# The Finance Uncertainty Multiplier

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# Outline

# Research Question

## Central Question

How do real and financial frictions **amplify, prolong, and propagate** the negative impact of uncertainty shocks?

- Uncertainty shocks play significant role in economic crises (2008 financial crisis, COVID-19)
- **Empirical challenge**: Identifying causal effects of second-moment shocks
- **Theoretical challenge**: Generating large, persistent responses matching slow recovery

## Key Insight

Financial frictions substantially amplify uncertainty's impact by preventing firms from costlessly buffering shocks via financial channels

# Motivation: Why Study Uncertainty and Finance Together?

**Empirical Evidence:**

- Sharp output drops during recent crises
- Slow recovery after Great Recession
- Correlation between uncertainty (VIX) and real/financial outcomes
- Financial conditions deteriorate during recessions

**Theoretical Gaps:**

- Real-only models: rapid bounce-back, no persistence
- Financial-only models: miss real-option effects
- Need interaction between both frictions
- Propagation to financial variables unexplained

## This Paper's Contribution

Shows that uncertainty shocks and financial shocks should NOT be considered individually, but **jointly** — they amplify each other

# Identification Challenge

## The Endogeneity Problem

- Uncertainty measures (stock volatility) are endogenous
- First-moment effects (downturns) correlated with second-moment effects (uncertainty)
- When commodity prices fall, uncertainty rises simultaneously
- Standard approach (lagged uncertainty) insufficient

## Novel Solution: Differential Exposure Instrumentation

Exploit firms' **differential industry-level exposure** to:

1. Energy price volatility (oil)
2. Exchange rate volatility (7 major currencies)
3. Policy uncertainty (EPU)

# Instrumentation Strategy: Key Intuition

**Example: Oil Price Uncertainty**

| **Firm Type** | **Directional Exposure** (First Moment) | **Uncertainty Exposure** (Second Moment) |
|---|---|---|
| Mining/Oil exploration | Positive (+) | Positive (+) |
| Airlines | Negative (–) | Positive (+) |
| Business services | Zero (0) | Zero (0) |

## Key Separation

Using absolute value of exposures $|\beta_j|$ multiplied by volatility shocks $\Delta\sigma$ allows us to:

- **Control for** oil price level exposure (first moment)
- **Identify from** oil price uncertainty exposure (second moment)

# Construction of Instruments

**Step 1: Estimate Industry-Level Sensitivities**

$$r_{i,t}^{\text{risk-adj}} = \alpha_j + \sum_c \beta_j^c \times r_t^c + \epsilon_{i,t}$$

where $\beta_j^c$ captures industry $j$'s sensitivity to commodity/currency/policy $c$

**Step 2: Construct Nine Instruments**

$$z_{i,t-1}^c = |\beta_{j,t-3}^c| \times \Delta\sigma_{t-1}^c$$

- Absolute value $|\beta|$: nondirectional exposure (second-moment)
- $\Delta\sigma^c$: change in volatility of oil, 7 currencies, policy
- Time lag (3 years): ensures predetermined exposure

# Data and Sample

## Data Sources

- **Stock returns**: CRSP daily data (1965–2019)
- **Accounting data**: Compustat annual (1965–2019)
- **Firm volatility**: 12-month standard deviation of daily returns
- **Option-implied volatility**: OptionMetrics (1996–2019)
- **Main 2SLS sample**: 1993–2019 (56,172 firm-year observations)

## Dependent Variables (Real & Financial)

- **Real**: Investment rate, intangible investment, employment, COGS, sales
- **Financial**: Cash holdings, debt, corporate payout (dividends + repurchases)

# Investment Results: OLS vs. 2SLS

| | OLS Realized | | IV Realized | | IV Implied |
|---|---|---|---|---|---|
| Investment rate$_{i,t}$ | (1) | (2) | (3) | (4) | (5) |
| $\Delta$Volatility$_{i,t-1}$ | $-0.023^{***}$ | $-0.024^{***}$ | $-0.057^{***}$ | $-0.041^{***}$ | $-0.058^{**}$ |
| | (0.002) | (0.002) | (0.014) | (0.014) | (0.022) |
| Firm controls | No | No | No | Yes | Yes |
| IV first-moment controls | No | No | Yes | Yes | Yes |
| Sample period | 1965–2019 | 1993–2019 | 1993–2019 | 1993–2019 | 1998–2019 |
| Observations | 95,394 | 56,172 | 56,172 | 56,172 | 26,977 |
| First-stage F-test | | | 87.22 | 79.68 | 69.91 |

