The Finance Uncertainty Multiplier

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Working Paper December 2017

Presenter

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Introduction

- Why are uncertainty shocks in some period (like 2008 crisis) drops in output, while in other periods (Brexit and Trump election) are accompanied by steady economic growth?

- Uncertainty shocks and Financial shocks are highly correlated. Are these the same shock? Do financial friction amplify impact of uncertainty shock?

Introduction

Key Results

1. Finance uncertainty multiplier
   Roughly doubles negative impact of Uncertainty

2. Uncertainty shocks and financial shocks are additive

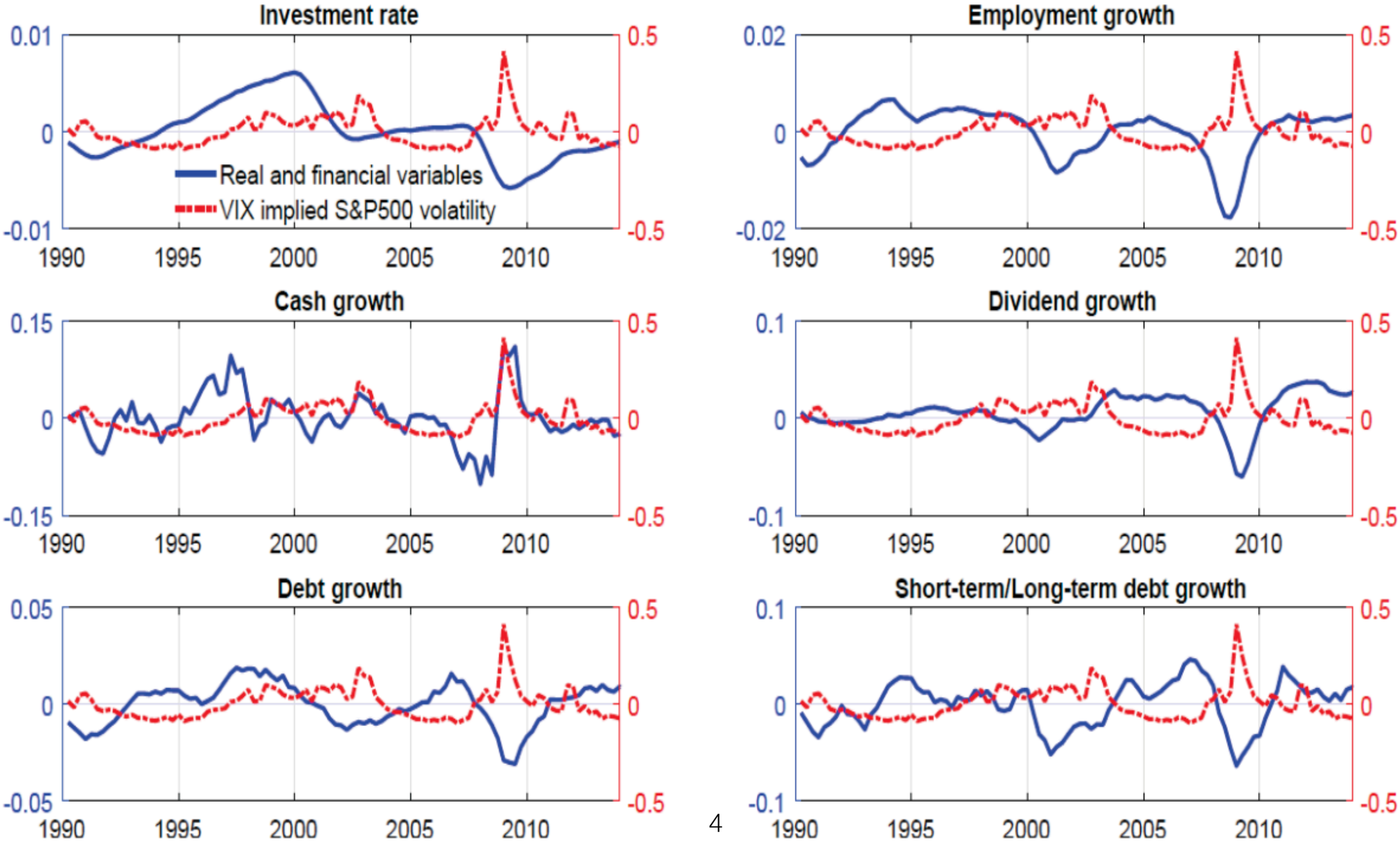
Table 1
Key results in simulation

	Uncertainty shock	Uncertainty + financial shocks
Real frictions	1.3%	n/a
Real+financial frictions	2.4%	4.0%

Introduction

Key Results

Figure 1: Uncertainty, real outcomes and financial flows



Model

Technology

Prodcution

