Nominal Exchange Rate Variability, Nominal Wage Rigidity, and the Pattern of Trade

ISHISE, Hirokazu

ishise@osipp.osaka-u.ac.jp

Osaka School of International Public Policy
Osaka University

Dec 2019

Exchange rate stabilization $\rightarrow$ Trade $\uparrow$?

- Benefit of fixed nominal exchange rate (NXRT): Stabilize NXRT $\rightarrow$ trade$\uparrow$?

Exchange rate stabilization $\rightarrow$ Trade $\uparrow$?

- Benefit of fixed nominal exchange rate (NXRT): Stabilize NXRT $\rightarrow$ trade$\uparrow$?
  - Myth: yes
  - Theory: classically yes, but some say no
  - Empirics: mixed

Exchange rate stabilization $\rightarrow$ Trade $\uparrow$?

- Benefit of fixed nominal exchange rate (NXRT): Stabilize NXRT $\rightarrow$ trade$\uparrow$?
  - Myth: yes
  - Theory: classically yes, but some say no
  - Empirics: mixed
- Studied aggregate (bilateral) trade
- Impacts may differ across sectors
- This paper: sector-level focusing on interactive impacts with nominal wage rigidity
  - Key nominal friction in biz cycles

Exchange rate variability × Wage rigidity

- Question: Does variability of nominal exchange rate hurt exports?
  - Answer: Yes, if the sector faces sticky wage workers

Exchange rate variability × Wage rigidity

- Question: Does variability of nominal exchange rate hurt exports?
  - Answer: Yes, if the sector faces sticky wage workers
- A toy model to see the mechanisms
- Empirics by "interaction-term" identification

Exchange rate variability × Wage rigidity

- Question: Does variability of nominal exchange rate hurt exports?
  - Answer: Yes, if the sector faces sticky wage workers
- A toy model to see the mechanisms
- Empirics by "interaction-term" identification
- A country whose nominal exchange rate varies little has comparative advantage in industries which intensively use sticky-wage workers

The idea goes back to ...

Freely fluctuating exchanges involve three serious disadvantages. In the first place, they create an element of risk which tends to discourage international trade. The risk may be covered by "hedging" operations where a forward exchange market exists; but such insurance, if obtainable at all, is obtainable only at a price and therefore generally adds to the costs of trading. (p. 210)

Ragner Nurkse, 1944, *International Currency Experience: Lessons of the Inter-War Period*, (Geneva: League of Nations).

and still popular...

A fixed exchange rate is typically used to stabilize the value of a currency... This makes trade and investments between the two currency areas easier...

"Fixed exchange rate system" Wikipedia, Accessed Nov 1, 2019.

A small open economy model

- $t = 0, 1, ...$
- Two-good ($i = 1, 2$) small-open
- HHs $\rightarrow$ (labor) $\rightarrow$ firms
- World goods price P_i^*, exogenously fixed
- No uncertainty except for NXRT ($\mathscr{E}$)
- $\mathscr{E}$: exogenous, stochastic

$$\ln \mathscr{E} \sim \text{iid} N(\mu, \sigma^2)$$

- Goods price in home $P_i = \mathscr{E} P_i^*$

One-period ahead wage rigidity

- Production factor: labor $l_{ji}(\upsilon)$
  - Differentiated (υ) workers $\Rightarrow$ HHs set wages
  - $j = f, s$: "flexible" & "sticky"-wage labor
- "Sticky" wage: nominal wage determined at the end of the previous period (as Obstfeld & Rogoff 00)
  - OR00: sticky-wage labor only
  - Why not Calvo, downward rigid inequality, etc?—Easy to handle variance

Firms use distinguished workers

Firms $i = 1, 2$, labor type $j = f, s$.

$$\max P_i y_i - \sum_j \int_0^1 W_{ji}(\upsilon) l_{ji}(\upsilon) \mathrm{d}\upsilon,$$

$$\text{where } y_i = a_i l_{fi}^{\omega_i} l_{si}^{1-\omega_i},$$

$$l_{ji} = \left(\int_0^1 l_{ji}(\upsilon)^{\frac{\phi-1}{\phi}} \mathrm{d}\upsilon \right)^{\frac{\phi}{\phi-1}}.$$

$$\Rightarrow \; l_{ji}(\upsilon) = \left(\frac{W_{ji}(\upsilon)}{W_{ji}} \right)^{-\phi} l_{ji} \qquad (\diamondsuit)$$

