The "Just-in-Time" Trade-Off: Micro Stability vs. Macro Resilience

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There Has Been A Lot of Recent Discussion Surrounding Supply Chains

Today's supply chains are too lean

The COVID-19 pandemic has highlighted the dangers of just-in-time principles.

Companies should shift from 'just in time' to 'just in case'

Pandemic has shown that businesses neglected vital safety margins

From just in time to just in case: Covid-19 brings supply chain resilience to the fore

Grocers Stopped Stockpiling Food. Then Came Coronavirus.

Supermarkets once kept months of inventory but drastically cut that to save on costs. Facing a shopper rush, they're now buying all they can get.

Coronavirus pandemic exposes fatal flaws of the 'just-in-time' economy

COVID-19 Has Rewritten Best Practices for Supply Chain

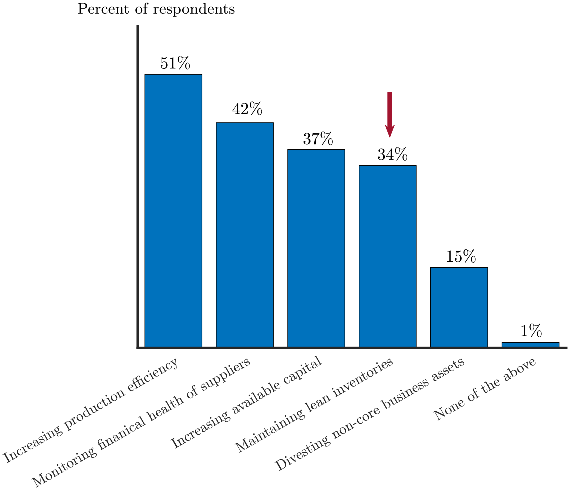
LOGISTICS REPORT

Post-Pandemic Supply Chains Seek 'Resilience,' Report Says

'State of Logistics Report' says 'painful and chaotic' 2020 will likely lead to more stockpiling, shifts in manufacturing

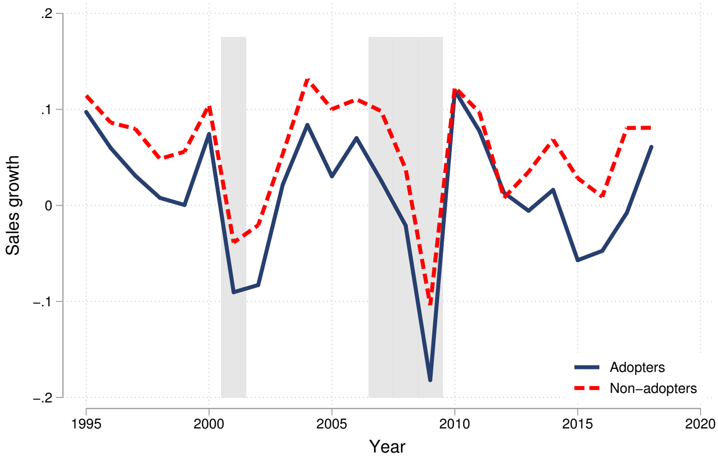
Why Should We Care?

Recession-Proofing Strategies



Note: These results are taken from a Fall 2019 BDO survey of manufacturing CFOs.

Does "Just-in-Time" Production Raise Exposure to Unexpected Shocks?



Note: The figure plots sales growth among identified adopters ("just-in-time" producers) and non-adopters. Source: Compustat, Kinney and Wempe (2002).

I Build A "Just-in-Time" Production Model

Exploit micro data on JIT adoption and US public firms

Less volatility on average, higher profits after adoption, but more sensitivity or comovement with macro fluctuations and disasters.

Build a rich GE model of JIT adoption

Firm inventories to support production in the face of micro productivity shocks, sunk/fixed cost tradeoff with increasing returns to adoption.

Structurally estimate the model

Estimate key parameters governing firm shock processes, inventory costs, etc, allowing for quantitative and counterfactual analysis.

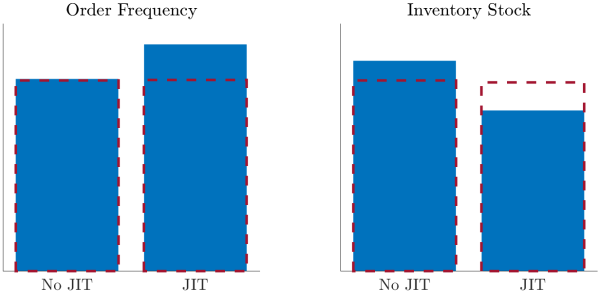
Uncover key tradeoff between micro stability and macro vulnerability

JIT adoption increases firm value by 1.1% and leads to micro smoothing, while increasing exposure to macro shocks by around 2.8%

Background on JIT

Intuition: Inventories as Waste and Buffer

- Firms need materials to produce
- JIT producers enjoy lower ordering costs
  - Less waste:
    adopt $\implies \uparrow$ Pr(order), $\downarrow$ order costs $\implies \uparrow$ profits
  - Smaller buffer:
    adopt+disaster $\implies \downarrow$ Pr(order), $\uparrow$ order costs $\implies \uparrow$ inventories