Table: Source: Alfaro, Bloom, and Lin (2024), Table 3

**Key Findings:**

- 2SLS estimates 1.7–2.4$\times$ larger than OLS
- Strong first-stage ($F > 70$)

# Effects on Real and Financial Variables

| | Investment Rate | Intangible Investment | Employment Growth | Sales Growth |
|---|---|---|---|---|
| $\Delta$Volatility$_{i,t-1}$ | $-0.041^{***}$ | $-0.052^{***}$ | $-0.032^{*}$ | $-0.217^{**}$ |
| | (0.014) | (0.016) | (0.016) | (0.082) |
| | Payout Growth | Debt Growth | Cash Growth | |
| $\Delta$Volatility$_{i,t-1}$ | $-0.423^{***}$ | $-0.137^{**}$ | $0.167^{**}$ | |
| | (0.085) | (0.053) | (0.067) | |

## Key Patterns

- **Real variables**: Investment, employment, sales all decline
- **Financial variables**: Firms increase cash, cut debt and payouts
- Consistent with **precautionary savings** channel

# Amplification by Financial Frictions

**Does uncertainty impact vary with financial conditions?**

| Investment rate$_{i,t}$ | Baseline | + Fin Index Interaction | + Firm Constraint | Triple Interaction |
|---|---|---|---|---|
| $\Delta\sigma_{i,t-1}$ | $-0.041^{***}$ | $-0.022^{**}$ | $-0.034^{***}$ | $-0.023^{**}$ |
| | (0.014) | (0.010) | (0.012) | (0.010) |
| $\Delta\sigma_{i,t-1} \times$ Fin_index$_t$ | | $-0.023^{**}$ | | $-0.019^{**}$ |
| | | (0.009) | | (0.008) |
| $\Delta\sigma_{i,t-1} \times D_{i,t-5}^{\text{constrained}}$ | | | $-0.020^{***}$ | 0.002 |
| | | | (0.006) | (0.009) |
| $\Delta\sigma_{i,t-1} \times D_{i,t-5}^{\text{constrained}} \times$ Fin_index$_t$ | | | | $-0.014^{***}$ |
| | | | | (0.005) |

## Amplification Effect

Impact of uncertainty on constrained firms during high financial friction periods:

# Time-Varying Impact: 2008-09 Financial Crisis

**Key Findings from Time-Series Analysis:**

- Mean impact normally around $-1.5$ percentage points
- During 2008–09: impact **tripled** to $-5.0$ percentage points
- Driven by both worsening credit conditions (Aaa-Baa spread) and binding firm constraints
- Explains why uncertainty is so damaging during recessions

# Model Overview

## Key Features

**Dynamic Stochastic General Equilibrium (DSGE) Model with:**

1. Heterogeneous firms
2. **Real frictions**: Fixed capital adjustment costs (Ss bands)
3. **Financial frictions**: Costly external financing, cash management
4. **Uncertainty shocks**: Time-varying volatility (macro & micro)
5. **Financial shocks**: Time-varying financing costs

- Firms maximize equity value by choosing investment and cash holdings
- Production function: $y_{j,t} = X_t z_{j,t} k_{j,t}^{\alpha}$ (decreasing returns)
- Stochastic productivity (aggregate $X_t$ and firm-specific $z_{j,t}$)
- Two-state Markov processes for volatilities and financing costs

# Firm's Problem

**Value function:**

$$v_{j,t} = \max_{i_{j,t}, n_{j,t+1}} \{e_{j,t} - \psi_{j,t} + E_t M_{t,t+1} v_{j,t+1}\}$$