Households as wage setter

$$\mathrm{E}\sum_t \beta^t \left[\ln c_t(\upsilon) - \sum_j \sum_i \frac{\Gamma}{\eta} l_{jit}(\upsilon)^\eta \right]$$

$$c(\upsilon) = \prod_i c_i(\upsilon)^{\alpha_i},$$

$$c(\upsilon) + \int_{h'} q(h') b(\upsilon, h') \mathrm{d}h'$$

$$= \sum_j \sum_i \frac{W_{ji}(\upsilon)}{P} l_{ji}(\upsilon) + b(\upsilon, h),$$

$$c(\upsilon) = \textstyle\sum_i P_i c_i(\upsilon)/P,$$

Labor demand ($\diamondsuit$).

Wage: markup over marginal cost

- $P = \prod_i P_i^{\alpha_i} = \prod_i (\mathscr{E} P_i^*)^{\alpha_i} = \mathscr{E} P^*$
- Full consumption insurance $\Rightarrow$ $c = c^*$, constant
- Symmetry $\Rightarrow$ drop υ

$$W_{fi} = \frac{\phi}{\phi - 1} \Gamma l_{fi}^{\eta - 1} P c^*$$

$$W_{si} = \frac{\phi}{\phi - 1} \Gamma \frac{\mathrm{E}\left[l_{si}^{\eta} \right]}{\mathrm{E}\left[\frac{l_{si}}{P c^*} \right]}$$

Long-run trade balance

Long-run trade balance

$$\sum_t \beta^t c^* = \sum_t \beta^t \mathrm{E} \sum_i P_i y_i / P$$

- c^* determined after calculating y_i

Remarks

- Pass-through
  - 100% path-through as an importer
  - 0% path-through as an exporter
  - Empirics: somewhere b/w, depending on countries, industries...
- Forward market
  - No access to forward market
  - (Possible extension) even available, needs to pay additional costs