Literature Review

Inventories and Aggregate Fluctuations

Bils and Kahn (2000), Caplin (1985), Davis and Kahn (2008), Eichenbaum (1984), Iacoviello et. al (2010), Irvine and Schuh (2002), Ramey and Vine (2004), Wang et. al (2011), Wen (2011), Midrigan and Kryvtsov (2012) Khan and Thomas (2007), McCarthy and Zakrajasek (2000), Scarf (1960), Hemapriya and Uthayakumar (2016), Ni (2020), Holt et al. (1960), Popkin (1965), Kahn (2008), Christiano (1988), Zakrajsek (1997), Blinder and Maccini (1991)

Micro and Macro Moderation

Ahmed et al (2002), Bloom et al (2017), Decker et al (2016), McConnell and Perez-Quiros (2000), Davis and Kahn (2008), Davis et al. (2007), Comin and Philippon (2005), Morley and Singh (2016), Gao(2017), Gali (2009), Benati and Surico (2009), Kahn (2008), Camacho et al. (2011), Herrera and Pesavento (2005), Clarida et al. (2000), Clark (2009)

Heterogeneous Firms in GE

Alessandria and Choi (2007), Bachmann and Ma (2012), Khan and Thomas (2003, 2007, 2008, 2013), Terry (2017), Meier (2020), Bachmann et al. (2013), Gourio and Kashyap (2007), Strebulaev and Whited (2012), Bustos (2011), Bachmann and Bayer (2013), Tauchen (1985), Alessandria et al. (2013), Midrigan and Kryvtsov (2012)

Just-in-Time and Supply Chains

Gao (2018), Kinney and Wempe (2002), Fullerton and McWatters (2001), Ahmad et al. (2003), Roumiantsev and Netessine (2008), Fullerton and McWatters (2001), Barrot and Sauvagnat (2016), Chen et al. (2005), Antras and Chor (2012), Boem et al. (2018), Carvalho et al (2016), Westerburg and Bode (2018), Zsidisin et al (2005)

Roadmap

1. **Empirical Evidence of JIT Trade-Off**
2. GE Model with JIT Production
3. Model Results
4. Unexpected Disaster

Data

1. Compustat
   - Panel of 5,299 unique publicly traded manufacturing firms spanning 1980-2019
   - JIT adoption data obtained from Kinney and Wempe (2002)
2. Stock returns
   - CRSP-Compustat
   - Cumulated monthly stock returns
3. Weather disasters
   - National Oceanic and Atmospheric Administration (NOAA)
   - Barrot and Sauvagnat (2016)

Firm-Level Evidence

$$y_{ijt} = \beta \text{adopter}_{ijt} + X'_{ijt}\gamma + \delta_i + \delta_{jt} + \varepsilon_{ijt}$$

	(1)	(2)	(3)
Growth rate	Inventory-sales ratio	Stock Return	Sales
Adopter	-0.064**	0.049*	0.029**
	(0.014)	(0.029)	(0.013)
Firm FE	Y	Y	Y
Industry × Year FE	Y	Y	Y
Controls	Y	Y	Y
Observations	33,783	33,783	33,783

Table : Firm-Level Panel Regressions

Note: The table reports firm-level panel regression results from Compustat Annual Fundamentals of manufacturing firms (NAICS 31-33). The dependent variables are (1) inventory-to-sales growth, (2) stock returns, and (3) sales growth. The regressor of interest is a firm-year specific adoption status indicator. Control variables (not displayed) are log firm size, log firm age, log cash-to-total assets. Industry by year fixed effects and firm fixed effects are also specified. Standard errors are clustered at the firm level. Standard deviation of dependent variables are 0.29, 0.63, and 0.25, respectively. *** denotes 1% significance, ** denotes 5% significance, and * denotes 10% significance. All series are in fractional units, so 0.01=1%

Levels Asset pricing implications

Industry-Level Evidence

1 std increase in change in share of adopters delivers ≈ 0.035-0.055 std decrease in changes to inventory-sales ratio and micro volatility

$$\Delta y_{jt} = \beta(\Delta \text{adoptshare}_{jt}) + \delta_j + \delta_t + \varepsilon_{jt}$$

	(1)	(2)	(3)	(4)
	Δ inventory-sale ratio	Δ iqr(inventory inv rate)	Δ iqr(sales growth)	Δ iqr(emp gwth)
Δ adoptshare	-0.042**	-0.055**	-0.043*	-0.035*
	(0.021)	(0.022)	(0.023)	(0.019)
Industry FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	3,010	3,010	3,010	3,010

Table : Industry-Level Long-Difference Regressions (Five-Year Horizon)

