Import Competition, Trade Credit, and Financial Frictions in General Equilibrium

Federico Esposito — Tufts University

Fadi Hassan — Bank of Italy, CEPR

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The role of trade credit

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- **Our focus**: the GE effects of trade credit in the context of the largest international trade shock of the last decades, the rise of China as a global manufacturing powerhouse.

What we do

- Highlight a new empirical stylized fact:
  - Positive link between the use of trade credit and exposure to import competition from China (at both sector and firm level)

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- Develop a multi-country multi-sector model with borrowing constraint, possibility of trade credit and endogenous employment that:
  - Rationalize the empirical stylized fact
  - Quantify the general equilibrium implication of trade credit on employment and wages
  - Disentangle the different channels at work and allow for a novel trade-off of trade credit between a "sales effect" and a "financial cost effect"

Our contribution

- Novel empirical fact: China shock and trade credit.
- We study the combination of borrowing constraints and trade credit in the transmission of international trade shocks.
- We introduce borrowing constraints and trade credit in the workhorse GE trade model with IO linkages (Caliendo and Parro 2015; Costinot and Rodriguez-Clare, 2014).
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  - We look at employment and account for GE effects.
  - We focus on: i) advanced economy (US), ii) longer-term horizon, iii) different shock; plus our model allow for both the negative and positive effects of trade credit and quantify the relative magnitudes.

Empirical motivation

Data

- Compustat between 1991-2007
- For sectoral analysis: aggregate firm-level data to 157 manufacturing sectors
- Trade credit: accounts payable (over revenues):
  - Similar aggregate trend to Census ▸ Trend
  - Net-trade credit (accounts payable − receivable) as a robustness when data is available
- Import competition from China:
  - Sector level: Autor, Dorn and Hanson (2013)
  - Firm level: abnormal returns around PNTR events as in Greenland et al. (2022)

Baseline specification

- Two-periods stacked differences (1991-1999 and 1999-2007):

$$\Delta TC_{st} = \beta_1 \cdot \Delta IP_{st} + X'_{st}\gamma + \delta_t + \varepsilon_{st}$$

- where:
  - ΔTC_{st} is the change in share of accounts payable in revenues
  - ΔIP_{st} is the change in import competition from China as in ADH 2013:

$$\Delta IP_{st} = \frac{\Delta IMP_{st}^{US}}{L_{s,91}^{US}}$$

instrumented with change in imports from China of 8 high-income countries:

$$\Delta IPO_{st} = \frac{\Delta IMP_{st}^{OTH}}{L_{s,91}^{US}}$$

  - Controls X_{st} include capital expenditures, inventories, debt over assets; δ_t is a period dummy ▸ Summary Statistics

China shock and trade credit

Table: $\Delta TC_{st} = \beta_1 \cdot \Delta IP_{st} + X'_{st}\gamma + \delta_t + \varepsilon_{st}$

	OLS		IV			IV, Placebo
Dep. var: Δ TC_{st}	(1)	(2)	(3)	(4)	(5)	(6)
Δ IP_{st}	0.023***	0.028**	0.028**	0.027***	0.028***	0.003
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Period dummy	✓	✓	✓	✓	✓	✓
Sector controls			✓	✓	✓	✓
Acemoglu et al (2016) controls				✓	✓	✓
2-digit Sector dummies					✓	✓
Observations	314	314	314	314	314	298
First Stage F-stat		269	44	144	150	184

- A one sd increase of exposure to China raises the share of trade credit in revenues by 2-3 percentage points.

China shock and trade credit, robustness

- Using net trade credit ▸ Net Trade Credit
- Using gravity-based China shock ▸ Gravity Shock
- Using firm-level abnormal stock returns ▸ Abnormal stock returns

Model

A trade model with trade credit

- Goals:
  - Rationalize the empirical evidence.
  - Quantify the impact of trade credit on employment after the China shock accounting for GE effects.