Benchmark: no wage rigidity

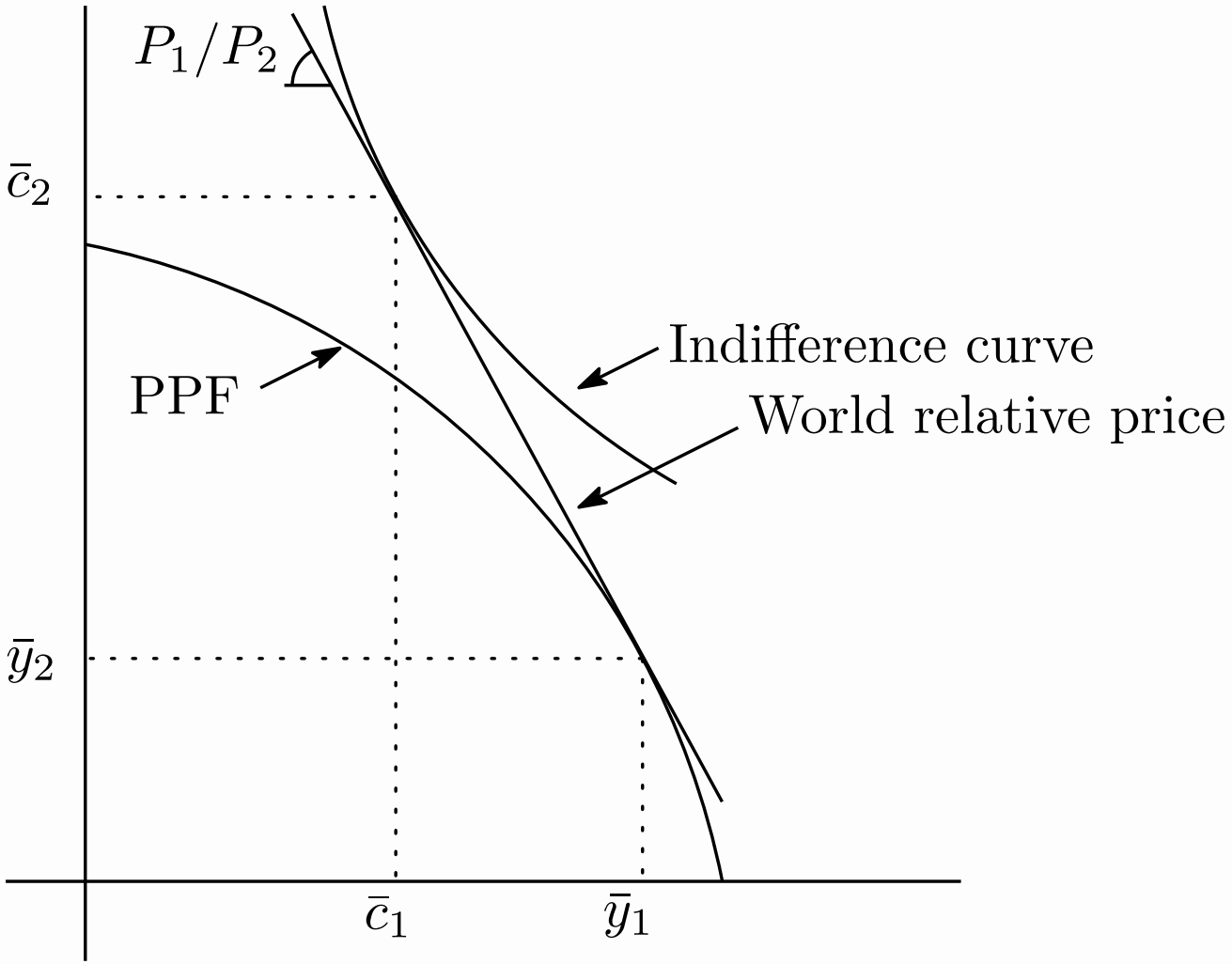
- No rigidity eqm: denoted by $\bar{}$

$$\bar{W}_{si} = P_i^* a_i \omega_i^{\frac{\omega_i}{\eta}} (1-\omega_i)^{\frac{\eta-\omega_i}{\eta}} \mathscr{E}$$

$$\bar{y}_i = a_i^{\frac{\eta}{\eta-1}} \left(\frac{P_i^*}{P^*} \frac{\phi-1}{\phi\Gamma} \right)^{\frac{1}{\eta-1}} \times \omega_i^{\frac{\omega_i}{\eta-1}} (1-\omega_i)^{\frac{1-\omega_i}{\eta-1}} \left(\frac{1}{\bar{c}^*} \right)^{\frac{1}{\eta-1}}$$

- Nominal prices: proportional to $\mathscr{E}$
- Real variables: do not depend on $\mathscr{E}$

Benchmark: no wage rigidity



Wage setting under wage rigidity

From FOCs

$$W_{si} = P_i^* a_i \omega_i^{\frac{\omega_i}{\eta}} (1-\omega_i)^{\frac{\eta-\omega_i}{\eta}} \tilde{\mathscr{E}}_i$$

where

$$\tilde{\mathscr{E}}_i \equiv \left(\mathrm{E}\left[\mathscr{E}^{\frac{\eta(\eta-\omega_i)}{\omega_i(\eta-1)}} \right] \Big/ \mathrm{E}\left[\mathscr{E}^{\frac{\eta(1-\omega_i)}{\omega_i(\eta-1)}} \right] \right)^{\frac{\omega_i}{\eta}}$$

- Difference: $\mathscr{E}$ vs $\tilde{\mathscr{E}}_i$
- Wage determined thru "expectation"

Output under rigidity depends on NXRT

- Output "gap" from no rigidity eqm

$$\frac{y_i}{\bar{y}_i} = \left(\frac{\bar{c}^*}{c^*}\right)^{\frac{1}{\eta-1}} \left(\frac{\mathscr{E}}{\tilde{\mathscr{E}}_i}\right)^{\frac{\eta(1-\omega_i)}{\omega_i(\eta-1)}}$$

y_i depends on

- fundamentals (e.g., a_i thru $\bar{y}_i$)
- the gap of consumption levels
- the gap b/w "expected" & realized NXRT
- $\mathscr{E} \uparrow \rightarrow y_i \uparrow$

Exchange rate stabilization $\rightarrow$ Trade $\uparrow$?

- Upward w-rigidity + depreciation ($\mathscr{E} \uparrow$)
  - High goods price, low labor cost
  - Rigid sector gets "competitiveness"
  - Output surge

Exchange rate stabilization $\rightarrow$ Trade $\uparrow$?

- Upward w-rigidity + depreciation ($\mathscr{E} \uparrow$)
  - High goods price, low labor cost
  - Rigid sector gets "competitiveness"
  - Output surge
- Downward w-rigidity + appreciation ($\mathscr{E} \downarrow$)
  - Low goods price, high labor cost
  - Rigid sector loses "competitiveness"
  - Output reduction
- Magnitude larger if ω_i smaller (= relying more sticky-wage workers)

Exchange rate stabilization $\rightarrow$ Trade $\uparrow$?