$$Y_t = \widetilde{Z}_t K_t^{\alpha} L_t^{1-\alpha},$$

Revenue Function

$$S\left(Z_t, K_t, L_t\right) = Z_t^{1-a-b} K_t^a L_t^b.$$

Demand

$$Q_t = B P_t^{-\varepsilon},$$

Model

Technology

Productivity->AR(1)

$$z_{t+1} = \rho_z z_t + \sigma_t \varepsilon^z_{t+1}$$

Stochastic volatility process

$$\sigma_t \in \{\sigma_L, \sigma_H\}, \text{where } \Pr(\sigma_{t+1} = \sigma_j | \sigma_t = \sigma_k) = \pi^{\sigma}_{k,}$$

Capital Accumulation

$$K_{t+1} = (1-\delta)K_t + I_t,$$

Nonconvex adjustment cost

$$G_t = c_k S_t \mathbf{1}_{\{I_t \neq 0\}},$$

Operating Profit

$$\Pi_t = S_t - \bar{W} L_t - F.$$

Model

Cash holding and External Financing cost

Cash accumulation

$$N_{t+1} = (1 + r_n)\, N_t + H_t,$$

Payout

$$E_t = \Pi_t - I_t - H_t - G_t.$$

Financing Cost

$$\Psi_t = \phi\left(\eta_t, \sigma_t\right) S_t \mathbf{1}_{\{E_t < 0\}}.$$

Model

Firm's Problem

$$V_t = \max_{I_t, L_t, K_{t+1}, N_{t+1}} \left[E_t - \Psi_t + \beta \mathbb{E}_t V_{t+1} \right],$$