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- Workhorse multi-country, multi-sector Armington trade model with IO linkages that we enrich with:
  - Financial frictions
  - Trade credit
  - Endogenous employment

Production enviroment

- Two types of producers:
  - Intermediate goods producers: use only labor.
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- Borrowing structure:
  - The constraint depend on revenues (consistent with flow-based borrowing as in Lian and Ma, 2021; Drechsel, 2022).
  - Firms face a size-dependent borrowing constraint (Gopinath et al., 2017; Caglio et al. 2021).
  - Trade credit is at least as expensive as bank credit (Giannetti et al., 2011; Cunat and Garcia-Appendini, 2012; pecking order of financial sources as in Restrepo et al. 2019; Costello, 2020; Hardy et al., 2022).

Extensions to the baseline model

- **Labor supply**. At baseline individuals decide wether to work or not and there is a single wage:
  - Wages differ across sectors and workers decide in which sector to work (depending on wages and sector specific efficiency shocks).
  - Frictional employment (as in Kim and Vogel, 2021). Employment will depend on labor force participation margin as well as on the matching rate.

- **Interest rates**. At baseline they are exogenous, but we make them endogenous and an increasing function of leverage (as in Chod et al., 2019).

- **Initial liquidity**: final goods producers have some initial liquidity to finance input expenditure (Garcia-Appendini and Mntoriol-Garriga, 2013; Amberg et al., 2021).

- **Customer searching**. At baseline suppliers of intermediate stick to their customers:
  - We allow suppliers to choose between extending trade credit to a current buyer or search for a new customer that pay fully on spot.
  - Search is subject to some fixed cost (interest rate on trade credit turns to be decreasing in such cost).

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- Suppose there is a trade shock: $\Delta \log \tau_{ij,s} \leq 0$.

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- **Proposition 1.** *The change in the share of trade credit in revenues is:*

$$\Delta tc_{i,s} \approx \underbrace{-\beta\gamma_{i,s}(1-\varpi_{i,s})\Delta \log Y^{B}_{i,s}}_{\text{Collateral effect}} + \underbrace{(1-\rho)\,(1-\varpi_{i,s})\varpi_{i,s}\left(\Delta \log P^{M}_{i,s} - \Delta \log w_i\right)}_{\text{Relative cost effect}}$$

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- Relative cost effect: if labor and inputs are complements in production ($\rho < 1$), then $tc_{i,s}$ increases if $\Delta \log P^M_{i,s} > \Delta \log w_i$

Proposition 1: reduced form estimation

Table: $\Delta tc_{i,s} = \beta_1 \underbrace{bc_{i,s}\Delta \log Y_{i,s}}_{\text{Collateral effect}} + \beta_2 \underbrace{\varpi_{i,s}\Delta \log \varpi_{i,s}}_{\text{Relative cost effect}}$

	Borrowing constraint: Revenues		Borrowing constraint: EBITDA	
	Unconditional correlation	China shock	Unconditional correlation	China shock
Dep. var: Δ tc_{st}	(1)	(2)	(3)	(4)
Collateral Effect	-0.067**	-0.023*	-0.025**	-0.023**
	(0.03)	(0.01)	(0.01)	(0.01)
Relative Cost Effect	-0.01***		-0.009**	
	(0.00)		(0.00)	
Sector dummies	✓	✓	✓	✓
Time Fixed Effect	✓	✓	✓	✓
Observations	2,389	314	2,328	314
R^2	0.18	0.25	0.14	0.27

- The collateral channel is the one that matters. The magnitude is very close to the estimated effect of the China shock on trade credit.

Structural estimation, model fit ... some other time!

Trade shock on employment: final goods producers

Proposition 2. *The log-change in **buyers**' sectoral employment is:*

$$\tilde{L}^B_{i,s} \approx \underbrace{\tilde{Y}^B_{i,s}}_{\text{Revenue effect}} - \underbrace{\chi_{i,s}\tilde{P}_{i,s}}_{\text{Input-cost effect}} - \underbrace{\mu_{i,s}\tilde{TC}_{i,s}}_{\text{Credit cost effect}}$$

where $\chi_{i,s} \equiv (1-\rho)(1-\varpi_{i,s})$ *and* $\mu_{i,s} \equiv \chi_{i,s}\frac{(1-\gamma_{i,s})\left(r^T_{i,s}-r_{i,s}\right)}{\delta_{i,s}}$.