- Upward w-rigidity + depreciation ($\mathscr{E} \uparrow$)
  - High goods price, low labor cost
  - Rigid sector gets "competitiveness"
  - Output surge
- Downward w-rigidity + appreciation ($\mathscr{E} \downarrow$)
  - Low goods price, high labor cost
  - Rigid sector loses "competitiveness"
  - Output reduction
- Magnitude larger if ω_i smaller (= relying more sticky-wage workers)
- On average...? Using log-normal assumption

Long-run (average/expected) effects

$$\mathrm{E}[y_i/\bar{y}_i] = (\bar{c}^*/c^*)^{\frac{1}{\eta-1}} \times \exp\left(-\frac{\sigma^2}{2}\left(\frac{\eta}{\omega_i(\eta-1)}\right)^2(1-\omega_i)(\eta-\omega_i)\right)$$

- Ignore $\bar{c}^*/c^*$ term
  - Comparing two industries (i and i'), common terms disappear
- $\omega_i \uparrow \rightarrow \mathrm{E}[y_i/\bar{y}_i] \uparrow$
- $\sigma \uparrow \rightarrow \mathrm{E}[y_i/\bar{y}_i] \downarrow$
- $\sigma \uparrow \rightarrow \mathrm{E}[y_i/\bar{y}_i] \downarrow\downarrow$ when ω_i low

Exchange rate variability × Wage rigidity

- Large fluctuation in rigid sector
- HHs dislike fluctuations in leisure
- On avg, low labor & output
- Sectors facing more sticky wage workers incur more "costs"
- A country whose nominal exchange rate varies little has comparative advantage in industries which intensively use sticky-wage workers

Empirical test: interaction-term identification

- Interaction-term identification (c.f., Romalis 04, Nunn 08, Cuñat & Melitz 12)
- Country-industry-(year) exports on country(-year) FEs, industry(-year) FEs, and the interaction-term:
  - Education^c $\times$ skill intensity$_i$ $\Rightarrow +$
  - Rule of law^c $\times$ contract intensity$_i$ $\Rightarrow +$
  - Labor market flex.^{c} $\times$ sector shock size$_i$ $\Rightarrow +$
  - Exchange rate var^c $\times$ wage rigidity$_i$ $\Rightarrow -$

Empirical test: interaction-term identification

- A country who faces variable NXRT has c.a. in industries whose wages are flexible