Note: The table reports industry-level panel regression results from Compustat Annual Fundamentals of manufacturing firms (NAICS 31-33). Industries are defined at the 4-digit NAICS-level. The dependent variables are (1) change in inventory-to-sales, (2) change in interquartile range of inventory investment rate, (3) change in interquartile range of sales growth, and (4) change interquartile range of employment growth over a five year horizon. The regressor of interest is the change in share of adopters within a given industry over the same horizon. All variables are standardized. Industry and year fixed effects are also specified. Standard errors are clustered at the industry level. *** denotes 1% significance, ** denotes 5% significance, and * denotes 10% significance. All series are in fractional units, so 0.01=1%

Details on JIT Adopter Data | Dispersion vs. Volatility

JIT Producers Are More Exposed

$$\text{salegwth}_{ijt} = \beta_1 \text{adopter}_{ijt} + \beta_2 \text{GDPgwth}_t + \beta_3(\text{adopter}_{ijt} \times \text{GDPgwth}_t) + X'_{ijt}\gamma + \delta_i + \delta_{jt} + \varepsilon_{ijt}$$

	(1)	(2)	(3)	(4)
	sales growth	sales growth	sales growth	sales growth
Adopter	-0.066***	-0.016**	0.076***	0.004
	(0.009)	(0.007)	(0.009)	(0.005)
GDP growth	1.857***	0.745***	0.760***	
	(0.069)	(0.051)	(0.052)	
Adopter × GDP growth	0.775**	0.732***	0.498**	0.226**
	(0.318)	(0.220)	(0.250)	(0.108)
Controls	N	Y	Y	Y
Firm FE	N	N	Y	Y
Industry FE	N	N	Y	N
Industry × Year FE	N	N	N	Y
Observations	48,806	39,488	38,994	33,783

Table : Firm-Level Exposure Regressions

Note: The table reports firm-level regression results from Compustat Annual Fundamentals of manufacturing firms (NAICS 31-33). The dependent variable is sales growth. The independent variable of interest is the interaction between time-varying indicator of JIT adoption and GDP growth. Control variables include log firm size, log firm age, log cash-to-total assets, inventory investment. Standard errors are clustered at the firm-level. * p<0.10, ** p<0.05, *** p<0.01. All series are in fractional units, so 0.01=1%

Industries with More JIT Are More Exposed

$$\text{salegwth}_{jt} = \beta_1 \text{adoptshare}_{jt} + \beta_2 \text{GDPgwth}_t + \beta_3 (\text{adoptshare}_{jt} \times \text{GDPgwth}_t) + X'_{jt}\gamma + \delta_j + \delta_t + \varepsilon_{jt}$$

	(1)	(2)	(3)	(4)
	sales growth	sales growth	sales growth	sales growth
Adopt share	-0.147**	-0.048	-0.027	0.002
	(0.057)	(0.033)	(0.034)	(0.026)
GDP growth	1.839***	0.329	0.312	
	(0.152)	(0.273)	(0.269)	
Adopt share × GDP growth	3.657**	3.510**	3.790***	2.309***
	(1.667)	(1.335)	(1.318)	(0.812)
Controls	N	Y	Y	Y
Industry FE	N	N	Y	Y
Year FE	N	N	N	Y
Observations	3,938	3,938	3,938	3,938

Table : Industry-Level Exposure Regressions

Notes: The table reports industry-level regression results from Compustat Annual Fundamentals of manufacturing firms (NAICS 31-33). The dependent variable is the averag sales growth across firms in the industry. The independent variable of interest is the interaction between the share of JIT adopters in an industry and GDP growth. Control variables include log of average firm size, log of average firm age, log of average firm cash-assets. In Column (4), GDP growth is subsumed in the fixed effect. Standard errors are clustered at the industry-level. * p<0.10, ** p<0.05, *** p<0.01. All series are in fractional units, so 0.01=1%

Weather Event Regressions

$$\text{salegwth}_{ijt} = \beta_1 \text{adopter}_{ijt} + \beta_2 \text{disaster}_{ijt} + \beta_3[\text{adopter}_{ijt} \times \text{disaster}_{ijt}] + X'_{ijt}\gamma + \delta_i + \delta_{jt} + \varepsilon_{ijt}$$

	Sales growth
Adopter	0.096**
	(0.035)
Weather disaster	-0.035*
	(0.020)
Adopter × Weather disaster	-0.055**
	(0.024)
Industry × Year FE	Y
Firm FE	Y
Controls	Y
Observations	919

Table : Firm-Level Weather Event Regressions

Note: The table reports firm-level panel regression results of Compustat manufacturing firms (NAICS 31-33). The dependent variable is sales growth while the independent variable of interest is the interaction of adoption year with a local weather events hitting suppliers of the firm. Controls include log firm age, size, sales, cash-to-assets, inventory-to-sales, COGS-to-sales, lagged COGS growth, and lagged average sales growth across suppliers. Firm fixed effects and industry by year fixed effects are specified. Standard errors are clustered along the firm and year levels. *** denotes 1% significance, ** denotes 5% significance, and * denotes 10% significance.