- **Revenue effect**: if trade shock lowers final goods sales, labor demand goes down (Autor et al., 2013)
- **Input-cost effect**: if trade shock lowers the cost of inputs (Jaravel and Sager, 2019), labor demand goes up when labor and inputs are complements
- **Credit-cost effect**: more trade credit raises borrowing costs, raising credit wedge, price and lowering production
- **Positive side of trade credit**: it expands the production possibilities of buyers and feeds into the revenue effect

Trade shock on employment: intermediate goods producers

Proposition 2. *The log-change in **suppliers**' sectoral employment is:*

$$\tilde{L}^S_{i,s} \approx \underbrace{\sum_{h,j} \xi^1_{ij,sh} \tilde{Y}^B_{j,h}}_{\text{Revenue effect}} - \underbrace{\sum_{h,j} \xi^1_{ij,sh} \tilde{\nu}^M_{ij,sh}}_{\text{Trade shares effect}} - \underbrace{\sum_{h,j} \xi^2_{ij,sh} \tilde{TC}_{j,h}}_{\text{Credit-cost effect}}$$

where $\xi^1_{ij,sh}$ *and* $\xi^2_{ij,sh}$ *depend on initial conditions and parameters*.

- **Revenue effect**: if trade shock lowers demand for final goods, suppliers' revenues decrease and labor goes down (Acemoglu et al., 2016)
- **Trade shares effect**: if there is reallocation of international across countries and sectors, labor goes down
- **Credit-cost effect**: if buyers demand more trade credit, i.e. $\tilde{TC}_{j,h} > 0$, suppliers borrow more from banks, increasing costs and lowering labor demand

Aggregate effects of the China shock

Table: General Equilibrium Effects of China Shock, 1991-2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Borrowing constraint Buyers:	No	Yes	Yes	Yes	Yes	Yes	Yes
Borrowing constraint Suppliers:	No	Yes	Yes	No	No	Yes	No
Trade Credit:	No	No	Yes	No	Yes	Yes	Yes
Trade Credit Cost:	-	-	$r^T > r$	-	$r^T > r$	$r^T = r$	$r^T = r$
Manuf. empl., buyers	-3.51	-6.11	-5.61	-6.04	-4.38	-5.48	-4.21
Manuf. empl., suppliers	-3.58	-6.51	-5.99	-6.17	-4.48	-6.12	-4.69
Total employment	0.25	-1.02	-0.78	-0.96	-0.29	-0.54	0.01
Real wage	0.76	-0.63	-0.15	-0.59	0.09	-0.14	0.10

Note: Numbers are expressed in log points x 100, summed across the two periods 1991-2000 and 2000-2007.

A frictionless world

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In a world with no frictions the China shock generates gains from trade in the US.

Introducing financial constraints

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Financial frictions leads to employment and wage losses

The role of trade credit

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Introducing trade credit strongly mitigates this negative effect

Disentangling the channels of the trade credit effect

Table: General Equilibrium Effects of China Shock, Decomposition

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Revenue effect	-3.71	-6.33	-5.42	-6.09	-4.29	-5.61	-4.32
Input-cost effect	0.20	0.22	0.24	0.05	0.16	0.13	0.11
Credit-cost effect	0	0	-0.43	0	-0.26	0	0
Manuf. empl., suppliers	-3.58	-6.51	-5.99	-6.17	-4.48	-6.12	-4.69
Revenue effect	-2.36	-4.90	-3.07	-4.81	-2.41	-3.37	-2.82
Trade shares effect	-1.22	-1.61	-1.52	-1.36	-1.03	-1.65	-1.45
Credit-cost effect	0	0	-1.40	0	-1.04	-1.10	-0.42

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Most of the gains come from the revenue channel...

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... which is stronger than the negative side of trade credit.