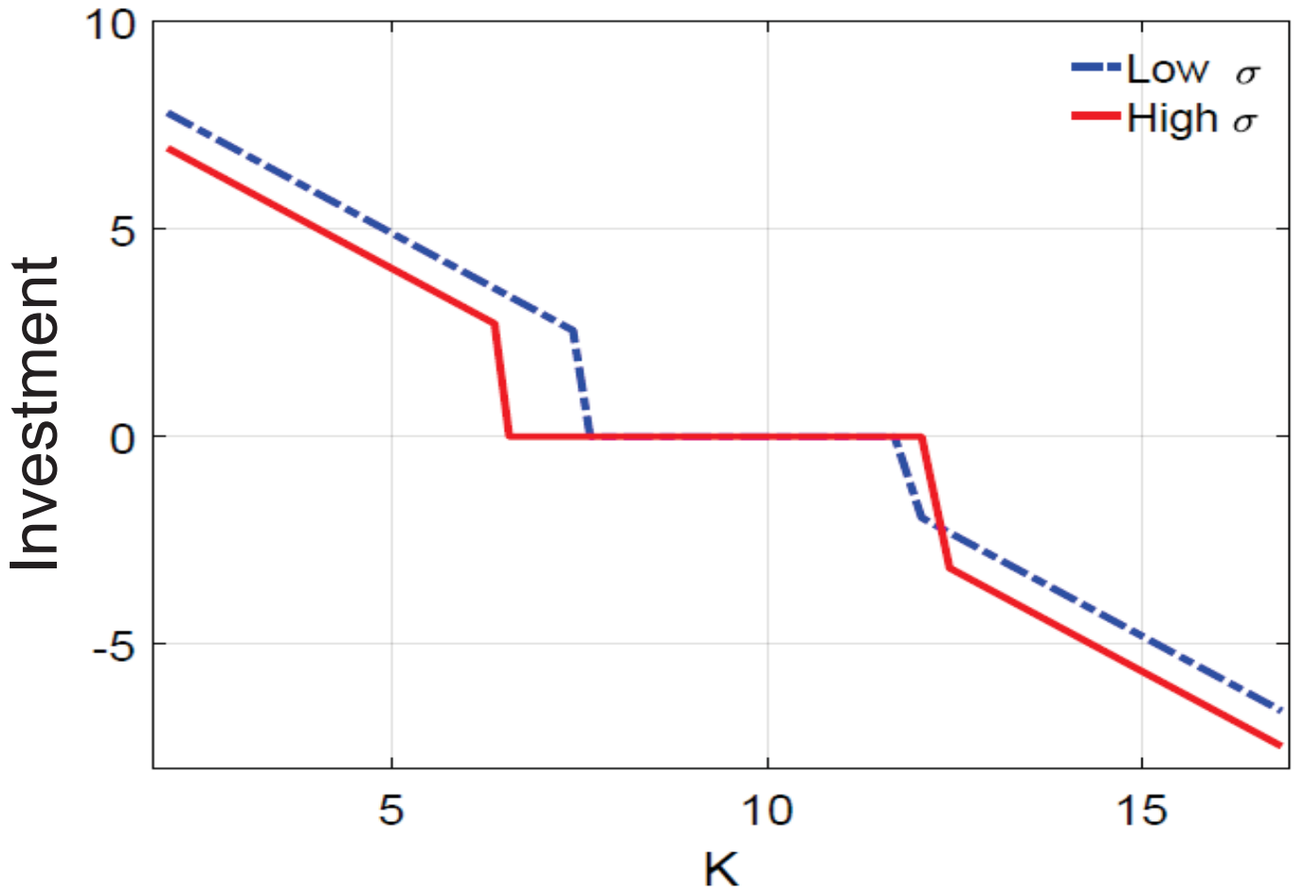
Calibration

Table 3
Parameter values under benchmark calibration

Description	Notation	Value	Justification
Technology			
Subjective discount factor	β	0.988	Long-run average of U.S. firm-level discount rate
Return on saving	r_n	0.01	80% of the risk-free rate (the cash to asset ratio for cash holding firms)
Share on capital	α	0.33	Capital share in output is one-third, labor share is two-thirds
Markup	ε	4	33% markup. With constant returns to scale yields a + b = 075
Wage	$\bar{w}$	1	Wage rate normalized to 1
Rate of depreciation for capital	δ	0.03	Capital depreciation rate assumed 3% per month
Fixed cost of investment	c_k	0.01	1% of quarterly output (We also show robustness with 2%, 4%)
Fixed operating cost	F	0.2	Firms' average SG&A to sales ratio
Uncertainty shock (2 state Markov)			
Conditional volatility of productivity	σ_L	0.051	Baseline uncertainty (Bloom et al 2016)
Conditional volatility in high uncertainty state	σ_H	0.209	Uncertainty shocks 4.1*baseline uncertainty (Bloom et al 2016)
Transition probability low to high uncertainty	$\pi^{\sigma}_{L,H}$	2.60%	Uncertainty shocks expected every 9.6 years (Bloom et al 2016)
Transition probability remaining in high uncertainty	$\pi^{\sigma}_{H,H}$	94%	Quarterly probability of remaining in high uncertainty (Bloom et al 2016)
Persistence of logged idiosyncratic productivity	ρ_z	0.95	Quarterly persistence of idiosyncratic productivity (Khan & Thomas 2008)
Stochastic financing cost (2 state Markov)			
Low external financing cost state	η_L	0.005	Low financing cost .5% of output (Altinkilic and Hansen 2000)
High external financing cost state	η_H	0.05	High financing cost 5% of output (Altinkilic & Hansen 2000). Also tried 0.025 & 0.1
Transition probability low to high financing cost state	$\pi^{\eta}_{L,H}$	2.60%	Same as uncertainty shock (Also tried 5%)
Transition prob. remaining in high financing cost state	$\pi^{\eta}_{H,H}$	94%	Same as uncertainty shock (Also tried 50%)
Impact of uncertainty on financial cost	λ	0.03	Correlation between the Baa-Aaa spread and VIX