**Key Components:**

- **Payout before financing cost**: $e_{j,t} = y_{j,t} - i_{j,t} - h_{j,t} - g_{j,t}$
- **Real adjustment cost**: $g_{j,t} = c_k y_{j,t} \mathbf{1}_{\{i_{j,t} \neq 0\}}$ (nonconvex)
- **Financial adjustment cost**: $\psi_{j,t} = \eta_t |e_{j,t}| \mathbf{1}_{\{e_{j,t} < 0\}}$ (proportional)
- **Capital accumulation**: $k_{j,t+1} = (1 - \delta) k_{j,t} + i_{j,t}$
- **Cash accumulation**: $n_{j,t+1} = R_n n_{j,t} + h_{j,t}$ (with $R_n < R$)

## Uncertainty Processes

Macro and micro volatilities: $\sigma^X \in \{\sigma_L^X, \sigma_H^X\}$, $\sigma_{j,t}^z \in \{\sigma_L^z, \sigma_H^z\}$

# Policy Functions: Ss Bands and Financial Frictions

**Key Insights from Policy Functions:**

- Classic Ss band behavior: invest/inaction/disinvest regions
- **Financial frictions expand Ss bands** beyond real-only model
- **Uncertainty expands bands further** (real-option + cash-option effects)
- Second flat region appears with financial constraints (binding $E = 0$)
- Triple interaction (high $\sigma$, high $\eta$, high $k$) creates largest inaction region

# Calibration Strategy

**Standard Parameters:**

- Discount factor: $\beta = 0.988$
- Capital share: $\alpha = 0.70$
- Depreciation: $\delta = 0.05$
- Return on cash: $R_n = 0.97R$

**Matched Moments:**

- Investment slope in IV regression
- Cash/revenue ratio
- Real adj. cost: $c_k = 0.03$
- Fin. costs: $\eta_L = 0.03$, $\eta_H = 0.06$

**Uncertainty Calibration (following Bloom et al. 2018):**

- Baseline: $\sigma_L^X = 0.0067$, $\sigma_L^z = 0.051$
- High state: $\sigma_H^X = 1.6 \times \sigma_L^X$, $\sigma_H^z = 4.1 \times \sigma_L^z$
- Transition: $\Pr(L \to H) = 0.026$, $\Pr(H \to H) = 0.943$ (shocks every 9.6 years)

# Main Quantitative Results

| **Model Specification** | **Peak Drop in Output (%)** |
|---|---|
| Real frictions only | $-1.8$ |
| Real + Financial frictions | $-3.9$ |
| **Amplification factor** | **2.17**$\times$ |

Table: Impact of Uncertainty Shocks (Table 1 from paper)

## Three Key Model Predictions

1. **Amplification**: Financial frictions **double** the impact on output
2. **Persistence**: Duration of drops doubles (1 period $\rightarrow$ 2+ periods)
3. **Propagation**: Effects spread to financial variables (cash $\uparrow$, payouts $\downarrow$)

# Impulse Responses: Real vs. Real+Financial Frictions

**Comparing Models:**

- **Real-only (black X)**: Sharp drop, rapid bounce-back, overshooting
- **Real+Financial (red triangle)**: Larger drop, persistent decline, slow recovery
- Financial model matches slow recovery after Great Recession
- TFP drops due to increased misallocation under uncertainty

# Propagation to Financial Variables

**Model with Real Frictions Only:**

- Investment drops, output falls
- Dividends **increase** (pay out profits)
- No cash dynamics

**Model with Real + Financial Frictions:**

- Investment drops, output falls
- **Cash holdings increase** (precautionary savings)
- **Dividends and equity payouts fall**
- **Debt issuance falls**
- Matches empirical evidence in Table 4

## Key Mechanism

Firms build cautionary cash balances after uncertainty shock, limiting internal funds available for investment rebound $\Rightarrow$ **persistence**

# Robustness Checks

**Alternative Specifications Tested:**

- Different transition probabilities for financial shocks
- Model without cash
- Constant vs. proportional financial costs
- Nonconvex financial adjustment costs
- $\pm 10\%$ variations in real and financial adjustment cost parameters

**Conclusion**: Qualitative results robust across specifications

# Policy Implications

## 1. Uncertainty and Finance are Complements, Not Substitutes

- Should NOT view as "uncertainty shocks vs. financial shocks"
- Instead: uncertainty shocks **amplified by** financial conditions
- Policy interventions should target **both** simultaneously