Trade credit vs. relaxing upstream borrowing constraint

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Trade credit is more effective than removing borrowing constraints upstream

Cheaper trade credit

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Reducing the cost of trade credit has redistributive effects in favor of the buyers and improves the aggregate equilibrium effect.

Conclusions

- We document a significant increase of trade credit after an import competition shock
- We propose a general equilibrium model to rationalize this evidence and analzye the GE effects of this financial channel
- The decline in the value of collateral increases the use of trade credit
- Trade credit mitigates the negative effect of the import competition shock
- Introducing trade credit has stronger effects than relaxing financial constraints upstream
- Cheaper trade credit favors downstream industries over upstream ones (with aggregate gains)

Thank you!

Top and bottom sectors for trade credit usage

Top Sectors
Office Furniture (2522)
Heating Equipment (3433)
Printed Circuit Boards (3672)
Fabricated Plate Work (3442)
Computer Storage Devices (3572)

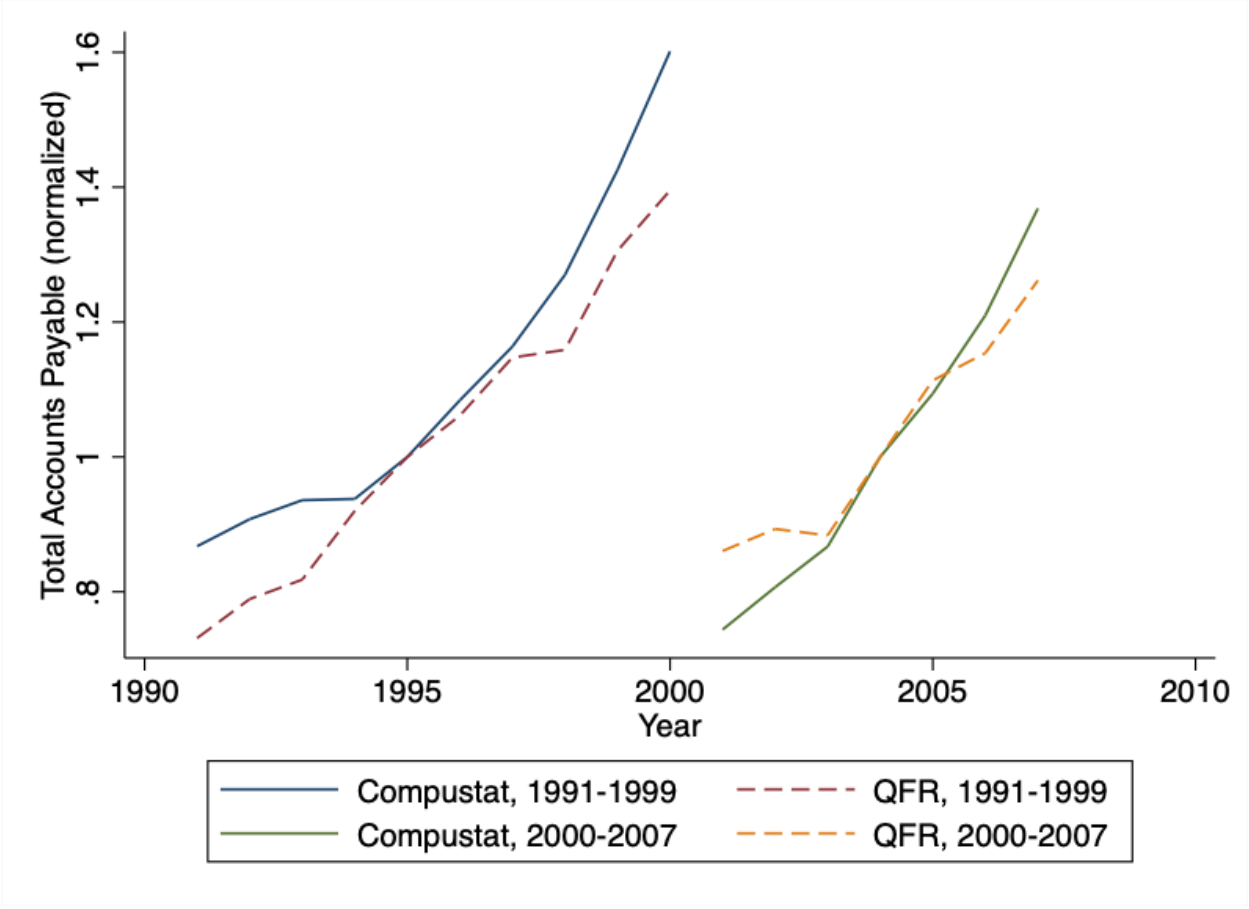
Bottom Sectors
Miscellaneous Metal Products (3339)
Bread and Other Bakery Products (2051)
Watches, Clocks, Clockwork Devices (3873)
Musical Instruments (3873)
Biological Products (2836)

