# Information Frictions and News Media in Global Value Chains

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## Motivation

- In global value chains, firms' decisions depend on conditions of their suppliers and customers
- Abundant empirical evidence: managers not fully aware of global states

**Questions:**

- What are the implications of incomplete information in GVCs?
- Do information frictions disproportionately affect more "open" industries?
- Can *news media* alleviate information frictions, facilitate shock transmission?

This paper: theory, data, quantification of imperfect information in GVCs

## This Paper: Theory

- Framework: economy with global production network and incomplete information
  - agents receive noisy private and public signals about global sectoral productivities
  - noises in public signals — non-technology shocks (Angeletos and La'O, 2010)
  - analytical solution with observed IO data as sufficient statistics
- Findings
  - informational frictions dampen the propagation of TFP shocks
  - noise in public signals generate fluctuations and international comovement
  - role of public signals increases in network distance between sectors

# This Paper: Measurement

- Novel data set
  - new panel of sectoral news coverage in top international newspapers
  - multi-country survey data on economic activity forecasts
  - new quarterly sector-level panel on hours and industrial production
- Findings
  - news coverage correlated with size and GVC participation, but only weakly
  - forecast error and dispersion decrease with news coverage
  - bilateral comovement increases in news coverage, more so for more connected sectors

## This Paper: Quantification

- Quantification: calibrate the model with evidence on news/forecast and GVC data
- Macro findings:
  - information frictions greatly dampen the effects of fundamental shocks
  - one fifth of fluctuations in hours are driven by noise shocks
  - interaction between expectations and network: noise shocks are more important for indirect effects
- Micro implications
  - local (sectoral) shock transmission to other country-sectors increases in news coverage

# Framework with Noisy GVCs

## Households

- A world economy with $J$ sectors indexed by $j, i$, $N$ countries indexed by $n, m$
- Each country-sector is populated by a continuum of information islands $\iota$
- Households' problem

$$\max \mathcal{F}_{n,t} - \sum_j \int H_{nj,t}(\iota)^{1+\frac{1}{\psi}} d\iota$$

subject to

$$P_{n,t}\mathcal{F}_{n,t} = \sum_j \int W_{nj,t}(\iota) H_{nj,t}(\iota) d\iota + \sum_j R_{nj,t} K_{nj}$$

  - fixed capital stock
  - sector-specific labor supply
  - composite of final goods: $\mathcal{F}_{n,t} = \prod_{m,j} \mathcal{F}_{mj,n,t}^{\pi_{mj,n}}$

## Production

- Production function for firm in country-sector $(n, j)$

$$Y_{nj,t} = \exp(z_{nj,t}) \left( K_{nj}^{1-\alpha_j} H_{nj,t}^{\alpha_j} \right)^{\eta_j} \left( \prod_{m,i} X_{mi,nj,t}^{\omega_{mi,nj}} \right)^{1-\eta_j}$$

  - fundamentals: TFP shock $z_{nj,t}$

- Two stages
  - stage 1: local labor markets clear at each island based on incomplete information
  - stage 2: firms choose intermediate inputs observing all market prices

## Stage 2

- The firm's problem is

$$\Omega_{nj,t}(H_{nj,t}) = \max_{X_{mi,nj,t}} P_{nj,t} \exp(z_{nj,t}) \left(K_{nj}^{1-\alpha_j} H_{nj,t}^{\alpha_j}\right)^{\eta_j} \left(\prod_{m,i} X_{mi,nj,t}^{\omega_{mi,nj}}\right)^{1-\eta_j} - \sum_{m,i} P_{mi,t} X_{mi,nj,t}$$

- Goods market clearing condition requires

$$P_{nj,t} Y_{nj,t} = \sum_{m} P_{m,t} \mathcal{F}_{m,t}\ \pi_{nj,m} + \sum_{m,i} (1-\eta_i) P_{mi,t} Y_{mi,t}\ \omega_{nj,mi}$$