Weather Event Regressions

$$\text{salegwth}_{jt} = \beta_1 \text{adoptshare}_{jt} + \beta_2 \sum_i \text{disaster}_{ijt} + \beta_3 \left[\text{adoptshare}_{jt} \times \sum_i \text{disaster}_{ijt} \right] + X'_{ijt}\gamma + \delta_i + \delta_{jt} + \varepsilon_{ijt}$$

	Sales growth
Share of adopters	0.035**
	(0.016)
Sum of disasters	0.0003
	(0.0003)
Share of adopters × Sum of disasters	-0.010**
	(0.004)
Year FE	Y
Industry FE	Y
Controls	Y
Observations	3,764

Table : Industry-Level Weather Event Regressions

Note: The table reports industry-level panel regression results of Compustat manufacturing firms (NAICS 31-33) at the four-digit NAICS level. The dependent variable is sales growth while the independent variable of interest is the interaction of the share of adopters with sum of weather events hitting firms within the industry. Controls include lagged sales growth, cash-to-assets, employment growth, inventory-to-sales, and inventory investment. Industry and year fixed effects are specified. Standard errors are clustered along the industry and year levels. *** denotes 1% significance, ** denotes 5% significance, and * denotes 10% significance.

Roadmap

1. Empirical Evidence of JIT Trade-Off
2. **GE Model with JIT Production**
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GE Heterogeneous Plant Inventory Model

In spirit of Khan and Thomas (2007), Alessandria and Choi (2007)

- Representative household
- Representative intermediate goods firm fulfills orders
  - CRS technology using labor and capital
- Rich final good sector
  - Establishments heterogeneous in productivity (z)
  - DRS technology using labor and materials
  - Option to adopt JIT
    - Adopters face lower order costs
    - Sunk cost of first adopting JIT
    - (Lower) continuation cost of remaining adopter

Representative Household

- Preferences

$$U(C, N^h) = \log(C) + \chi(1 - N^h)$$

- Can work in final goods sector or intermediate goods sector
  - N^h is the sum of total labor across sectors
- Paid wage, w for labor
- Price of final good, p Household optimality implies:

$$p = \frac{1}{C}, \quad w = \frac{\chi}{p}$$

Representative Intermediate Goods Firm

- Produces orders (O) according to

$$O = K^{\alpha} L^{1-\alpha}$$

  where K is capital, L is labor
- q - price of intermediate good
- FOC for inputs yields closed form solution for q

$$q = \left(\frac{1 - \beta(1-\delta)}{\beta\alpha} \right)^{\alpha} \left(\frac{w}{1-\alpha} \right)^{1-\alpha}$$

Final Good Firms

- Heterogeneous in
  - Idiosyncratic productivity
  - Inventory holdings
  - JIT adoption status
- Produce according to

$$y = zn^{\theta_n} m^{\theta_m}, \quad \theta_n + \theta_m < 1$$

  - Labor (n), materials (m)
  - Materials taken from existing inventory stock (s) to use in production
- Orders subject to ordering cost $\xi \sim U[\underline{\xi}, \overline{\xi}]$
  - Plants can adopt JIT production strategy at a sunk cost
  - JIT adopters face lower order cost distribution $\overline{\xi}_A < \overline{\xi}_{NA}$

Timeline of Final Goods Firm Decisions

Periods broken into three stages. Enter period with productivity (z), inventory stock (s), and adoption status (a)

Stage 1

- Decide whether to adopt technology
- All adopters pay c_f
- Non-adopters pay sunk cost $c_s + c_f$

Stage 2

- Order cost ξ realized. Plants decide whether to place order.
- Cost drawn from uniform distribution with upper bound such that $\overline{\xi}_A < \overline{\xi}_{NA}$

Stage 3

- Choose amount of labor and materials to produce final good

Adoption Decision

Stage 1: Idiosyncratic state is (z, s, a). Decide whether to adopt JIT

$$V^A(z,s,a) = \max\left\{ -pwc(a) + \int V(z,s,1)dG(\bar{\xi}_A), \int V(z,s,0)dG(\bar{\xi}_{NA}) \right\}$$

where $c(a) = (1-a)c_s + ac_f$, and a is an indicator for JIT adoption

Order Decision

Stage 2: Decide whether to place order

$$V(z,s,a) = \max \left\{ -pw\xi + pqs + V^{O}(z,s,a), \widetilde{V}(z,s,a) \right\}$$

where

$$V^{O}(z,s,a) = \max_{s^* \geqslant s} \left\{ -pqs^* + \widetilde{V}(z,s^*,a) \right\}$$

Note: inventory can only be adjusted upward (no option to liquidate)
$\Longrightarrow s^*(z,s,a)$

Production Decision

Stage 3: Enter with s or s^* and choose remaining stock, s' to maximize value of production

$$\widetilde{V}(z,s,a) = \max_{s' \in [0,s]} \pi(z,s,s') + \beta \mathbb{E}[V^A(z',s',a')]$$

where

$$\pi(z,s,s') = p[zn(z,s,s')^{\theta_n}(s-s')^{\theta_m} - c_m s' - wn(z,s,s')]$$

- c_m is the cost of storing unused inventory

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External Parameterization

Externally calibrated parameters: $\{\beta, \theta_m, \theta_n, \chi, \delta, \alpha, \underline{\xi}\}$

Description	Parameter	Value	Notes
Discount Factor	β	0.962	Real rate of 4%
Material share	θ_m	0.499	Material share from NBER-CES
Labor share	θ_n	0.260	Labor share as in Khan and Thomas (2013)
Leisure preference	χ	2.150	One third of hours worked
Capital depreciation	δ	0.065	Capital investment rate (NBER-CES)
Capital share	α	0.270	Khan and Thomas (2013)
Order cost lower bound	$\underline{\xi}$	0.000	Khan and Thomas (2007)

Table : Adoption Model Calibration

Note: Annual calibration.