Policy Functions

Figure 2A: Real fixed costs only

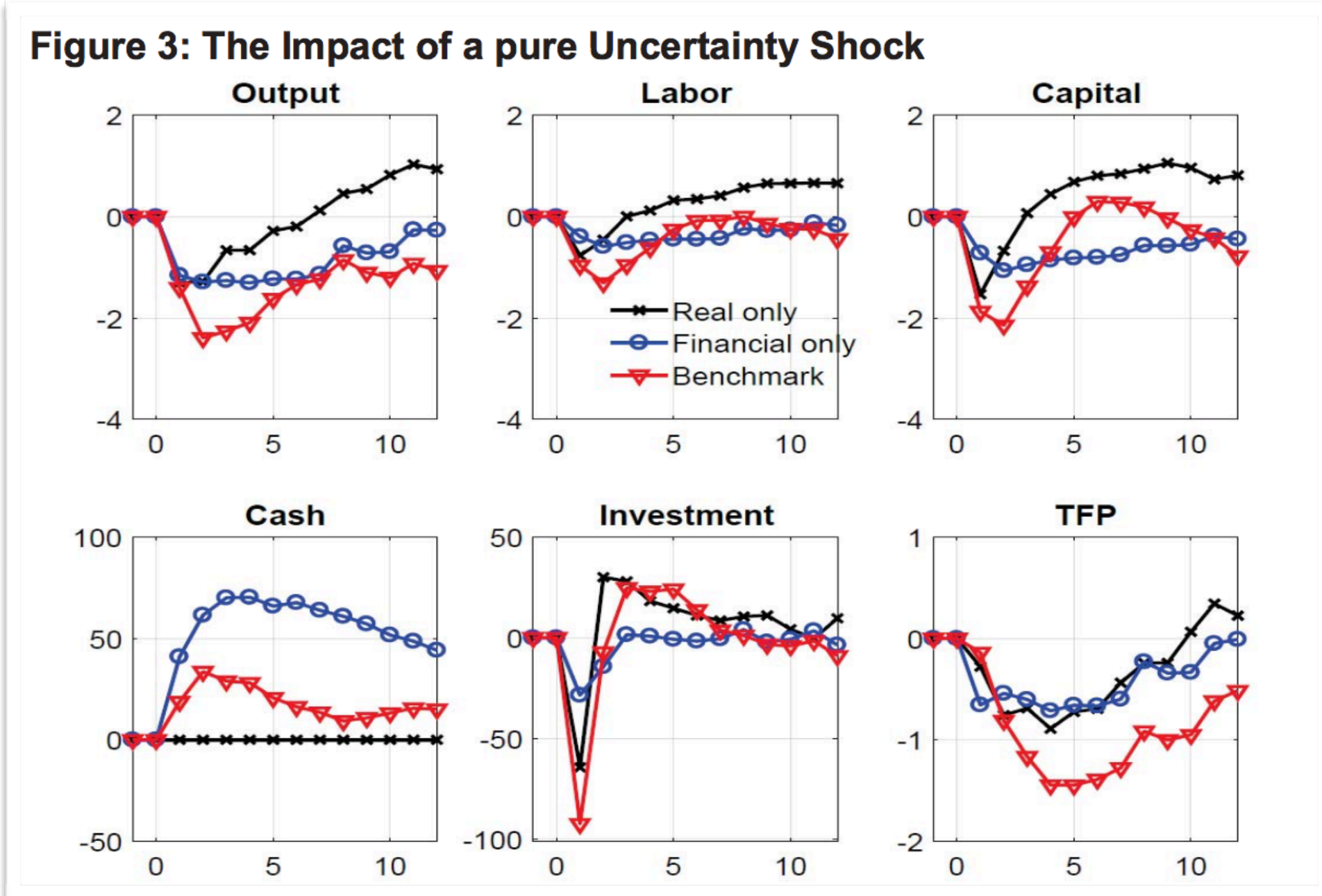


Benchmark Result

Table 4
Coefficient on changes in volatility for real and financial variables.

	Real		**Financial**	
	I/K	dEmp	dCash	dDiv
A: Data				
ΔVolatility	-0.080	-0.068	0.197	-0.522
B: Real frictions				
ΔVolatility	-0.042	-0.014	0.000	-0.031
C: Financial frictions				
ΔVolatility	-0.021	-0.004	1.071	-0.700
D: Real+financial frictions				
ΔVolatility	-0.077	-0.027	0.316	-0.372
E: No frictions				
ΔVolatility	0.003	0.006	0.000	-7.230

Impulse responses



Data

- Stock return from CRSP
- Accounting variable from compustat(Annual Frequency)
- Firm level uncertainty:
  - Realized annual uncertainty
  - Option-implied uncertainty from OptionMetrics

Identification Strategy

- Using Instrument to estimate effect firm's uncertainty on it's activities

- Instrument: Different exposure of aggregate uncertainty shocks(Policy, currency, oil price, treasuries)

    - Estimate sensitivity of each firm(industry) to aggregate shocks.

    - Construct weighted uncertainty from 10 component

Instrument Construction

Estimation of Sensitivities

$$r_{i,t}^{risk\_adj} = \alpha_j + \sum_c \beta_j^c \cdot r_t^c + \epsilon_{i,t}$$

Risk adjusted computation

$$r_{i,t}^{excess} = \alpha_i + \beta_{i,mkt} \cdot MKT_t + \beta_{i,HML} \cdot HML_t + \beta_{i,SMB} \cdot SMB_t + \beta_{i,UMD} \cdot UMD_t + \varepsilon_{i,t}$$