## Stage 1: Information Island $(n, j, \iota)$

- Firms and workers make hiring and labor supply decisions based on local information $\mathcal{I}_{n,j,\iota,t}$
- Combining local labor demand and supply

$$\ln H_{nj,t}(\iota) = \left(1 + \frac{1}{\psi} - \alpha_j\right)^{-1} \mathbb{E}\left[\frac{1}{\eta_j} z_{nj,t} \middle| \mathcal{I}_{n,j,\iota,t}\right] + \left(1 + \frac{1}{\psi} - \alpha_j\right)^{-1} \mathbb{E}\Bigg[\underbrace{\frac{1}{\eta_j} \ln P_{nj,t}}_{\text{own price}} + \underbrace{\left(1 - \frac{1}{\eta_j}\right) \sum_{m,i} \pi^x_{mi,nj} \ln P_{mi,t}}_{\text{intermeidate goods price}} - \underbrace{\sum_{m,i} \pi^f_{mi,n} \ln P_{mi,t}}_{\text{final goods price}} \Bigg| \mathcal{I}_{n,j,\iota,t}\Bigg]$$

- Prices are functions of global hours $\{H_{nj,t}\}$ and productivities $\{z_{nj,t}\}$

## Network Game

- Sectoral labor in stage 1 can be represented as a beauty-contest game

$$\ln \mathbf{H}_t = \boldsymbol{\varphi}\, \overline{\mathbb{E}}_t[\boldsymbol{z}_t] + \boldsymbol{\gamma}\, \overline{\mathbb{E}}_t\left[\ln \mathbf{H}_t\right]$$

  - dependence on exogenous fundamental

$$\boldsymbol{\varphi} = \left(\frac{1+\psi}{\psi}\mathbf{I} - \boldsymbol{\alpha}\right)^{-1} \mathbf{M}$$

  - dependence on decisions of other sectors in global value chains

$$\boldsymbol{\gamma} = \left(\frac{1+\psi}{\psi}\mathbf{I} - \boldsymbol{\alpha}\right)^{-1} (\mathbf{M}\boldsymbol{\eta} - \mathbf{I})\, \boldsymbol{\alpha}$$

  - required knowledge about network encoded in $\mathbf{M}$

$$\mathbf{M} = \boldsymbol{\pi}(\mathbf{I} - (\mathbf{I} - \boldsymbol{\eta})\boldsymbol{\omega})^{-1}$$

## Incomplete Information Economy

In each information island $(n, j, \iota)$, agents receive two sets of signals

1. Private noisy signal about other sectors' fundamental

$$x_{nj,mi,t}(\iota) = z_{mi,t} + u_{nj,mi,t}(\iota), \qquad u_{nj,mi,t}(\iota) \sim N(0, \tau_{nj,mi}^{-1})$$

2. Public news about other sectors' fundamental

$$s_{mi,t} = z_{mi,t} + \epsilon_{mi,t}, \qquad \epsilon_{mi,t} \sim N(0, \kappa_{mi}^{-1})$$

   - the precision will be connected with news coverage intensity
   - idea – signals about sectors with higher news coverage more precise

## Higher-Order Expectations

- Consider the response of hours in sector $(n, j)$ to a TFP shock in sector $(m, i)$

$$\ln H_{nj,t} = \varphi_{nj,mi}\overline{\mathbb{E}}_{nj,t}[z_{mi,t}] + \sum_{k,\ell} \boldsymbol{\gamma}_{nj,k\ell}\ \varphi_{k\ell,mi}\ \overline{\mathbb{E}}_{nj,t}\left[\overline{\mathbb{E}}_{k\ell,t}[z_{mi,t}]\right] + \cdots$$

- Equilibrium outcomes depend on interactions between higher-order expectations and network

$$\ln \mathbf{H}_t = \boldsymbol{\varphi}\overline{\mathbb{E}}_t[\boldsymbol{z}_t] + \boldsymbol{\gamma}\boldsymbol{\varphi}\overline{\mathbb{E}}_t^2[\boldsymbol{z}_t] + \boldsymbol{\gamma}^2\boldsymbol{\varphi}\overline{\mathbb{E}}_t^3[\boldsymbol{z}_t] + \ldots$$

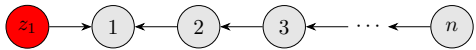
  - direct effects are arrested by first-order uncertainty
  - indirect effects are arrested by higher-order uncertainty, more influenced by news

- Frictionless solution:

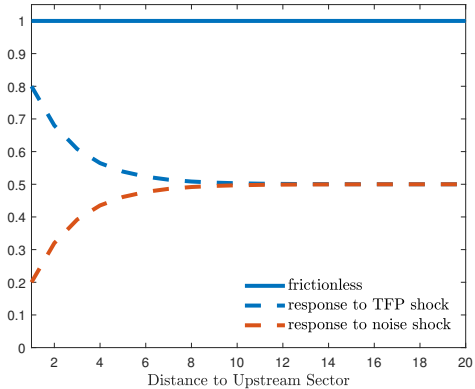
$$\ln \mathbf{H}_t = \boldsymbol{\varphi}\boldsymbol{z}_t + \boldsymbol{\gamma}\boldsymbol{\varphi}\boldsymbol{z}_t + \boldsymbol{\gamma}^2\boldsymbol{\varphi}\boldsymbol{z}_t + \ldots = (\mathbf{I} - \boldsymbol{\gamma})^{-1}\boldsymbol{\varphi}\ \boldsymbol{z}_t$$

# Vertical Network Example

- Stylized "snake" network




- Transmission of TFP and noise shocks – perfect vs imperfect information



# Calibration and Data/Empirics

# Calibration

| Param. | Value | Source | Related to |
|---|---|---|---|
| **Fundamental Economy Parameters** | | | |
| $\psi$ | 2 | | Frisch elasticity |
| $\alpha_j$ | [.38, .69] | KLEMS 2019 | labor and capital shares |
| $\eta_j$ | [.33, .65] | KLEMS 2019 | intermediate input shares |
| $\pi_{mi,n}$ | | WIOD 2016 | final use trade shares |
| $\omega_{mi,nj}$ | | WIOD 2016 | intermediate use trade shares |
| **Information Friction Parameters** | | | |
| $\tau_{nj,mi}$ | ? | | private signal precisions |
| $\kappa_{nj}$ | ? | | public signal precisions |

# International News Coverage: New Data

- Economic news coverage by country×sector in G7 + Spain newspapers
  - Approach: manual collection of frequency of news coverage
  - newspapers: WSJ, FT, NYT, USA Today, FT, Shimbun, etc
    - Factiva tags for each "economic" news article
    - count number of country×sector tags in a newspaper-quarter
    - limitation: no information on content of news article, only frequencies
    - Product: quarterly panel of coverage intensity, 1995-2020, 11 newspapers

▸ What in the news

- Data patterns
  - news coverage variation is cross-sectional: $R^2$ is 0.75-0.88
  - most variation unexplained by size/network position/volatility: max $R^2$ around 0.35-0.4
- Real data: new dataset of quarterly sectoral hours and IP
  - harmonized data from national statistical agencies, 23 sectors, 8 countries, unbalanced panel

## News Coverage and Forecasts

- Do higher news coverage frequencies reduce forecast error and dispersion?

$$\left|\text{forecast error}\right|_{f,n,t} = \beta_0 + \beta_1 \log F_{n,t} + \delta_{f,n} + \delta_t + \epsilon_{f,n,t}$$

$$SD\left(\left|\text{forecast error}\right|_{f,n,t}\right)_{n,t} = \beta_0 + \beta_1 \log F_{n,t} + \delta_n + \delta_t + \varepsilon_{n,t}$$

  - individual forecaster $f$, forecast GDP/unemployment of county $n$
  - $\log F_{n,t}$: log news frequency share of country $n$
  - data from Consensus Forecasts – individual forecasters, unbalanced panel

- Finding: Individual forecast error and forecast dispersion both decrease in news coverage frequencies
  - For calibration: precision of news signal increases in news coverage

| | Panel A: nowcast errors | | Panel B: nowcast errors (IV residuals) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Dep. Var | \|forecast error\| | SD (\|forecast error\|) | \|forecast error\| | SD (\|forecast error\|) |
| $\log F_{n,t}$ | -0.0817*** | -0.0295*** | -0.0873*** | -0.0301*** |
| | (0.0099) | (0.0107) | (0.0100) | (0.0108) |
| Observations | 18,582 | 800 | 18,517 | 796 |
| $R^2$ | 0.379 | 0.706 | | |
| Time FE | yes | yes | yes | yes |
| Country-forecaster FE | yes | | yes | |
| Country FE | | yes | | yes |
| Instrument | | | yes | yes |

- IV-residuals –$\log F_{n,t}$ regressed on non-linear function of productivity growth
- 1 SD increase in news coverage 0.16 (0.22) SD decrease in nowcast (forecast) errors
- 1 SD increase in news coverage 0.24 (0.36) SD decrease in nowcast (forecast) dispersion

▸ Unemployment ▸ Forecasts

## Internally Calibrated Parameters

- Assumptions on information structure
  - perfectly observe own sector's TFP
  - private signal precision about other sectors: $\tau$
  - public signal precision: $\kappa_{nj} = \chi_0 + \chi_1 F_{nj}$