Structural Estimation

Estimate seven parameters: $\theta = [\rho_z \ \sigma_z \ \overline{\xi}_{NA} \ \overline{\xi}_A \ c_s \ c_f \ c_m]'$

by targeting 10 moments

- Mean inventory-sales ratio
- Covariance of inventory-sales ratio with log sales
- Skewness of inventory-sales ratio

In total: 5 moments from adopters, 5 moments from non-adopters

Overidentified SMM

$$\widehat{\theta} = \arg\min_{\theta} [m(\theta) - m(X)]' W [m(\theta) - m(X)]$$

- Optimal weighting matrix via clustered bootstrap (at firm level)
- Simulated annealing

Parameter Estimates

Description	Parameter	Estimate	Standard error
Idiosyncratic shock persistence	ρ_z	0.718	0.083
Idiosyncratic shock dispersion	σ_z	0.099	0.013
Order cost distribution (non-adopters)	$\overline{\xi}_{NA}$	0.190	0.021
Order cost distribution (adopters)	$\overline{\xi}_A$	0.109	0.007
Sunk cost of adoption	c_s	0.086	0.012
Continuation cost of adoption	c_f	0.015	0.004
Carrying cost	c_m	0.075	0.006

Table : Estimated Parameters

Note: Objective function value minimized at 424.89. Ten establishments per firm assumed.

Model Fit

Moment	Model	Data
Mean(inventory-sales ratio|adopter)	0.122	0.145
Mean(inventory-sales ratio|non-adopter)	0.187	0.194
Std(inventory-sales ratio|adopter)	0.052	0.042
Corr(inventory-sales ratio, log sales|adopter)	-0.513	-0.232
Std(log sales|adopter)	0.204	0.195
Std(inventory-sales ratio|non-adopter)	0.068	0.068
Corr(inventory-sales ratio, log sales|non-adopter)	-0.480	-0.379
Std(log sales|non-adopter)	0.245	0.264
Skew(inventory-sales|adopter)	0.618	-0.010
Skew(inventory-sales|non-adopter)	0.344	0.620

Table : Model vs. Data Moments

Steady State Values

% of Benchmark		
GDP	Order freq.	Order size
2.06	13.79	-6.63
Inventory stock	Capital Inv.	Consumption
-17.99	3.78	1.25
q	Measured TFP	Labor
0.91	0.74	2.67
Firm value		
1.09		

Table : Steady State Values, Adoption Model

Note: The table reports steady state values of the Adoption model relative to the Benchmark model, in percent.

Implications for Misallocation

- Measured TFP rises
  - Inputs reallocated to high MP producers
  - Also: reduction in economy-wide orders costs
- Manifested in lower micro volatility:

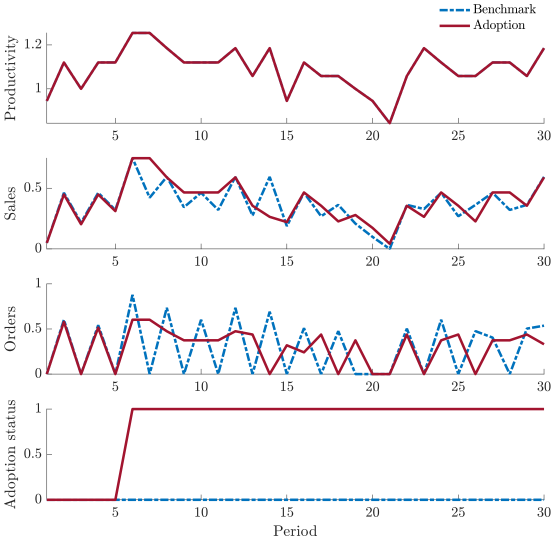
	Sales	Labor	Inventory Inv.	MP Materials
Benchmark	1.00	1.00	1.00	1.00
Adoption	0.93	0.92	0.89	0.94

Table : Simulated Firm-Level Volatility and MP Dispersion

Note: The take reports results from an unconditional simulation of 10,000 firms (each consisting of ten plants) over 100 periods. Columns (1)-(3) report firm-level volatility while column (4) reports the dispersion in marginal product of materials from an. All quantities are normalized such that they equal one in the benchmark model.

