

Are Your Labor Shares Set in Beijing? The View Through the Lens of Global Value Chains

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Banca d'Italia, 14 December 2021

Why labor shares? Why China? And why GVCs?

▶ **Income inequality.**

- ▶ Capital ownership and income highly concentrated (e.g., Piketty 2014).
- ▶ Smaller labor share implies increase in income inequality among people.
- ▶ Most of literature: globalization plays minor role in the evolution of LS.
- ▶ But does it?

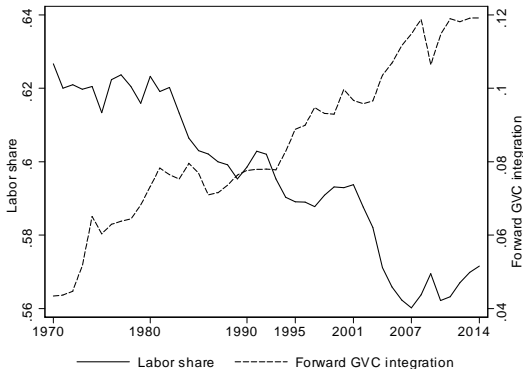
▶ Understanding role of globalization difficult w/o considering **GVCs**.

- ▶ Labor shares defined over value added.
- ▶ Apply methodology to address production and GVCs in VA terms.

▶ Freeman (1995) asked: "Are your wages set in Beijing?". Answering such questions increasingly requires a **different data approach**.

- ▶ Grossman & Rossi-Hansberg (2008).
- ▶ Gross trade stats misleading: Johnson (2014), Ito, Rotunno & Vézina (2017), Timmer, Miroudot & de Vries (2018).
- ▶ **Increasingly so since China joined WTO in 2001**: Koopman, Wang & Wei (2012), Kee & Tang (2016), Jakubic & Stolzenburg (2018).

WLS (GDP) : $y_{ct} = \alpha_c + \beta_t + \varepsilon_{ct} \implies \text{plot } \hat{\beta}_t + \text{level}$



- ▶ This paper: focus on 2001–2007 acceleration in decline of LSs.
 - ▶ Labor share stops falling as GVC intensity levels off.
 - ▶ Also in Gutierrez & Piton (2020) Grossman & Oberfield (2021).
 - ▶ LS from PWT 9.1, includes self-employment (**other measures**).

What we find, main takeaway messages

- ▶ Forward GVC integration contributes to $LS\downarrow$.
 - ▶ Due to **upstream, intermediate input exporting**.
 - ▶ Strong association in **2001–2007**, not in other periods.
- ▶ **China** accounts for much of this.
 - ▶ 2001 accession to WTO \rightarrow 2007, "slowbalization".
 - ▶ Think of China importing upstream inputs, not exporting them; consistent with Kee & Tang (2016), Chor, Manova & Yu (2020).
- ▶ Patterns of specialization consistent with **within-VC HO mechanics**.
 - ▶ Upstream intermediate input production more K-intensive.
 - ▶ Sposi, Yi & Zhang (2020).
- ▶ $LS\downarrow$ via change in **functional specialization** of labor:
 - ▶ Fabrication $\downarrow\downarrow$, but also management \downarrow , marketing \downarrow , while \approx R&D.
 - ▶ Consistent with ideas in Baldwin (2016).
- ▶ **MNEs** associated with offshoring of both assembly and input prod.

Related literature on labor shares

▶ Classics

- ▶ Smith (1776), Ricardo (1817), Kaldor (1957), Solow (1958)...

▶ Technological and technical change.

- ▶ Kennedy (1964), Acemoglu (2003), Acemoglu & Restrepo (2018), von Lehm (2018).
- ▶ Karabarbounis & Neiman (2014) vs. Oberfield & Raval (2014), Glover & Short (2020).

▶ Structural change.

- ▶ Ngai & Pissarides (2007), Buera & Kaboski (2012), McAdam & Willman (2013).

▶ Deregulation, concentration/competition, monopsony, role of firms.

- ▶ Blanchard & Giavazzi (2003), Weinberger & Leblebicioglu (2020), Kyryä & Maliranta (2008), Autor, Dorn, Katz, Patterson & Van Reenen (2020), Brooks, Kaboski, Li, and Qian (2019).

▶ Many papers focus on U.S. / few on LDCs.

