Turbulent Business Cycles

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Highlight

Increases in risk of firms' productivity reshuffle ("turbulence") generate recession through a misallocation channel.

- Turbulence is associated synchronized and persistent declines in aggregate activity
- Turbulence is associated with resource reallocation from high- to low-productivity firms
- Misallocation effect of turbulence is amplified by credit frictions
- A RBC model with hetero. firm and credit friction shows underlying transmission mechanism and quantifies the impact of turbulence shock

What Is Turbulence ?

Turbulence measures time-varying risk of reshuffle in firms' productivity ranking.

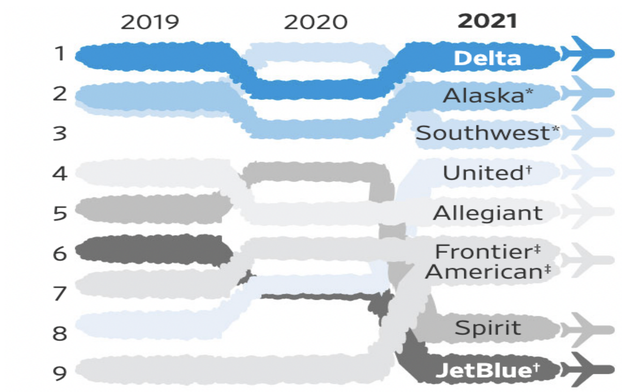

Figure 1:Example: Turbulent Airline Industry

Measuring Turbulence

Turbulence is measured as the (inverse of) Spearman correlations of firms' productivity rankings between adjacent years.

- Consider firm-level TFP process

$$z_{j,t+1} = \begin{cases} z_{j,t} & \text{with prob} \quad \rho_t, \\ \tilde{z} & \text{with prob} \quad 1-\rho_t, \end{cases}$$

where $\tilde{z} \in \{z_1, \ldots, z_J\}$ is i.i.d. drawn from $\tilde{G}(z)$

  - ρ_t does NOT affect cross-section distribution of productivity (z)

- 2 steps to measure turbulence
  1. Estimate firm-level total factor productivity (TFP) of U.S. public firms following Syverson (2004), Bloom et al. (2018) etc.
  2. Sort the firm-level TFP within industry in each year and estimate the Spearman rank correlations between adjacent years (ρ_t).

- Turbulence measured as $1-\rho_t$
  - $1-\rho_t = 0 \Rightarrow$ no turbulence
  - $1-\rho_t = 1 \Rightarrow$ high turbulence
  - $1-\rho_t \uparrow$: more churning in productivity
    $\Rightarrow$ high- prod. firm less likely to remain productive
    $\Rightarrow$ low- prod. firm less likely to remain unproductive

- Turbulence vs. Uncertainty

	Turbulence		Uncertainty	
Firm productivity	(High)	(Low)	(High)	(Low)
Con. Variance	↑	↑	↑	↑
Uncon. Variance	−−	−−	↑	↑
Con. Mean	↓	↑	−−	−−
Uncon. Mean	−−	−−	−−	−−

Turbulence is Counter-cyclical

High prod. firms are less likely to remain productive in recessions.

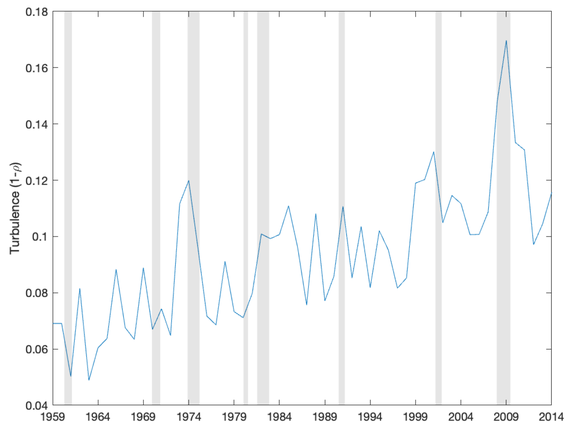

Figure 2:Micro-level Turbulence.(Data: Compustat-NBERCES)

Turbulence Associated with Recession

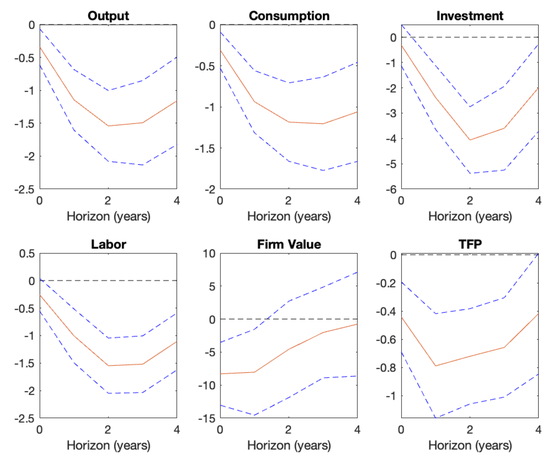

Figure 3:Estimated Response to Turbulence Shock using Local Projection

$$x_{t+h} - x_{t-1} = \beta_0^h + \beta_1^h turb_t + \beta_2^h turb_{t-1} + \beta_3^h Z_{t-1} + \epsilon_{t+h},$$