JIT Production Mutes the Inventory Cycle

Tracking Simulated Path for a Random Plant



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Resilience to Unexpected Disaster Shock

Let

$$O = AK^{\alpha}L^{1-\alpha}$$

where $A = 1$ in the steady state

- Exercise: consider unexpected shock to A
  - Disaster shock (i.e. COVID-19)
- Adoption model exhibits greater exposure to unforeseen disaster

Matching 2020Q2 Real GDP Contraction

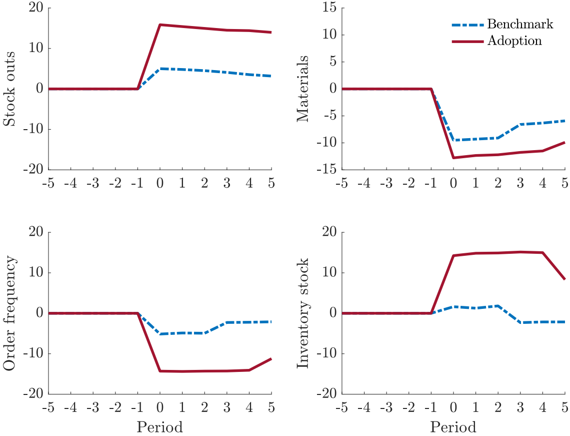
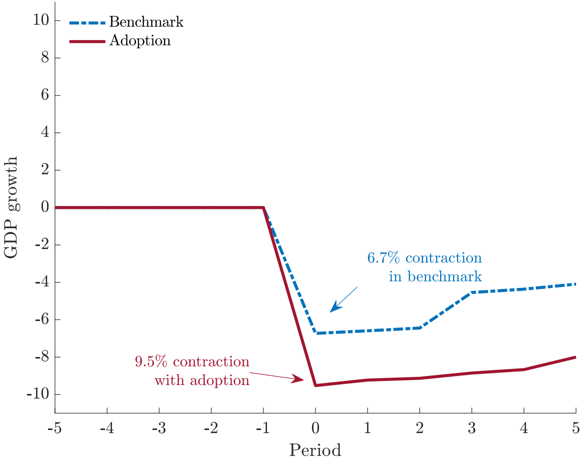


Figure: Impulse Response to Unexpected Shock

Note: The figure plots impulse responses to productivity shock that matches the 9.5% y/y decline in real GDP. All figured plotted in growth rates (%). Shock persistence = 0.956.

GDP falls more sharply in Adoption Model



Note: The figure plots GDP impulse response to productivity shock that matches the 9.5% y/y decline in real GDP. Shock persistence = 0.956.

Alternate persistence specifications

Understanding the Sources of Vulnerability

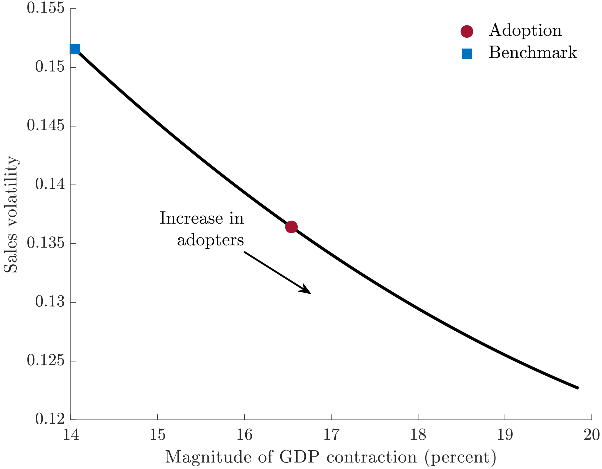
Unexpected Shock Implies $\uparrow q$

Cost of placing an order $= pw\xi + pq \times$ (order size)

Two channels:

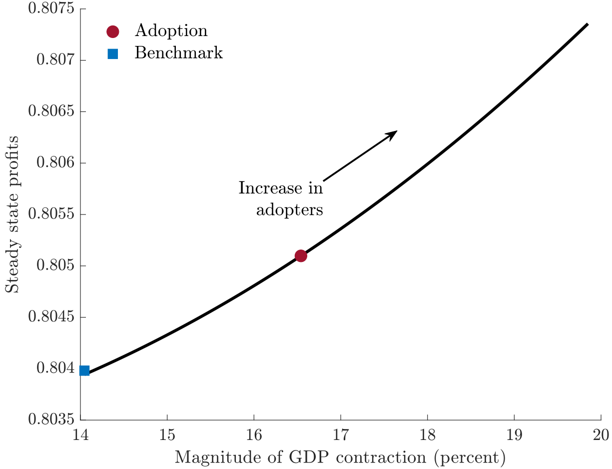
1. Stock outs
   - Adopters carry fewer inventories in normal times
2. Order threshold
   - Some abandon JIT
     - Those who abandon JIT now face $\uparrow q$ <u>and</u> $\uparrow \overline{\xi}$
   - Order threshold falls
     - Inaction region expands further, and inventories drawn down more slowly

The JIT Trade-Off: Micro Stability vs. Macro Vulnerabiliity



Benchmark to Adoption: ↓ 7.0% sales volatility at cost of ↑ 2.8% output contraction

The JIT Trade-Off: Micro Stability vs. Macro Vulnerabiliity



Benchmark → Adoption: ↑ 0.15% SS profits at cost of ↑ 2.8% output contraction

Conclusion

- In the data, JIT adopters
  - Hold fewer inventories and enjoy higher profits
    - ⋆ Face less firm volatility
  - Are riskier
    - ⋆ Earn higher asset returns
    - ⋆ Are more exposed to aggregate fluctuations
- Realistically calibrated model reproduces this trade-off
  - JIT adopters escape larger order costs
    - ⋆ Reallocation of inputs to high MP producers
  - ...but JIT adopters also hold fewer inventories across time
    - ⋆ Materials needed for production
    - ⋆ Inventories drawn down more slowly conditional on unexpected shock
- Quantify JIT trade-off

Thank You!