- Strategy to pin down $\tau$, $\chi_0$, $\chi_1$: run forecast error and dispersion regressions inside the model

$$\left|\text{forecast error}\right|_{f,n,t} = \beta_{01}^M + \beta_1^M \log F_{n,t} + \delta_n + \varepsilon_{nt}$$
$$SD\left(\left|\text{forecast error}\right|_{f,n,t}\right)_{n,t} = \beta_{02}^M + \beta_2^M \log F_{n,t} + \delta_n + \varepsilon_{nt},$$

  - together with unconditional dispersion of forecast error

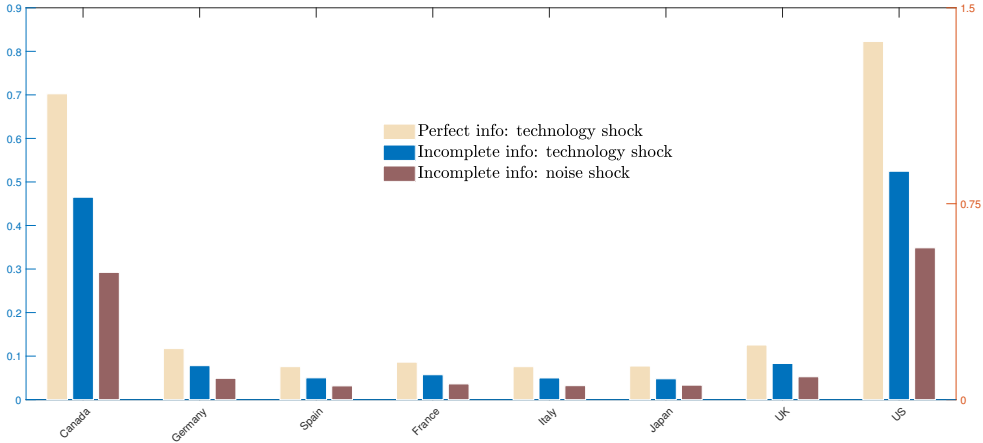
## Internally Calibrated Parameters

| **Indirect inference** | | | | |
|---|---|---|---|---|
| | Data | | Model | |
| | (1) | (2) | (1) | (2) |
| Dep. Var | $\lvert FE \rvert$ | SD $(\lvert FE \rvert)$ | $\lvert FE \rvert$ | SD $(\lvert FE \rvert)$ |
| $\log F_{n,t}$ | -0.0817*** | -0.0295*** | -0.0730*** | -0.0270*** |
| | (0.0099) | (0.0107) | (0.0044) | (0.0019) |
| Observations | 18,582 | 800 | 816 | 816 |
| $R$-squared | 0.379 | 0.706 | 0.668 | 0.543 |
| Time FE | yes | yes | | |
| Country-forecaster FE | yes | | | |
| Country FE | | yes | yes | yes |
| **Unconditional moment** | | | | |
| SD $(\lvert$forecast error$\rvert)$ | | 0.077 | | 0.080 |

- $\tau = 0.11$, $\chi_0 = 0.22$ and $\chi_1 = 1.45$

# Quantification

# Impulse Responses to U.S. Shocks



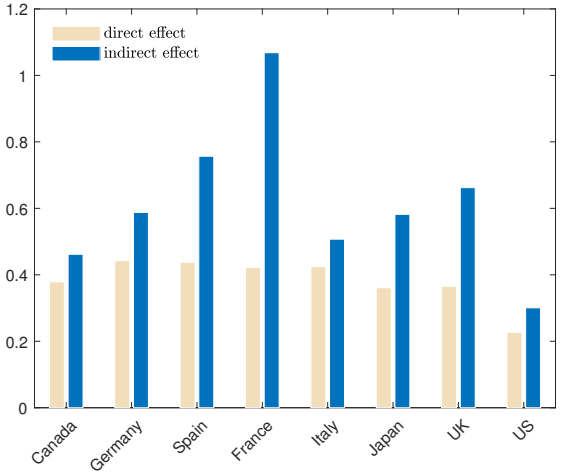

- Heterogeneous responses across locations
- TFP: Dampened response with informational friction