- ▶ Blanchard (1997), Elsby, Hobijn & Sahin (2013, *suggest offshoring*), Rognlie (2016).
- ▶ Harrison (2005) and Rodriguez and Jayadev (2010), Weinberger & Leblebicioglu (2021).

▶ Very few address role of GVCs.

- ▶ IMF (2017), closest to ours, but: no causal inference, little on mechanisms, limited discussion.

Data and Methodology

Data

- ▶ World I/O tables (WIOT) and labor shares by $cty \times ind \times year$.
 - ▶ 1995–2007: WIOD 2013 release, 40 countries, 35 industries (ISIC rev. 3).
 - ▶ 2007–2014: WIOD 2016 release, 43 countries, 56 industries (ISIC rev. 4).
 - ▶ We harmonize countries and industries dimensions.
 - ▶ But cannot merge (1993 vs. 2008 System of National Accounts).
- ▶ Caveats for WIOD: proportionality assumptions
- ▶ Cross-border ownership indicators: from Ramondo, Rodriguez-Clare & Tintelnot (2015) (average values for 1996–2001).
- ▶ CEPII gravity database.

Leontief (1936) at the international level

$$X = AX + Y$$

- ▶ X = output, Y = world demand final goods, A = unit requirements.
- ▶ a_{ij}^{od} = value of inputs from industry i located in country o that is needed to produce 1\$ worth of product j in country d .

$$X = (I - A)^{-1} Y = BY$$

- ▶ Pre-multiply by factor f cost share in gross output

$$V_f = F_f V$$

where V = VA intensity of output, F_f = factor f share in VA.

$$V_f X = V_f BY$$

- ▶ $V_f BY$ = factor incomes for any factor f in every $c \times i$.

V_fBY

- ▶ Matrix describes the (ultimate) sources of primary factor income.
- ▶ Typical element of V_fBY matrix: $(v_fby)_{ij}^{od}$:
 - ▶ **Payments to factor** f employed in sector i in origin country o from **contributing to production of final good** j in destination country d , through any and every type of linkage.
 - ▶ Export of intermediate inputs if $o \neq d$.
 - ▶ Exports of final goods: splits of y .
- ▶ Accounting identities (world is closed economy)
 - ▶ World GDP = sum all elements of Y (expenditure approach).
 - ▶ World GDP = sum all elements of VB_Y (income approach).

Accounting for changes in LSs

- ▶ Factor payments become more reliant on forward GVC participation.
- ▶ Decompose $\Delta(V_f BY)$ into parts due to
 - ▶ $\Delta V_f =$ within-industry changes.
 - ▶ $\Delta B =$ change in network structure (industry composition).
 - ▶ $\Delta Y =$ change in final demand (industry composition).
- ▶ On average, $\Delta LS = -2.45$, of which :
 - ▶ $\Delta V_f \implies -1.06$, within-industry changes.
 - ▶ $\Delta Y \implies -0.44$, due to shift towards foreign demand.
 - ▶ $\Delta B \implies -0.47$, due to changes in supply chains.
- ▶ Upshot: analysis both at industry and country level.
- ▶ Magnitudes of changes within manufacturing larger, but similar relative importance of various dimensions (dropped to ease presentation).

Accounting for changes in LSs: changes in GVC network

- ▶ Stone's decomposition of ΔB into parts due to
 - ▶ ΔB^d = strictly domestic VCs (domestic I/O linkages).
 - ▶ ΔB^x = strictly bilateral VCs (exports of intermediate inputs).
 - ▶ ΔB^g = complex GVCs (exports of intermediate inputs).
- ▶ $\Delta B = -0.47$ (changes in supply chains) :
 - ▶ Due to shift from domestic VCs ($\Delta B^d = -1.59$)
 - ▶ to foreign VCs ($\Delta B^x + \Delta B^g = 0.42 + 0.70$),
 - ▶ where $\Delta B^g = 62\%$ of $\Delta B^x + \Delta B^g$.
- ▶ Upshot: complex GVCs important, cannot use only direct links.

Regressions

Stacked panel of changes

$$\Delta LS_{ict} = \gamma_1 \Delta FWD_{ict} + \gamma_2 \Delta BACK_{ict} + \gamma_3 \Delta EXP_{ict} + \gamma_4 \Delta IMP_{ict} \\ + \kappa_1 \Delta \ln q_{ct} + FEs + \varepsilon_{ict}$$

▶ Globalization

- ▶ *FWD* = forward GVC intensity in VA.
- ▶ *BACK* = offshoring of intermediate inputs intensity in total inputs.
- ▶ *EXP* = export intensity of final goods in VA.
- ▶ *IMP* = import intensity of final goods in domestic absorption.