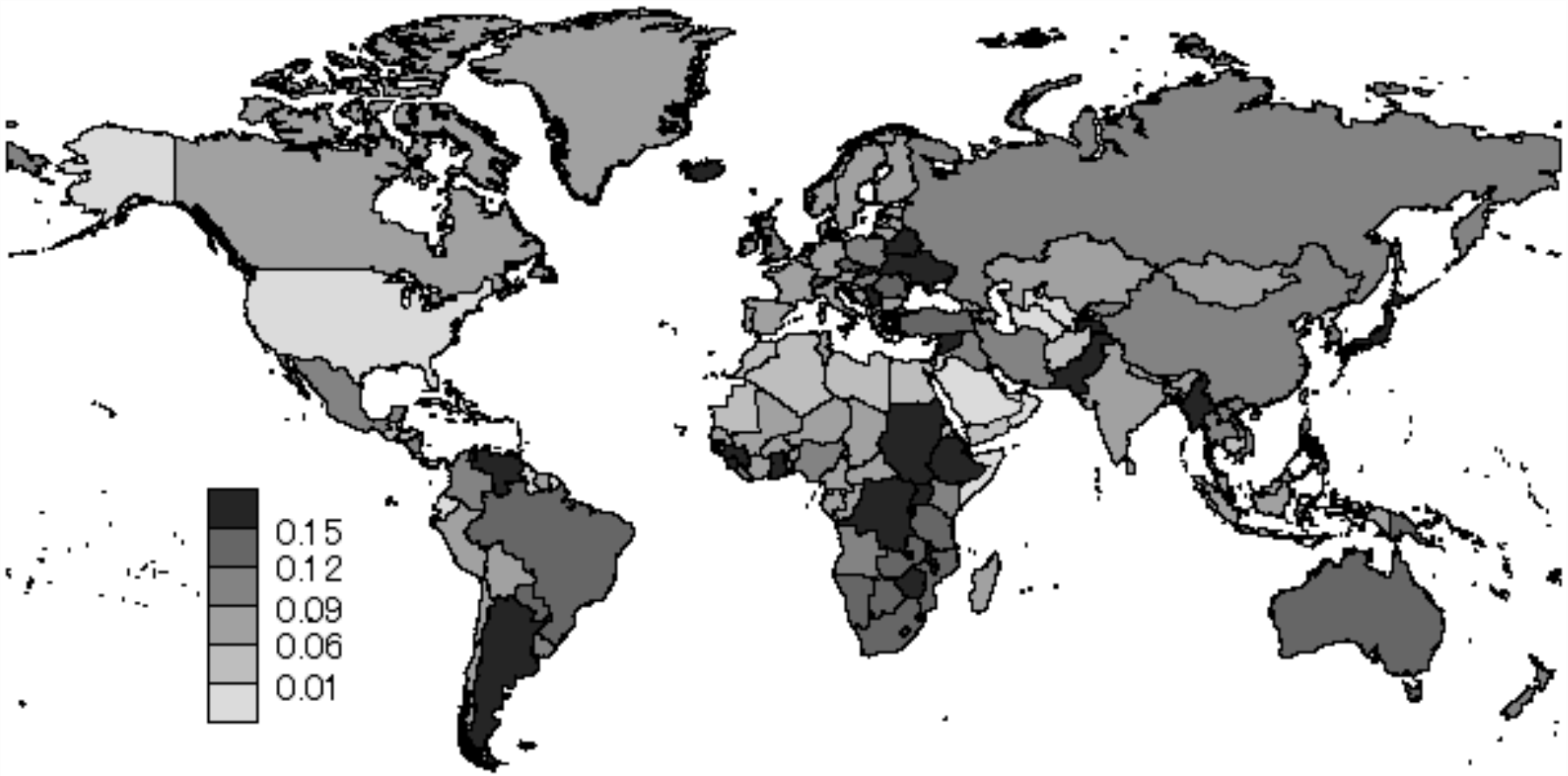
$$\ln x_{it}^{c} = (\mathbf{z}^{c} \circ \mathbf{q}_{i})'\beta + \gamma_{t}^{c} + \delta_{it} + \ldots + u_{it}^{c}$$

  - country c, industry i, year t
  - x_{it}^{c}: c's exports of i to the world in t
  - $\mathbf{z}^{c}$: country variables (e.g., σ(NXRT))
  - $\mathbf{q}_{i}$: industry variables (e.g., Wage rigidity)
  - $\circ$: element-by-element multiplication
  - γ_{t}^{c}: country-year FE
  - δ_{it}: industry-year FE
- Check β

Trade data + Current Population Survey

- Trade data ($t = 2011, \ldots, 2015$)
  - UN comtrade, manufacturing only
  - HS-6 $\rightarrow$ US-IO industries ($i = 1, \ldots, 53$)
- Country-year variables
  - Lagged 8-year averages
- NXRT: Own currency to USD, monthly
  - Coeff of variation (SD/AVG)
- Wage rigidity: US-CPS, 1989–2006
  - Prob of wage unchange in one-year
  - Avg a/s workers in industry i

Nominal exchange rate variability



Source: IFS

Wage rigidity from US CPS

- Apply US data to all countries
  - Common practice in the literature
  - Data availability
- Available US data
  - CPS (Many cross-section)
  - PSID (longer)
  - Survey of Income and Program Participation (high frequency: c.f., Barattierri et al. 14, Bils et al. 2019)

Wage rigidity from US CPS

- Sector-level wage rigidity: US CPS
  - 4 months surveys, 8 months no surveys, 4 months surveys
  - All months : age, working status, industry, occupation, hours, but no wage/earnings
  - Last month of the each of the 4 months ("Outgoing Rotation Group" questions): hourly wage, weekly earnings, usual hours worked, weeks per year
- Panel connection possible from 1989
- Pooled obs 1989–2007 (or –2017)

Wage rigidity from US CPS

- Focus on hourly wage
  - Robustness: if hourly wage missing, supplement by weekly earnings / usual hours worked
  - Still ignoring many workers
- Industry: 1990 US census industry code (85 relevant for mfg)
  - (Census90 $\rightarrow$ SIC87) $\rightarrow$ (NAICS92 $\rightarrow$ IO02 (53 4-digit))
  - Agg emp weight in 97 Economic census
  - Robustness: map to 274 IO2 6-digit