## Business Cycle Statistics

| | (1) Perfect Information | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | | Incomplete Information | | | Data |
| | TFP | TFP | Noise | Total | |
| **Bilateral hours correlation** | | | | | |
| Uncorrelated noise | 0.094 | 0.113 | 0.054 | 0.096 | 0.187 |
| Correlated noise ($\rho = 0.024$) | 0.094 | 0.113 | 0.329 | 0.187 | |
| **Bilateral labor wedge correlation** | | | | | |
| Uncorrelated noise | — | 0.056 | 0.024 | 0.049 | |
| Correlated noise | — | 0.056 | 0.268 | 0.118 | |

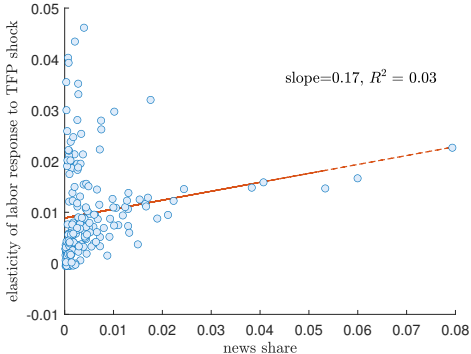
- Small correlation in noise shocks matches data hours comovement
- Hours volatility $\approx \frac{1}{2}$ of perfect information model

# Importance of Noise Shocks: Direct vs. Indirect Effects

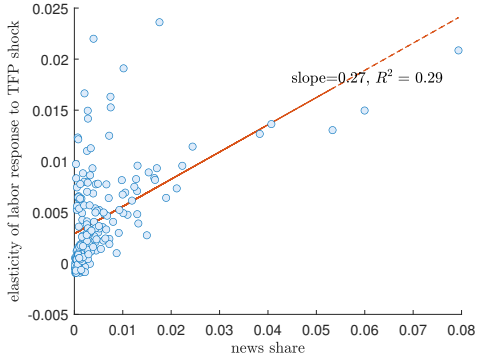



- $\frac{\mathbb{V}(\text{noise-driven fluctuations})}{\mathbb{V}(\text{TFP-driven fluctuations})}$ higher for indirect effects

# Role of News Coverage in TFP Shock Transmission



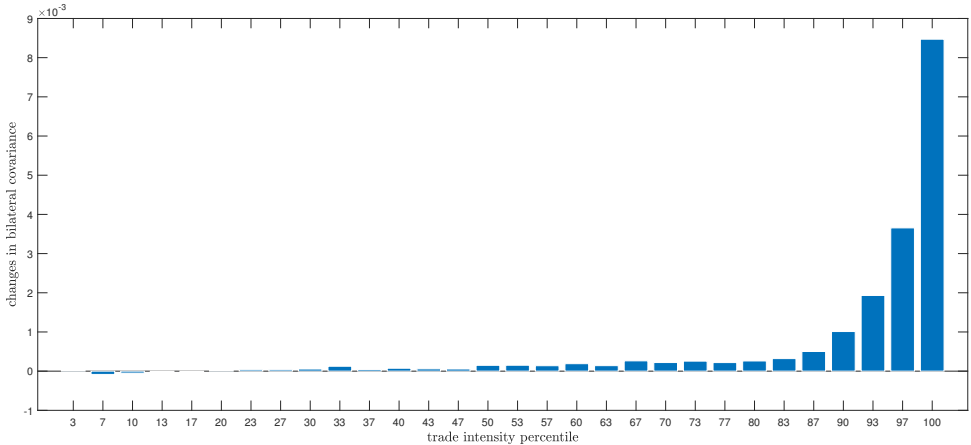

A. Perfect Information Model




B. Incomplete Information Model

- Average elasticity of labor response measures the magnitude of the transmission effect
- Transmission effect is much more correlated with news coverage in noisy information world

# Theoretical Trade-Covariance-News Relationship




- Bilateral covariance increases most for more connected sectors when news coverage increasing
- Trade-comovement-news regressions show similar results with rich fixed effects

## Interaction between News and Network Effects

- Are country-sectors more remote from each other more influenced by noise shocks?
- Test: sector $(n, j)$'s labor response to sector $(m, i)$'s shocks

$$\frac{\mathbb{V}(\text{noise-driven fluctuations})_{nj,mi}}{\mathbb{V}(\text{total fluctuations})_{nj,mi}} = \beta_0 + \underbrace{0.164}_{(0.004)} \, d_{nj,mi} + \delta_{mi} + v_{nj,mi},$$