Construction of Instrument

$$|\beta_j^{c,weighted}|.\Delta\sigma_t^c$$

$$\beta_j^{c,weighted} = w_c^j \beta_j^c \qquad \& \qquad w_j^c = \frac{abs(t_j^c)}{\sum_c (t_j^c)}$$

Empirical Finding

- Investment Result
- Intangible Capital Employment and sales
- Financial Variable
- The Finance Uncertainty multiplier

Investment Result

Table 5
Investment rate

Investment rate$_{i,t}$	(1) OLS Realized	(2) IV Realized	(3) IV Realized	(4) OLS Implied	(5) IV Implied	(6) IV Implied
ΔVolatility$_{i,t-1}$	-0.031***	-0.080***	-0.028***	-0.089***	-0.215***	-0.079**
	(-19.896)	(-3.881)	(-2.754)	(-10.520)	(-4.220)	(-2.584)
Book Leverage$_{i,t-1}$			-0.050***			-0.037***
			(-8.444)			(-5.739)
Stock Return$_{i,t-1}$			0.008***			0.005*
			(2.957)			(1.747)
Log Sales$_{i,t-1}$			-0.021***			-0.020***
			(-6.673)			(-5.013)
Return on Assets$_{i,t-1}$			0.129***			0.120***
			(5.188)			(3.710)
Tangibility$_{i,t-1}$			-0.114***			-0.120***
			(-5.953)			(-3.366)
Tobin's Q$_{i,t-1}$			0.050***			0.054***
			(10.013)			(8.330)
1st moment 10IV$_{i,t-1}$	No	No	Yes	No	No	Yes
Firm, time FE	Yes	Yes	Yes	Yes	Yes	Yes
SE cluster(3SIC)	Yes	Yes	Yes	Yes	Yes	Yes
Observations	127,361	28,650	28,326	26,237	17,683	17,487
F 1st st. Cragg-D		166.8	179.2		78.79	60.41
F 1st st. Kleib.-P		19.33	18.02		13.20	11.49
p-val Sargan–H J		0.246	0.873		0.680	0.988