▸ Return

How representative is Compustat

Return

- We compare the aggregate trend in Compustat to the Quarterly Financial Report produced by the US Census.
  - Any manufacturing firm with assets over \$250K may be included in the QFR sample. Firms above \$250m always included.



Summary Statistics

Return

Table: Summary Statistics, 1991-2007

	Mean	Std	Min	Max
Trade credit over revenues (TC_{st})	0.31	0.13	0.02	0.95
Change in trade credit over revenues (Δ TC_{st}	0.00	0.17	-1.38	0.77
Δ $Exposure_s$	20.86	63.12	-35.18	592
IV for Δ $Exposure_s$	13.87	37.13	-17.62	408
Capital exp. over assets	0.04	0.02	0.00	0.15
Inventories over assets	0.14	0.07	0.00	0.41
Debt over assets	0.22	0.12	0.00	0.71
Prod. workers share of employment (1991)	0.66	0.15	0.19	0.90
Log average wage in 1991	10.58	0.26	9.85	11.09
Capital/value added in 1991	0.99	0.64	0.19	3.52
Computer investment as share of total (1990)	0.08	0.07	0.00	0.44
High-tech investment as share of total (1990)	0.09	0.05	0.01	0.18

Note: Statistics computed over a sample of 157 manufacturing industries at the 4-digit level. Δ $Exposure_s$ and IV Δ $Exposure_s$ are taken from Autor et al. (2013). $Trade\ Credit_{st}$, capital expenditure over assets, inventories over assets and debt over assets are taken from Compustat. All remaining variables are from Acemoglu et al. (2016).

Shock Balance Test

Return

Table: Shock balance test, 1991-2007

Variable	Coefficient	Standard Error
Capital exp. over assets	0.001	(0.00)
Inventories over assets	-0.001	(0.00)
Debt over assets	-0.025*	(0.01)
Prod. workers share of employment (1991)	-2.054	(2.31)
Log average wage in 1991	0.002	(0.03)
Capital/value added in 1991	-0.002	(0.03)
Computer investment as share of total (1990)	0.014	(0.01)
High-tech investment as share of total (1990)	0.010*	(0.01)

Note: Regressions of the industry-level covariates on the China shokc as in Autor et al. (2013). The regressions control for period dummies and are weighted by average industry exposure shares. Clustered standard errors (at the 3-digit SIC level) are in parentheses.

China shock and trade credit, robustness

Return

Table: Exposure to Imports from China and Change in Net Trade Credit, 2004-2007

	OLS	IV
Dep. var: Δ *Net* TC_{st}	(1)	(2)
Δ $Exposure_{st}$	0.035***	0.036***
	(0.01)	(0.01)
Period dummy	✓	✓
Sector controls	✓	✓
Acemoglu et al (2016) controls	✓	✓
2-digit Sector dummies	✓	✓
Observations	145	145
First Stage F-stat		16

Note: Sample of 145 manufacturing industries (4-digit level). Column (1) uses an OLS estimator, column (2) uses an IV estimator. Sector controls include inventories over assets, capital expenditures over assets, long-term debt over assets in 2004. Acemoglu et al (2016) controls include production workers as a share of total employment, the log average wage, and the ratio of capital to value added in 1991; and computer investment as a share of total investment and high-tech equipment as a share of total investment in 1990. Clustered standard errors (at the 3-digit level) are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