  - $d_{nj,mi}$ is the ratio of second order effects to first+second order effects
  - $\delta_{mi}$ controls for signal precision for $(m, i)$

# Conclusion

- New theory of information frictions in global value chain framework
  - informational frictions dampen the transmission of TFP shocks
  - public signal shocks: a new source for international fluctuations
  - higher-order expectations matter more for sectors more distant in GVC
- New data set on global news coverage to discipline theory
  - news coverage mitigates information frictions, facilitates transmission of fundamental shocks

| | Panel A: nowcast errors | | Panel B: one-year ahead forecast errors | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Dep. Var | \|forecast error\| | SD (\|forecast error\|) | \|forecast error\| | SD (\|forecast error\|) |
| $\log F_{n,t}$ | -0.0817*** | -0.0295*** | -0.290*** | -0.0609*** |
| | (0.0099) | (0.0107) | (0.0272) | (0.0157) |
| Observations | 18,582 | 800 | 17,338 | 768 |
| $R^2$ | 0.379 | 0.706 | 0.668 | 0.543 |
| Time FE | yes | yes | yes | yes |
| Country-forecaster FE | yes | | yes | |
| Country FE | | yes | | yes |

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# Global News Coverage and Consensus Forecast Errors: Unemployment

| | Panel A: nowcast errors | | Panel B: one-year ahead forecast errors | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Dep. Var | \|forecast error\| | SD (\|forecast error\|) | \|forecast error\| | SD (\|forecast error\|) |
| $\log F_{n,t}$ | -0.1690*** | -0.0069 | -0.2620*** | -0.0054 |
| | (0.0349) | (0.0066) | (0.0327) | (0.0117) |
| Observations | 16,348 | 700 | 15,271 | 672 |
| $R^2$ | 0.111 | 0.642 | 0.233 | 0.567 |
| Time FE | yes | yes | yes | yes |
| Country-forecaster FE | yes | | yes | |
| Country FE | | yes | | yes |

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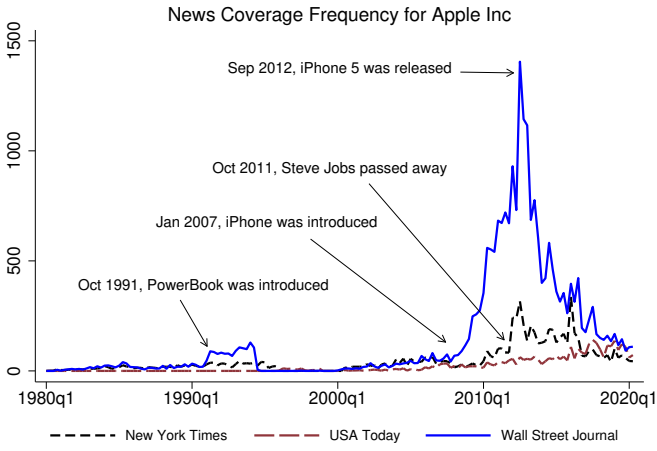
# Company-Specific Figures: Apple

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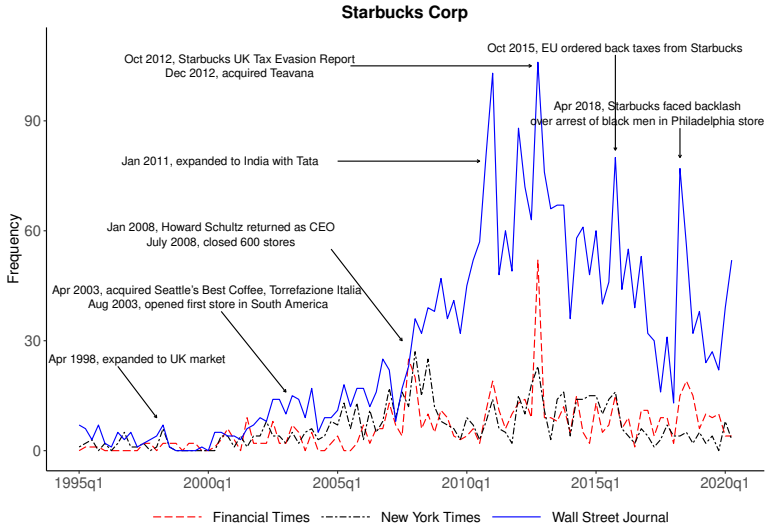
# Company-Specific Figures: JP Morgan Chase



# Company-Specific Figures: Starbucks