Intangible Capital Employment and sales

Table 7
Additional Real Quantities

	(1) OLS Realized	(2) IV Realized	(3) IV Realized	(4) OLS Implied	(5) IV Implied	(6) IV Implied
A: ΔIntangible Capital Investment$_{i,t}$						
ΔVolatility$_{i,t-1}$	-0.054***	-0.097***	-0.036**	-0.138***	-0.187***	-0.056
	(-10.848)	(-4.134)	(-2.208)	(-9.347)	(-2.869)	(-1.066)
Observations	66,865	17,168	17,013	16,290	10,982	10,887
F 1st st. Cragg-D		109.6	111.9		41.06	38.04
F 1st st. Kleib.-P		15.10	16.33		8.325	10.30
p-val Sargan–H J		0.329	0.416		0.241	0.302
B: ΔEmployment$_{i,t}$						
ΔVolatility$_{i,t-1}$	-0.037***	-0.068***	-0.007	-0.115***	-0.241***	-0.045
	(-11.867)	(-2.657)	(-0.248)	(-10.677)	(-3.429)	(-0.550)
Observations	124,768	28,495	28,158	26,132	17,591	17,396
F 1st st. Cragg-D		165.9	178.1		79.12	60.25
F 1st st. Kleib.-P		18.92	17.59		13.36	11.66
p-val Sargan–H J		0.177	0.586		0.231	0.440
C: ΔCost of Goods Sold$_{i,t}$						
ΔVolatility$_{i,t-1}$	-0.056***	-0.251**	-0.137***	-0.209***	-0.807**	-0.337***
	(-10.376)	(-2.241)	(-3.642)	(-5.642)	(-2.436)	(-3.086)
Observations	128,974	28,720	28,376	26,384	17,710	17,507
F 1st st. Cragg-D		167.6	179.8		78.98	60.42
F 1st st. Kleib.-P		19.24	17.94		13.18	11.50
p-val Sargan–H J		0.170	0.029		0.181	0.023

Financial Variable

Table 8
Financial Outcomes

	(1) OLS Realized	(2) IV Realized	(3) IV Realized	(4) OLS Implied	(5) IV Implied	(6) IV Implied
A: ΔTotal Debt$_{i,t}$						
ΔVolatility$_{i,t-1}$	-0.078***	-0.256***	-0.160**	-0.198***	-0.811***	-0.678***
	(-9.702)	(-3.400)	(-2.382)	(-6.744)	(-5.407)	(-4.217)
Observations	127,911	28,545	28,320	26,198	17,586	17,470
F 1st st. Cragg-D		166.3	179.5		77.67	60.15
F 1st st. Kleib.-P		19.10	17.85		13.14	11.52
p-val Sargan–H J		0.0967	0.334		0.761	0.856
B: ΔPayout$_{i,t}$						
ΔVolatility$_{i,t-1}$	-0.158***	-0.522***	-0.297***	-0.521***	-1.394***	-0.803**
	(-13.318)	(-4.772)	(-2.710)	(-8.548)	(-4.743)	(-2.590)
Observations	129,158	28,738	28,389	26,402	17,715	17,512
F 1st st. Cragg-D		167.6	180		78.97	60.41
F 1st st. Kleib.-P		19.24	17.93		13.17	11.48
p-val Sargan–H J		0.370	0.687		0.988	0.996
C: ΔCash holding$_{i,t}$						
ΔVolatility$_{i,t-1}$	0.032***	0.197***	0.148**	0.115***	0.639***	0.516**
	(3.714)	(2.984)	(2.253)	(3.573)	(3.850)	(2.435)
Observations	128,985	28,721	28,374	26,381	17,709	17,506
F 1st st. Cragg-D		167.6	179.8		78.92	60.38
F 1st st. Kleib.-P		19.25	17.93		13.17	11.50
p-val Sargan–H J		0.664	0.559		0.441	0.511