Wage rigidity from US CPS

Code	Name	Rigidity
3110	Food manufacturing	9.35%
3121	Beverage manufacturing	10.74%
3122	Tobacco manufacturing	9.31%
3130	Textile mills	10.29%
3140	Textile product mills	15.39%
3150	Apparel manufacturing	15.58%
3160	Leather and allied product manufacturing	20.23%
3210	Wood product manufacturing	13.68%
3221	Pulp, paper, and paperboard mills	9.79%
3222	Converted paper product manufacturing	10.85%
3230	Printing and related support activities	14.63%
3240	Petroleum and coal products manufacturing	13.68%
3251	Basic chemical manufacturing	8.99%
3252	Resin, rubber, and artificial fibers manufacturing	10.15%
3253	Agricultural chemical manufacturing	7.75%
3254	Pharmaceutical and medicine manufacturing	9.98%
3255	Paint, coating, and adhesive manufacturing	9.57%
3256	Soap, cleaning compound, and toiletry manufacturing	7.56%
3259	Other chemical product and preparation manufacturing	9.54%
3260	Plastics and rubber products manufacturing	12.78%
3270	Nonmetallic mineral product manufacturing	11.10%
3315	Foundries	8.48%
331A	Iron and steel mills and manufacturing from purchased steel	9.06%
331B	Nonferrous metal production and processing	8.61%
3321	Forging and stamping	12.26%
3322	Cutlery and handtool manufacturing	7.99%
3323	Architectural and structural metals manufacturing	10.86%
3324	Boiler, tank, and shipping container manufacturing	12.44%

Wage rigidity from US CPS

3331	Agriculture, construction, and mining machinery manufacturing	11.57%
3332	Industrial machinery manufacturing	8.13%
3333	Commercial and service industry machinery manufacturing	7.89%
3334	HVAC and commercial refrigeration equipment manufacturing	9.11%
3335	Metalworking machinery manufacturing	11.99%
3336	Engine, turbine, and power transmission equipment manufacturing	10.27%
3339	Other general purpose machinery manufacturing	10.09%
3341	Computer and peripheral equipment manufacturing	10.38%
3344	Semiconductor and other electronic component manufacturing	11.42%
3345	Electronic instrument manufacturing	11.15%
3346	Manufacturing and reproducing magnetic and optical media	11.71%
334A	Audio, video, and communications equipment manufacturing	11.60%
3351	Electric lighting equipment manufacturing	11.44%
3352	Household appliance manufacturing	7.41%
3353	Electrical equipment manufacturing	11.53%
3359	Other electrical equipment and component manufacturing	11.62%
3361	Motor vehicle manufacturing	9.77%
3364	Aerospace product and parts manufacturing	9.26%
336A	Motor vehicle body, trailer, and parts manufacturing	10.70%
336B	Other transportation equipment manufacturing	10.31%
3370	Furniture and related product manufacturing	12.25%
3391	Medical equipment and supplies manufacturing	9.57%
3399	Other miscellaneous manufacturing	12.65%

Source: CPS

Wage rigidity from US CPS

Probability of no wage change (after 1 yr)

332A	Ordnance and accessories manufacturing	0.031
3352	Household appliance manufacturing	0.074
3256	Soap, cleaning compound, and toiletry manufacturing	0.076
	⋮	
336B	Other transportation equipment manufacturing	0.103
3341	Computer and peripheral equipment manufacturing	0.104
	⋮	
3140	Textile product mills	0.154
3150	Apparel manufacturing	0.156
3160	Leather and allied product manufacturing	0.202

Correlated to other characteristics

	W	P	K	H	N	E	A	R
Wage rigidity								
Price flexibility								
K-intensity	−0.40	0.48						
H-intensity	−0.28							
NR-intensity		0.51	0.38	−0.30				
External financial dep.	−0.30			0.59				
Asset tangibility		0.64	0.40	−0.29	0.64	−0.32		
Relationship specificity		0.72	0.44		0.67		0.54	
Concentration of input		0.73	0.32			−0.43	0.46	0.62
Job complexity	0.46		−0.34	−0.71		−0.64		
Volatility of sales						0.43		
Intermediation	0.32		−0.49	−0.39		−0.42		
Broda-Weinstein elast.								
Downstreamness		−0.35	−0.31		−0.73		−0.45	−0.58

Data supports theoretical prediction

	(1)	(2)	(3)
$\text{Exch}^c \times \text{w-rigid}_i$	-0.58^{**}	-0.52^{*}	-0.53^{*}
	(0.29)	(0.28)	(0.28)
$\text{Inf}^c \times \text{w-rigid}_i$	✓	✓	✓
Other comp. adv.	✓	✓	✓
All other int.terms	✓	✓	✓
$\text{GDPpc}^c \times i$-dummy		✓	
$\text{GDPpw}^c \times i$-dummy			✓
Country-year FE	✓	✓	✓
Industry-year FE	✓	✓	✓
Year	2011–15	2011–15	2011–15
# Country	124	124	124
Obs.	29,056	29,056	29,056

Which factor contributes more?

