industry to the total inputs of the customer industry to weigh the supplier industry HHI and supplier Z-score. Our subsamples consist of firms with lower supplier bargaining power (that is, industries with supplier industry HHI below the annual mean) and lower settlement risk (that is, industries with industry Z-score above the annual mean). Column (1) presents the results on the full sample. Column (2) examines the subsample of firms with lower supplier bargaining power and Column (3) firms that have lower settlement risk. All variables are defined in Appendix B. Cost shock is measured by the negative percentage change in Chain-Type Price Indexes for intermediate input by industry provided by the Bureau of Economic Analysis. The dependent variable is N_Growth. We report the results when total assets are used to classify the financial constrained firms. The regressions are estimated with firm-fixed effects and year-fixed effects. t-statistics in parentheses are adjusted using the Huber-White estimator allowing within firm clusters to avoid potential heteroskedasticity and serial correlation. Coefficients significant at the 10%, 5%, and 1% levels are marked with *, **, and ***, respectively.

	(1) N_Growth_t	(2) N_Growth_t	(3) N_Growth_t
Sample	Full	Low Supplier Bargaining Power	Low Settlement Risk
$CostShock_t^+$	0.0308***	0.0113	-0.00826
	(2.80)	(0.96)	(-0.30)
$CostShock_t^+ \times FC_t$	-0.0658***	-0.0483**	-0.0897*
	(-3.06)	(-2.22)	(-1.68)
$CostShock_t^-$	-0.0444***	-0.0356***	-0.00687
	(-5.24)	(-3.86)	(-0.48)
$CostShock_t^- \times FC_t$	0.0680***	0.0621***	0.0469*
	(4.25)	(3.63)	(1.78)
Other Controls	Yes	Yes	Yes
Observations	85429	46541	49022
$Adj.R^2$	0.119	0.130	0.134

Table IA.5 Cash Holding and Inventory Behavior

This table presents the results exploring variations of industry cash holding on the asymmetric response of inventory growth to cost shocks using the real data. All variables are defined in Appendix B. Observations are at annual frequency. For each year, we define the Lcash dummy in two ways to capture the observations with low cash holdings. In Column (1), we obtain the median cash holding of all unconstrained (constrained) firms within the industry and use its time-series distribution to determine the high industry cash vs low industry cash years. *Lcash* is a dummy that equals to 1 if the industry median cash holding-to-capital ratio is below the median of the time-series distribution, and 0 otherwise. In Column (2), we obtain the median cash holding of all firms within the industry-year and use its cross-sectional distribution in each year to determine the high cash vs low cash industries. *Lcash* is a dummy that equals to 1 if the industry median cash holding-to-capital ratio is below the median of the cross-sectional distribution, and 0 otherwise. We include *Lcash* and its interactions with all the other variables to the specifications in Table 6. Cost shock is measured by the negative percentage change in Chain-Type Price Indexes for intermediate input by industry provided by the Bureau of Economic Analysis. The dependent variable is N_Growth. We report the results when total assets are used to classify the financial constrained firms. The regressions are estimated with firm-fixed effects and year-fixed effects. t-statistics in parentheses are adjusted using the Huber-White estimator allowing within firm clusters to avoid potential heteroskedasticity and serial correlation. Coefficients significant at the 10%, 5%, and 1% levels are marked with *, **, and ***, respectively.

	(1) N_Growth_t	(2) N_Growth_t
$CostShock_t^+$	0.0319***	0.0266**
	(2.88)	(2.39)
$CostShock_t^+ \times FC_t$	-0.0616***	-0.0701***
	(-2.88)	(-3.26)
$CostShock_t^-$	-0.0459***	-0.0576***
	(-4.63)	(-5.14)
$CostShock_t^- \times Lcash_t$	0.00679	0.0228*
	(0.56)	(1.95)
$CostShock_t^- \times FC_t$	0.0491***	0.0379*
	(2.81)	(1.71)
$CostShock_t^- \times FC_t \times Lcash_t$	0.0544*	0.0586**
	(1.89)	(2.02)
Other Controls	Yes	Yes
Observations	75,219	76,125
$Adj.R^2$	0.118	0.117

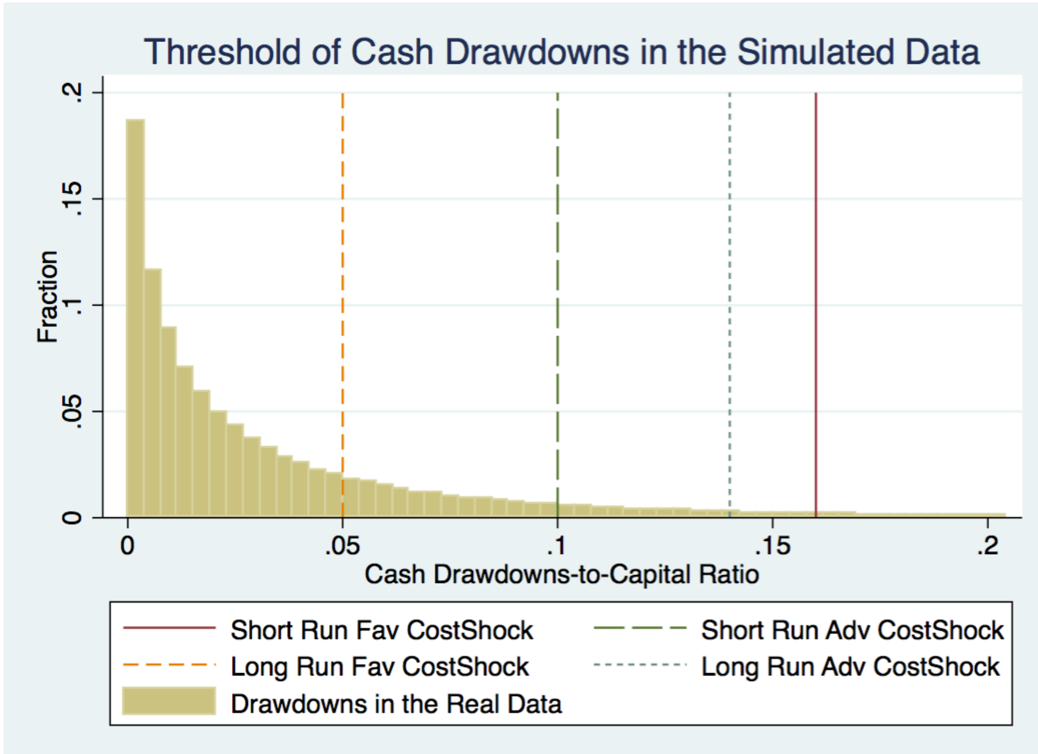

Figure IA.1. Threshold of Cash Drawdowns in the Simulated Data This figure plots the threshold of cash drawdowns financial constrained firms needed in the model in order for our results on the simulated data to disappear. Cash Drawdowns are modeled as negative dividend scaled by lagged capital. We multiply the number by -1 in order to reflect that it is an inflow to the firm when positive. To generate the simulated data allowing for cash drawdowns, we decrease the bound of financial constraints from zero and solve the model. We perform our baseline test on the newly simulated panel. The thresholds are therefore the bound of negative dividend (scaled by lagged capital) allowed for financial constrained firms at which our results become insignificant. We plot the threshold for the asymmetric response and dynamic adjustment against the histogram of actual cash drawdowns in the real data, which is the negative change of cash holdings (opposite to saving). We also multiply the number by -1 in order to compare with the drawdowns.

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