China shock and trade credit, robustness

Return

Table: Exposure to Imports from China and Trade Credit, Robustness

	OLS	IV				IV, Placebo
Dep. var: Δ *Net* TC_{st}	(1)	(2)	(3)	(4)	(5)	(6)
Δ $Exposure_{st}$	0.021**	0.025**	0.025**	0.025**	0.026**	0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Period dummy	✓	✓	✓	✓	✓	✓
Sector controls			✓	✓	✓	✓
Acemoglu et al. (2016) controls				✓	✓	✓
2-digit Sector dummies					✓	✓
Observations	314	314	314	314	314	298
First Stage F-stat		269	44	144	150	184

Note: Sample of 157 manufacturing industries (4-digit level), stacked across two sub-periods. Columns (1) to (5) consider the sub-periods 1991-1999 and 1999-2007, while column (6) consider the sub-periods 1970-1979 and 1979-1989. Column (1) uses an OLS estimator, columns (2) to (6) use an IV estimator. Sector controls include inventories over assets, capital expenditures over assets, long-term debt over assets at the beginning of each period. Acemoglu et al. (2016) controls include production workers as a share of total employment, the log average wage, and the ratio of capital to value added in 1991; and computer investment as a share of total investment and high-tech equipment as a share of total investment in 1990. Robust standard errors in parentheses are clustered at the 3-digit level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Gravity-based China shock

Return

Table: Exposure to Imports from China and Change in Trade Credit, Gravity shock

Dep. var: Δ TC_{st}	(1)	(2)	(3)	(4)	(5)
Δ $Exposure_{st}$	0.042***	0.048***	0.047***	0.047***	-0.009
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Period dummy	✓	✓	✓	✓	✓
Sector controls		✓	✓	✓	✓
Acemoglu et al. (2016) controls			✓	✓	✓
2-digit Sector dummies				✓	✓
Observations	288	288	288	288	278

Note: Sample of 144 manufacturing industries (4-digit level), stacked across two periods 1991-1999 and 1999-2007. Sector controls include inventories over assets, capital expenditures over assets, long-term debt over assets. Acemoglu et al. (2016) controls include production workers as a share of total employment, the log average wage, and the ratio of capital to value added in 1991; and computer investment as a share of total investment and high-tech equipment as a share of total investment in 1990. Robust standard errors in parentheses are clustered at the 3-digit level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Firm-level China shock

Return

Table: Exposure to Imports from China and Change in Trade Credit, Abnormal returns

Dep. var: $\Delta\ TC_{it}$	(1)	(2)	(3)	(4)
$China_i^{AAR} * Post_t$	0.089***	0.056**	0.089***	0.072**
	(0.03)	(0.02)	(0.03)	(0.04)
Year Fixed Effect	✓	✓	✓	✓
Firm Fixed Effect		✓	✓	✓
Sector controls			✓	✓
Greenland et al. (2022) controls				✓
Observations	27,404	27,400	27,267	26,182

Note: Sample of 2,052 manufacturing firms and 17 years between 1991 and 2007. Sector controls include inventories over assets, capital expenditures over assets, long-term debt over assets, all interacted with post-2000 dummy. Greenland et al. (2022) controls include property, plant and equipment (PPE) per worker, firm size (as measured by the log of market capitalization), book leverage, and Tobin's Q, all interacted with post-2000 dummy. Robust standard errors in parentheses are clustered at the 3-digit level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Parameters

Return

- $\varepsilon_s = \sigma_s$: elasticity of substitution across goods: we set it to 5 for all sectors
- ϕ: we use 2.53 as estimated in Adao et al 2021, also similar to Chetty et al 2013.
- ρ: elasticity of substitution between labor and inputs. We set it to 0.5 as in Atalay 2017
- $\kappa = 0.2$ from Adao et al 2021.
- Calibrate the collateral elasticity β from Table 4