▶ Technical change

- ▶ $\Delta \ln q$ = change in relative price of investment (standardized).
- ▶ Panel of changes: 1995–2001, 2001–2007, 2007–2014.
- ▶ WLS (VA weights), two-way clustered SEs by c and by i .

Concerns for identification

$$\Delta LS_{ict} = \gamma_1 \Delta FWD_{ict} + \gamma_2 \Delta BACK_{ict} + \gamma_3 \Delta EXP_{ict} + \gamma_4 \Delta IMP_{ict} \\ + \kappa_1 \Delta \ln q_{ct} + FEs + \varepsilon_{ict}$$

- ▶ Measurement error in VA would bias coef. to ΔFWD towards 1.
 - ▶ Works against finding negative coef. to ΔFWD .
- ▶ Main threat: biased technological change.
 - ▶ Suppose

$$Q = [\alpha (AK)^\rho + (1 - \alpha) (BL)^\rho]^{1/\rho},$$

then

$$LS = 1 - \alpha^\sigma (A/R)^{\sigma-1}.$$

- ▶ A affects both LS and exports (similarly, B , R); direction depends on whether $\sigma \gtrless 1$ KN vs OR and GS debate.
- ▶ Structural gravity-based IV: purge trends in A + production costs.

Instrument: sketch

- ▶ Consider gravity relationship *à la* Eaton & Kortum (2002):

$$\ln X_{cd} = -\theta \ln \tau_{cd} + \underbrace{\ln T_c - \theta \ln w_c}_{\gamma_c} + \underbrace{\ln X_d - \ln \Phi_d}_{\delta_d},$$

where

$$\Phi_d = \underbrace{T_c w_c^{-\theta}}_{\exp\{\gamma_c\}} \tau_{cd}^{-\theta} + \sum_{j \neq c} T_j (w_j \tau_{jd})^{-\theta}.$$

1. Purge X_{cd} from variation in γ_c , including inside $\Phi_d \implies \tilde{X}_{cd}$.
2. IV uses changes in \tilde{X}_{cd} over time

$$\Delta Z_{ict} = \ln \sum_{d \neq c} \widetilde{vby}_{cd}^{i,t} - \ln \sum_{d \neq c} \widetilde{vby}_{cd}^{i,t-1},$$

where we use $\widetilde{vby}_{cd}^{i,t}$ for X_{cd} .

- ▶ exogenous to $cty \times ind$ **technological change**, cost variation.
- ▶ w_c absorbs costs of domestic factors + imported inputs.

Instrument: discussion

$$\ln X_{cd} = -\theta \ln \tau_{cd} + \underbrace{\ln T_c - \theta \ln w_c}_{\gamma_c} + \underbrace{\ln X_d - \ln \Phi_d}_{\delta_d},$$

- ▶ Gravity structure above is for trade in gross terms (EK).
- ▶ We apply to VA payments to primary factors.
 - ▶ Similar structure in multi-industry I/O of Caliendo and Parro (2015).
 - ▶ Can adapt sequential GVC model of Antras and de Gortari (2020) to this structure, if VA share in gross output declines with downstreamness at rate $1/n$ ($n = 1$ is first step, N is the last), which is what we find.

VA share and downstreamness

Instrument: implementation

$$X_{cd} = \exp\left\{-\theta \ln \tau_{cd} + \underbrace{\ln T_c - \theta \ln w_c}_{\gamma_c} + \underbrace{\ln X_d - \ln \Phi_d}_{\delta_d}\right\}$$

- ▶ For each industry i and $t \in \{1995, 2001, 2007, 2014\}$:
- ▶ PPML for $X_{cd}^{i,t} = (vby)_{cd}^{i,t} = \sum_j (vby)_{cd}^{ij,t}$, including $c = d$.
 - ▶ obtain $\widehat{\gamma}_c^{i,t}$, $\widehat{\delta}_d^{i,t}$ and residual $(\widehat{\tau}^{-\theta})_{cd}^{i,t}$ —up to some normalization.
 - ▶ $\widehat{\Phi}_d^{i,t} = X_d^{i,t} / \exp\{\widehat{\delta}_d^{i,t}\}$, where $X_d^{i,t} = \sum_c (vby)_{cd}^{i,t}$ is data.
 - ▶ replace $\widehat{\gamma}_c^{i,t}$ by its average across c , $\widetilde{\gamma}^{i,t}$, $\implies \widetilde{vby}_{cd}^{i,t}$.
- ▶ IV for ΔFWD_{ict} :

$$\Delta Z_{ict} = \ln \sum_{d \neq c} \widetilde{vby}_{cd}^{i,t} - \ln \sum_{d \neq c} \widetilde{vby}_{cd}^{i,t-1}$$