Back-Up Slides

Just-in-Time Production (JIT)

- Originated in Japan
  - Toyota Production System (or Kanban system)
  - Post-WWII competition with US auto industry
  - Toyota could not produce large batches of autos or auto parts compared to US manufacturers at the time
    - Low domestic demand
    - Market demanded small quantities of many different models
  - System devised to eliminate waste
- JIT as a philosophy
- "Pull system" – final goods firm places order from upstream suppliers only when it needs to satisfy demand
- Build relationship with suppliers, information sharing, commitment to deliver promptly, enter into long-term contracts
- More examples: GM, Dell, Goodyear Tires, Johnson & Johnson

Back

Details on JIT Adopter Data

- Compustat Fundamentals Annual data from 1970-2019.
- Merge firm-level data on identified JIT manufacturers, graciously provided by William Wempe[1] and Xiaodan Gao[2].
  - Data obtain through literature reviews, Lexis/Nexis searches, key word searches made to SEC filings and financial news
- These data provide the specific year in which a Compustat manufacturing firm adopted JIT
- I searched through each of these firms to verify that they indeed adopted JIT, and merged these with my 1970-2019 Compustat data set
- This left me with about 130 identified JIT adopters

Back

[1] Kinney, Michael R. and William F. Wempe. "Further Evidence on the Extent and Origins of JIT's Proftabiliity Effects." *The Accounting Review*, Vol. 77, No. 1, 2002, 203-225.

[2] Gao, Xiaodan. "Corporate Cash Hoarding: The Role of Just-in-Time Adoption". *Management Science*, Vol. 64, No. 10, 2018, 4858-4876

JIT Adopters Are Riskier

Stock returns			
	$\beta(r_{it}, r_{Mt})$	$\mathrm{corr}(r_{it}, r_{Mt})$	$\mathrm{std}(r_{it})$
Adopters	1.09	0.78	0.24
Non-adopters	1.08	0.74	0.25
Sales growth rates			
	$\beta(\Delta y_{it}, \Delta y_{USt})$	$\mathrm{corr}(\Delta y_{it}, \Delta y_{USt})$	$\mathrm{std}(\Delta y_{it})$
Adopters	2.25	0.82	0.08
Non-adopters	1.29	0.64	0.06
Real Excess returns (%)			
	$r_{it} - r_t^f$		
Adopters	11.41		
Non-adopters	8.25		

Table : Returns Adoption Status (Portfolios)

Note: The top panel reports stock return betas and other moments for adopters and non-adopters where r_{it} is the cumulative annual stock returns of the firm and $r_{M,t}$ is the cumulative return to the SP500. The bottom panel reports sales betas and other moments for adopters and non-adopters where $y_{US,t}$ refers to log real US gross domestic product. The third panel reports real excess returns, where the risk free rate is taken to be the 10-year government bond. Back

Firm-Level Evidence: Levels

	(1) Inventory-sales ratio	(2) Market value	(3) Sales
Adopter	-0.252***	0.069**	0.031**
	(0.052)	(0.031)	(0.014)
Firm FE	Y	Y	Y
Industry × Year FE	Y	Y	Y
Controls	Y	Y	Y
Observations	45,852	45,852	45,852

Table : Firm-Level Panel Regressions (Levels)

Note: The table reports firm-level panel regression results from Compustat Annual Fundamentals of manufacturing firms (NAICS 31-33). The dependent variables are the log of: (1) inventory-to-sales ratio, (2) market value, and (3) sales growth. Industry by year fixed effects and firm fixed effects are specified. Standard errors are clustered at the firm level. * $p<0.10$, ** $p<0.05$, *** $p<0.01$. All series are in fractional units, so 0.01=1%

Back

Industry Volatility

$$\Delta \text{vol}(y_{jt}) = \beta(\Delta \text{adoptshare}_{jt}) + \delta_j + \delta_t + \varepsilon_{jt}$$