1. x_t: log level of GDP, C, I, H, firm value, and TFP;
2. $turb_t$: turbulence in log units ($log(1-\rho_t)$);
3. Z_t: vector of controls (Δ GDP, inflation, interest rate)

(Mis-)allocation Effect of Turbulence

Adverse effects of turbulence are stronger on high-productivity firms.

$$x_{jt} = \beta_0 + \beta_1 High\_TFP_{jt} + \underbrace{\beta_2}_{<0^{***}} Turb_t * High\_TFP_{jt} + \mu_j + \eta_t + \epsilon_{jt},$$

1. x_{jt}: YoY growth of employment, capital, value-added, or market value of firm j in year t
2. $High\_TFP_{jt} = 1$ if firm TFP above median
3. $Turb_t$: turbulence measured by $1-\rho_t$
4. μ_j and η_t: firm fixed effects and year fixed effects

Credit Friction → Reallocation Effect

Misallocation effects of turbulence are stronger in industries with higher external finance dependence.

$$x_{it} = \beta_0 + \beta_1 High\_FF_{it} + \underbrace{\beta_2}_{<0^{***}} Turb_t * High\_FF_{it} + \mu_i + \eta_t + \epsilon_{it},$$

1. x_{it}: IQR of employment (or capital) in industry i and year t;
2. $High\_FF_{it} = 1$ iff industry's external financing dependence (KZ index) above median
3. μ_i and η_t: industry and year fixed effects

RBC Model w. Turbulence Shock

Intuition is simple ...

- Heterogeneous firms facing idiosyncratic productivity
- Financial frictions: Firms finance working capital against expected equity value (Jermann-Quadrini 2012; Lian-Ma, 2021)
- Misallocation channel of turbulence
  - Turbulence ↑ ⇒ expected value of high-productivity firms ↓
  - Tightened borrowing constraints for high-productivity firms ⇒ reallocation toward low-productivity firms ⇒ TFP ↓ ⇒ recession

Key equations to deliver the intuition...

- Production function

$$y_{jt} = A_t z_{jt} k_{jt}^{\alpha} n_{jt}^{1-\alpha} \tag{1}$$

- Idiosyncratic productivity z_{jt} follows process

$$z_{j,t+1} = \begin{cases} z_{jt} & \text{with prob} \quad \rho_t, \\ \tilde{z} & \text{with prob} \quad 1-\rho_t, \end{cases} \tag{2}$$

where ρ_t is turbulence shock

- Bellman equation:

$$V_t(z_{jt}, \tau_{jt}) = \max_{k_{jt}, n_{jt}} \tau_{jt} A_t z_{jt} k_{jt}^{\alpha} n_{jt}^{1-\alpha} - R_t k_{jt} - W_t n_{jt} + \mathbb{E} M_{t+1} V_{t+1}(z_{jt+1}, \tau_{jt+1})$$

s.t. credit constraint

$$R_t k_{jt} + W_t n_{jt} \leq \theta \mathbb{E} M_{t+1} V_{t+1}(z_{jt+1}, \tau_{jt+1}) \equiv \theta B_{jt} \tag{3}$$

where $\tau_j \sim F(\tau)$: i.i.d. distortion (Hsieh-Klenow 2009; Buera-Shin 2013)

Impact of turbulence shock

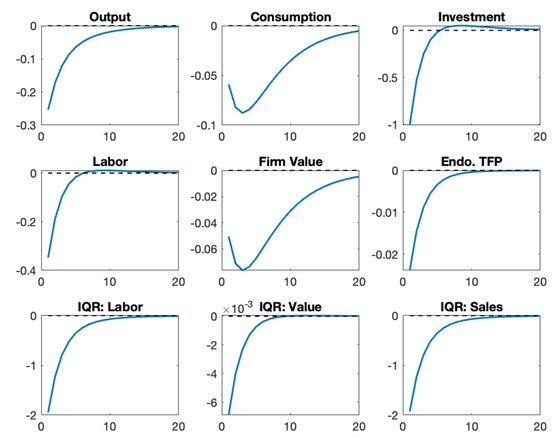

Figure 4:Impulse responses to one std turbulence shock

Credit frictions crucial for amplifying turbulence...

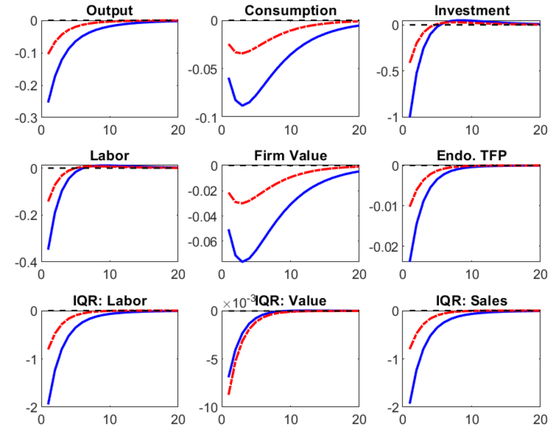

Figure 5:Counterfactual: "Quasi-fixed" borrowing limit (red lines): If borrowing limit is insensitive to firm value, impact of turbulence shock is greatly mitigated.