## 2. Financial Interventions Most Effective During High Uncertainty

- Reducing financial frictions (e.g., credit facilities) has largest impact when uncertainty is elevated
- Explains rationale for emergency lending facilities (2008, 2020)
- Even small reductions in financing costs can have large effects

## 3. Timing Matters: Act Early

- Effects are persistent (2+ quarters)

# Recent Applications

**COVID-19 Crisis (2020):**

- Massive uncertainty spike (VIX $> 80$)
- Simultaneous tightening of financial conditions
- Model predicts tripling of impact $\Rightarrow$ justifies aggressive policy response
- PPP loans, Fed facilities targeted at maintaining firm liquidity

**Silicon Valley Bank Collapse (2023):**

- Banking sector shock creates financial friction spike
- Heightened uncertainty about financial stability
- Paper's framework suggests amplified effects on investment
- Supports case for rapid intervention to prevent cascade

# Summary of Contributions

1. **Empirical**: Novel instrumentation strategy addressing endogeneity
   - Differential exposure to energy, currency, policy uncertainty
   - Causal identification of second-moment effects
   - Shows OLS underestimates by factor of 1.7–2.4

2. **Empirical**: Amplification by financial frictions
   - Constrained firms respond 60% more than unconstrained
   - Impact triples during financial crises (2008–09)
   - Effects extend to real **and** financial variables

3. **Theoretical**: DSGE model with real and financial frictions
   - Amplification: doubles impact on output
   - Persistence: doubles duration of drops
   - Propagation: spreads effects to cash, debt, payouts

# Key Takeaways

## Main Result

Financial frictions are a **multiplier** for uncertainty shocks:

- Prevent costless buffering via financial channels
- Create cash-option effects complementing real-option effects
- Generate persistent responses via precautionary savings

## For Policymakers

- Target uncertainty **and** financial conditions jointly
- Financial interventions most effective during high uncertainty periods
- Small reductions in financing costs can have large macroeconomic effects

## For Researchers

# Thank You!

Questions and Discussion

**The Finance Uncertainty Multiplier**
Alfaro, Bloom, and Lin (2024)
*Journal of Political Economy*, Vol. 132, No. 2

Replication code: `https://nbloom.people.stanford.edu/research`

# Appendix: First-Stage Results

**Nine Instruments:**

- Oil price volatility exposure
- 7 major currency volatility exposures (EUR, CAD, JPY, GBP, CHF, AUD, SEK)
- Economic Policy Uncertainty (EPU) exposure

**First-Stage Performance:**

- F-statistics: 70–87 (well above threshold of 10)
- Sargan-Hansen J-test: Cannot reject instrument validity ($p > 0.4$)
- Instruments strong across all specifications

**Controls:**

- 9 aggregate first-moment controls (price levels, not volatility)
- 2 firm-level controls (Tobin's Q, stock returns)
- 4 standard finance controls (tangibility, leverage, ROA, size)
- 8 lagged dependent variables (autocorrelation)

# Appendix: Model Details

**Aggregate Productivity Process:**

$$\log(X_{t+1}) = \log(\bar{X})(1-\rho^X) + \rho^X \log(X_t) + \sigma_t^X \varepsilon_{t+1}^X$$

**Firm Productivity Process:**

$$\log(z_{j,t+1}) = \rho^z \log(z_{j,t}) + \sigma_{j,t}^z \varepsilon_{j,t+1}^z$$

**Stochastic Volatility (Two-State Markov):**

$$\sigma^X \in \{\sigma_L^X, \sigma_H^X\}, \quad \Pr(\sigma_{t+1}^X = \sigma_l^X | \sigma_t^X = \sigma_k^X) = \pi_{k,l}^{\sigma^X}$$
$$\sigma_j^z \in \{\sigma_L^z, \sigma_H^z\}, \quad \Pr(\sigma_{j,t+1}^z = \sigma_l^z | \sigma_{j,t}^z = \sigma_k^z) = \pi_{k,l}^{\sigma^z}$$

**Financing Cost Shocks:**

$$\eta_t \in \{\eta_L, \eta_H\}, \quad \Pr(\eta_{t+1} = \eta_l | \eta_t = \eta_k) = \pi_{k,l}^{\eta}$$