The Finance Uncertainty Multiplier

- Attempt to tease out **FUM** by running double and triple interaction of uncertainty from financial frictions.

$$I_{i,t}/K_{i,t-1} = \beta_0 + \beta_1 \Delta\sigma_{i,t-1} + \beta_2 D_{crisis\_year,t}$$

$$+\beta_3 D_{crisis\_year,t} \cdot \Delta\sigma_{i,t-1} + \beta_4 D_{fin.constrained,i,t-1} + \beta_5 D_{fin.constrained,i,t-1} \cdot \Delta\sigma_{i,t-1}$$

$$+\beta_6 D_{crisis\_year,t} \cdot D_{fin.constrained,i,t-1} + \beta_7 D_{crisis\_year,t} \cdot D_{fin.constrained,i,t-1} \cdot \Delta\sigma_{i,t-1}$$

The Finance Uncertainty Multiplier

Table 9
Impact of Realized Volatility on Investment for Financially Constrained and Unconstrained Firms during Financial Crisis and non-Crisis Years

Crisis period: Jan-01-2008 to Dec-31-2009	2SLS with full set of controls (1-8)							
Investment Rate$_t$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial Constraint Measure			S&P Ratings	Whited-Wu	Employees	Assets	Age	Size&Age
ΔVolatility$_{i,t-1}$ (Realized)	-0.028***	-0.012	-0.010	-0.025**	-0.026**	-0.022**	-0.021**	-0.017†
$D_{crisis,t}$		-	-	-	-	-	-	-
$D_{crisis,t} \cdot \Delta$Volatility$_{i,t-1}$		-0.087***	-0.070***	-0.063***	-0.068***	-0.102***	-0.059**	-0.092***
$D_{fin\_constrained,i,t-1}$			-0.006*	0.006	0.005	0.002	-	-0.026
$D_{fin_constrained,i,t-1} \cdot \Delta$Volatility$_{i,t-1}$			-0.007	0.020†	0.019	0.017	0.006	0.016
$D_{crisis,t} \cdot D_{fin\_constrained,i,t-1}$			0.003	-0.012*	-0.012*	-0.018***	-0.000	-0.013**
$D_{crisis,t} \cdot D_{fin_constrained,i,t-1} \cdot \Delta$Volatility$_{i,t-1}$			-0.028	-0.047**	-0.053**	-0.039*	-0.021	-0.042*
Observations	28,326	28,326	28,326	21,345	21,203	21,315	22,380	21,353
F-test 1st stage Cragg-D	179.2	80.92	39.33	26.97	33.28	22.34	33.34	25.18
F-test 1st stage Kleib.-P.	18.02	8.550	5.495	4.249	4.793	5.224	4.745	5.810
p-val Sargan–Hansen J	0.873	0.652	0.587	0.530	0.728	0.805	0.944	0.671

Conclusion

- Using a dynamic model with Financial and real friction and shocks delivers three insight:

1. Real and financial frictions doubles impact of uncertainty

2. Combining shock with a financial shock increases the impact of uncertainty

3. Uncertainty not only reduce investment and hiring but also raise firms cash holding.

One More Thing

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