- Many (highly colinear) variables
- Focus on a few interaction terms
  - Full set of FEs & GDPpc
- Reporting standardized coefficients
  - One SD change in the interaction term associated w/ β SD change in log exports

Comparison of factors: beta coefficients

	Stad. β	SE
Exchange rate variability^c $\times$ Wage rigidity$_i$	-0.56^*	(0.29)
Schooling^c $\times$ H-intensity$_i$	-0.066	(0.072)
K/L ratio^c $\times$ K-intensity$_i$	0.13	(0.38)
Financial development^c $\times$ External fin. dep$_i$	0.093^{**}	(0.039)
Financial development^c $\times$ Asset tangibility$_i$	-0.053	(0.11)
Rule of law^c $\times$ Rel. specificity$_i$	-0.11^{**}	(0.044)
Labor flexibility^c $\times$ Sales volatility$_i$	-0.059	(0.052)
Natural resource^c $\times$ NR-intensity$_i$	0.17^*	(0.089)
Inflation rate^c $\times$ Price flexibility$_i$	-0.0095	(0.017)
Inflation rate^c $\times$ Wage rigidity$_i$	0.55^*	(0.30)

Robustness checks

Some have been done, some to be added

- Cross-section
- Average trade over years as cross-section
- Exchange rate
  - Nominal effective exchange rate
  - Coeff of variation of growth rate
  - different lag years
- Wage rigidity
  - Supplemented w/ weekly earnings
  - 6-digit industry
  - SIPP data
- Poisson Pseudo ML

Exchange rate stabilization $\rightarrow$ Trade $\uparrow$?

- Question: Does exchange rate variability hurts exports?
  - Answer: Yes, if the sector faces sticky wage workers
- Theory: Two-sector small open, one-period advance wage setting
- Intuition: Sectors facing sticky wage workers incur adjustment costs
- Empirics: Interaction-term identification
- A country whose nominal exchange rate varies little has comparative advantage in industries which intensively use sticky-wage workers

Appendix slides

Exchange rate variability × Wage rigidity

- Question: Does variability of nominal exchange rate hurt exports?
  - Answer: Yes, if the sector faces sticky wage workers
- Theory
  - Two-sector small open economy
  - Two-factors: flexible- & sticky-wage labor
  - Sticky-wage: one-period ahead determination
  - Variance of NXRT leads to more production in sector using more flex wage workers

Exchange rate variability $\times$ Wage rigidity

- Question: Does variability of nominal exchange rate hurt exports?
  - Answer: Yes, if the sector faces sticky wage workers
- Intuitive idea
  - NXRT fluctuation $\Rightarrow$ uncertainty about nominal sales
  - w/o nominal rigidity, does not matter
  - w/ nominal rigidity, costly to adjust
  - Sectors facing more sticky wage workers incur more costs

Exchange rate variability × Wage rigidity

- Question: Does variability of nominal exchange rate hurt exports?
  - Answer: Yes, if the sector faces sticky wage workers
- Empirics
  - Data: country-sector level exports 2011–2015, matched with sector level wage rigidity constructed by panel dimension of US CPS
  - Method: "Interaction-term identification" of comparative advantage
  - Reasonably robust to various checks

Exchange rate variability × Wage rigidity

- Question: Does variability of nominal exchange rate hurt exports?
  - Answer: Yes, if the sector faces sticky wage workers
- Result
  - A country whose nominal exchange rate varies less has comparative advantage in industries which intensively use sticky-wage workers

Long-run (average/expected) effects

A property of log-normal variable $\ln x \sim N(\mu, \sigma^2)$

$$\mathrm{E}x^{\rho} = \rho\mu + 0.5\rho^2\sigma^2$$

The "expected" NXRT

$$\tilde{\mathscr{E}}_i = \exp\left(\mu + \frac{\sigma^2}{2}\frac{\eta}{\omega_i}\frac{\eta + 1 - 2\omega_i}{\eta - 1}\right)$$