Initial Conditions

Return

- n_i: is the initial employment rate in U.S., from CBP (0.7 in both periods, 1 for foreign countries)
- $\chi_{oi,s}$: final consumption trade shares within sector (source: Comtrade + EORA).
- $\chi^M_{oi,ks}$: intermediates trade shares. If $r_{j,k} \approx r_k$ for all countries, then $\chi^M_{oi,ks} \approx \chi_{oi,k}$.
- $\psi_{i,s}$: For U.S. we directly use the financial constraint and compute $\psi_s = \frac{BC_s}{\left(Y^F_s\right)^{1+\beta}}$ using Compustat data. For foreign countries we multiply ψ_s by the relative financial development vs the U.S. (share of banking credit in GDP)
- $\gamma_{i,s}$: We find it as, using Compustat data,$\gamma_s = \frac{BC_s}{TC_s+BC_s}$. For foreign countries we multiply γ_s by the relative financial development vs the U.S.
- $\delta_{i,s}$: find it as $\delta_{i,s} = \gamma_{i,s}(1 + r_{i,s}) + (1 - \gamma_{i,s})\left(1 + r^T_{i,s}\right)$
- We find value added VA_i from the WIOT and then find $Y^F_{i,s}$ and $Y^S_{i,s}$. We find sectoral value added shares as $VA_{i,s} = Y^F_{i,s}\varpi_{i,s} + Y^S_{i,s}$.

Initial Conditions Return

- $\alpha_{i,ks}$: share of expenditures of sector s on goods from sector k within country i (source: BEA table in 1992 for U.S.). We assume the same shares for foreign countries
- $\varpi_{i,s}$: share of value added in production costs (source: NBER Manufacturing database for U.S.). We assume the same shares for foreign countries
- $\xi_{i,s}$: sectoral consumption share (source: BEA for U.S.). We assume the same shares for foreign countries
- $r_{i,s}$: for the U.S., we measure the average annual interest rate as the ratio of interest expenses to long-term debt in Compustat. For foreign countries, we take the national policy interest rate and add the sectoral spread computed for the U.S. (relative to the national average).
- $r_{i,s}^{T}$: we first rely on an aggregate estimate from Giannetti et al. (2011) that finds an average annualized trade credit interest rate of 28% for U.S. firms. Then we add the sectoral credit spreads for the U.S. computed in Gilchrist and Zakrajsek (2012). For foreign countries, we take the U.S. values and add the spread between the foreign policy interest rate and the U.S. one.

Construct China shock

Return

- Gravity implies that:

$$\Delta \log X_{ij,s} = -\epsilon_s \Delta \log \tau_{ij,s} - \epsilon_s \Delta \log c_{i,s} + \epsilon_s \Delta \log P_j + \Delta \log I_j.$$

- This can be written as a gravity equation that can be estimated period by period:

$$\Delta \log X^t_{ij,s} = -\epsilon_s \Delta \log \tau^t_{ij,s} + o^t_{i,s} + d^t_{j,s}.$$

where $o^t_{i,s}$ is an origin-sector fixed effect and $d^t_{j,s}$ is a destination-sector fixed effect.

- Up to a first order approximation, the definition of $\Delta M^t_s \equiv \sum_j \frac{\Delta X^t_{\text{China}j,s}}{L^{t_0}_{\text{US},s}}$, where j is each of the 8 high-income countries in AADHP, is equal to
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$$\Delta M^t_s = \sum_j \frac{X^{t_0}_{\text{China}j,s}}{L^{t_0}_{\text{US},s}} \left(-\epsilon_s \Delta \log \tau^t_{\text{China}j,s} + o^t_{\text{China},s} + d^t_{j,s}\right)$$

- Under the assumption that $\Delta \log \tau^t_{\text{China}j,s} = \Delta \log \tau^t_{\text{China},s}$, we can compute:

$$\Delta \log \tau^t_{\text{China},s} = \frac{\Delta M^t_s}{-\epsilon_s \sum_j X^{t_0}_{\text{China}j,s}} - \frac{\sum_j X^{t_0}_{\text{China}j,s} \left(o^t_{\text{China},s} + d^t_{j,s}\right)}{-\epsilon_s \sum_j X^{t_0}_{\text{China}j,s}}$$