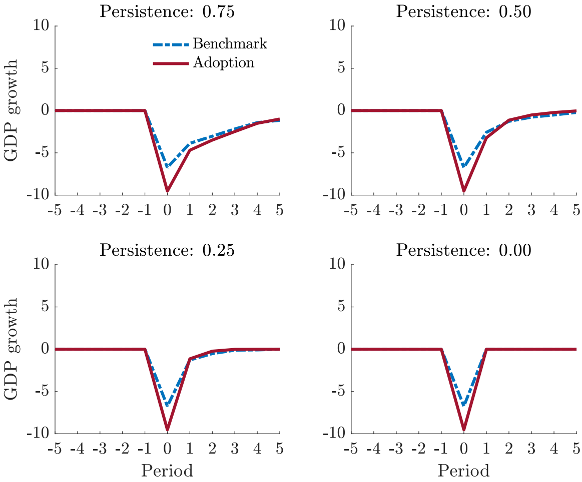
	(1)	(2)	(3)
	Δ vol(inventory inv rate)	Δ vol(sales growth)	Δ vol(stock return)
Δ adoptshare	-0.294**	-0.048**	0.013
	(0.119)	(0.020)	(0.015)
Industry FE	Y	Y	Y
Year FE	Y	Y	Y
Observations	1,818	1,818	1,818

Table : Industry-Level Volatility Regressions

Note: The table reports industry-level panel regression results from CRSP and Compustat Quarterly Fundamentals data of manufacturing firms (NAICS 31-33). Industries are defined at the 4-digit NAICS-level. The dependent variables are the change in: (1) inventory investment rate volatility, (2) sales growth volatility, and (3) stock return volatility. Volatility measures are constructed by taking the 2-year standard deviation of each outcome variable for the average firm in each industry. Industry and year fixed effects are specified. Standard deviations of outcomes variables are 0.79, 0.11, and 0.04, respectively Standard errors are clustered at the industry level. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Back

Alternate Persistence Specifications

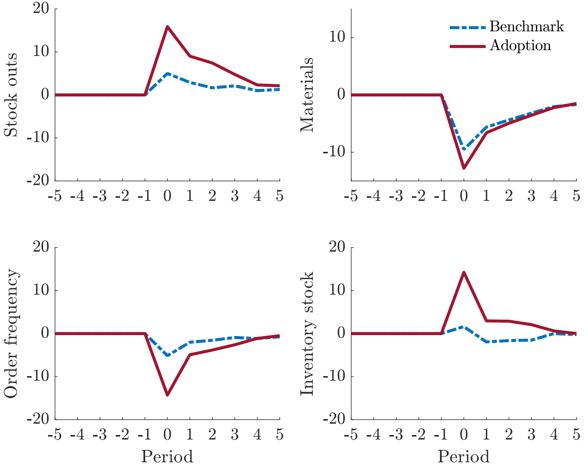


Impulse Response: GDP Growth

Back

Alternate Persistence Specifications

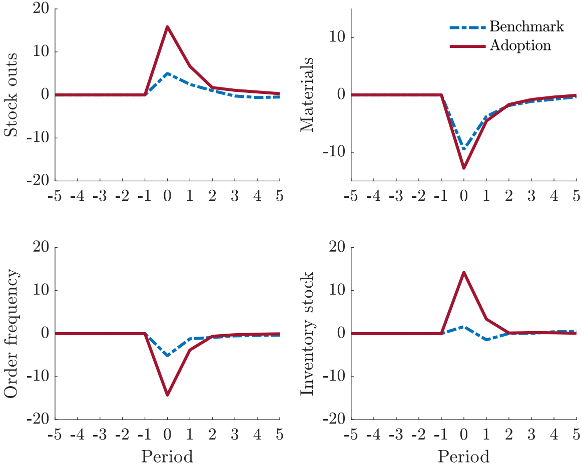
Shock Persistence: 0.75



Back

Alternate Persistence Specifications

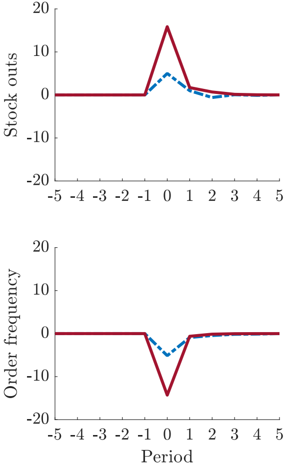
Shock Persistence: 0.50



Back

Alternate Persistence Specifications

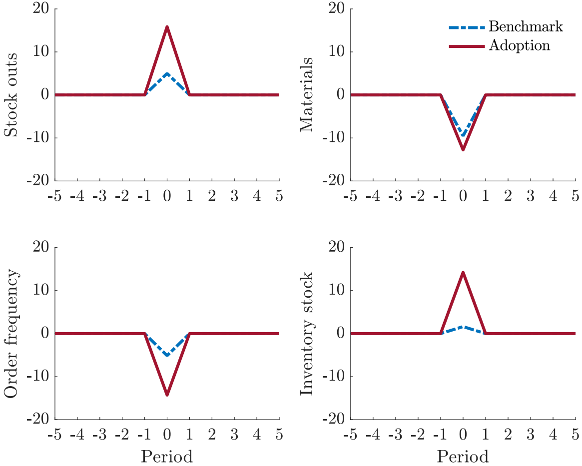
Shock Persistence: 0.25



Back

Alternate Persistence Specifications

Shock Persistence: 0.00



Back