- Note: if $\sigma = 0$, $\mathscr{E} = \tilde{\mathscr{E}}_i = e^{\mu} \Rightarrow$ Back to benchmark

What's new?: NXRT-based Comp adv

- σ(NXRT)$\uparrow \rightarrow$ trade $\downarrow$?
  - Ethier 73, Clark 73, ...: risk aversion of firms
  - Bacchetta & van Wincoop 00: sticky output price
  - Hooper & Kohlhagen 78, ...: empirics
  - Focusing on the aggregate trade

This paper: Interactions w/ industry characteristics (i.e., comparative advantage)

What's new?: NXRT-based Comp adv

- Open-economy macro: aggerage short-run
  - Obstfeld & Rogoff 00: nominal wage rigidity, NXRT variability
  - Gali & Monacelli 16: wage & price rigidity, NXRT, optimal policy
  - Schmitt-Grohé & Uribe 16: downward rigidity, currency pegs, unemployment

This paper: sector-level long-run

What's new?: NXRT-based Comp adv

- Recent papers on comparative advantage
  - Costinot 09: Theory highlighting interaction of country & industry characteristics
  - Romalis 04: educated country + skill intensive industry
  - Nunn 07, Levchenko 07: law enforcement + contract intensive industry
  - Cuñat & Melitz 12: labor market flexibility + industry shock size
  - Ishise 19: Trend inflation rate + input price rigidity

This paper: NXRT, wage rigidity

...about USD

[M]ost governments sought exchange-rate stability amid the sloshing tides of money.... Governments worry more about big swings in the dollar than in other currencies; trade is often conducted in dollar terms; ... It remains the world's principal "anchor" currency, against which others seek to limit volatility...

"It's been a privilege; Free exchange" The Economist; London. 422 (9027): 65. Feb 11, 2017.

Data

- Trade data ($t = 2011, \ldots, 2015$)
  - UN comtrade, manufacturing only
  - HS-6 $\rightarrow$ US-IO industries ($i = 1, \ldots, 53$)
- Country-year variables
  - Lagged 8-year averages
  - For trade 2015, avg of 2009–2014
  - For trade 2014, avg of 2008–2013

Exchange rate variability

- NXRT of country's currency to USD, monthly from IMF
- Measurement: Coefficient of variation
  - SD over 96 months / Avg over 96 months
  - Robustness: Coeff of variation of growth rate
- Why USD?: widely used as the vehicle currency

Other determinants of Comp. adv.

Including many other interaction terms

- Education^c $\times$ skill$_i$
- Kstock^c $\times$ k/l-ratio$_i$
- Rule of law^c $\times$ contract intensity$_i$
- Financial development^c $\times$ External finance dependency$_i$
- Labor market flexibility^c $\times$ sector shock size$_i$
- Inflation rate^c $\times$ Input price rigidity$_i$
- etc...
- NXRT^c and industry characteristics
- Country characteristics $\times$ wage rigidity$_i$

Robustness checks

Some have been done (but no presentation tables), some to be added

- Cross-section of other years
- Average trade over years as cross-section
- Exchange rate
  - Coeff of variation of growth rate
  - Years of lags
- Wage rigidity
  - Supplemented w/ weekly earnings
  - 6-digit industry
- Poisson Pseudo ML

Regression results

	(1)	(2)	(3)	(4)	(5)
$\text{Exch}^c \times \text{w-rigid}_i$	0.030	-0.71^{***}	-1.32^{***}	-1.12^{***}	-1.20^{***}
	(0.022)	(0.19)	(0.37)	(0.37)	(0.37)
$\text{Inf}^c \times \text{w-rigid}_i$		✓	✓	✓	✓
$\text{Exch}^c \times \text{Price terms}_i$		✓	✓	✓	✓
$\text{Country terms}^c \times \text{w-rigid}_i$			✓	✓	✓
$\text{Exch}^c \times \text{Industry}_i$			✓	✓	✓
Other comp. adv.			✓	✓	✓
$\text{GDPpc}^c \times i$-dummy				✓	
$\text{GDPpw}^c \times i$-dummy					✓
Country FE	✓	✓	✓	✓	✓
Industry FE	✓	✓	✓	✓	✓
Year	2013	2013	2013	2013	2013
# Country	161	150	120	120	120
Obs.	7,691	7,237	5,978	5,978	5,978

Extension (to be added)

- Generalize to N-sector model
  - Combined w/ CES aggregater (Armington trade model), the main result should hold
  - c.f., Levchenko 07, Ishise 19