Instrument: sensitivity

- ▶ Alternative 1:

$$\Delta Z_{ict} = \frac{\sum_{d \neq c} \widetilde{vby}_{cd}^{i,t}}{\sum_d \widetilde{vby}_{cd}^{i,t}} - \frac{\sum_{d \neq c} \widetilde{vby}_{cd}^{i,t-1}}{\sum_d \widetilde{vby}_{cd}^{i,t-1}}.$$

- ▶ Significantly weaker IV; ΔEXP_{ict} includes VA in denominator, too.
- ▶ Alternative 2:

$$\Delta Z_{ict} = \ln \sum_{d \neq c} \widetilde{vay}_{cd}^{i,t} - \ln \sum_{d \neq c} \widetilde{vay}_{cd}^{i,t-1},$$

where **vay** uses only direct I/O linkages (vs. **vby**).

- ▶ Similar results within manufacturing, but weak IV when all industries included; few, ill-identified direct links in services.
- ▶ Conley, Hansen & Rossi (2012)'s "Local-to-Zero Approximation".
 - ▶ Reasonable uncertainty about exclusion restriction does not render W2SLS results uninformative (SEs remain small).

Table 4. Changes in Labor Shares and Forward GVC Integration in 1995-2014

	Dependent variable: Δ labor share						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Manufacturing industries							
Δ forward intensity	-0.276** (0.118)	-0.224* (0.105)	-0.313** (0.110)	-0.321** (0.123)	-0.365** (0.123)	-0.296*** (0.053)	-0.429*** (0.080)
Δ backward intensity	-0.159 (0.179)	-0.137 (0.171)	-0.228 (0.198)	-0.179 (0.190)	-0.259 (0.225)	-0.217 (0.206)	-0.287 (0.298)
Δ exports of final goods intensity	0.031 (0.090)	0.049 (0.068)	0.066 (0.063)	0.077 (0.096)	0.115 (0.087)	0.130* (0.067)	0.135 (0.096)
Δ imports of final goods intensity	0.015 (0.015)	0.015 (0.013)	0.013 (0.013)	0.013 (0.015)	0.012 (0.012)	0.013 (0.010)	0.022 (0.013)
Δ log relative price of investment	-0.006 (0.050)	0.006 (0.057)	-0.017 (0.061)	-0.006 (0.051)	-0.017 (0.061)	0.002 (0.075)	0.012 (0.075)
Fixed effects	-	Per	Cty	Ind	Cty, Ind	Cty, Ind, Per	Cty-Ind, Per
Observations	1,532	1,532	1,532	1,532	1,532	1,532	1,522
R-squared	0.026	0.079	0.117	0.044	0.135	0.185	0.301

► IQR ΔFWD associated with 20% of IQR of ΔLS (column 7).

Table 5. Changes in Labor Shares and Forward GVC Integration in 1995-2014: W2SLS

	Dependent variable: Δ labor share					
	(1)	(2)	(3)	(4)	(5)	(6)
	Manufacturing industries			Private sector industries		
	WLS	W2SLS	1st stage	WLS	W2SLS	1st stage
Δ forward intensity	-0.429*** (0.080)	-0.685*** (0.115)		-0.283** (0.107)	-0.305** (0.145)	
Δ backward intensity	-0.287 (0.298)	-0.399 (0.306)	-0.292*** (0.082)	-0.153 (0.149)	-0.160 (0.153)	-0.194*** (0.055)
Δ exports of final goods intensity	0.135 (0.096)	0.188 (0.109)	0.072 (0.050)	0.126 (0.129)	0.132 (0.139)	0.135* (0.068)
Δ imports of final goods intensity	0.022 (0.013)	0.024* (0.013)	0.006 (0.004)	0.013* (0.007)	0.013* (0.007)	0.006 (0.003)
Δ log relative price of investment	0.012 (0.075)	0.029 (0.074)	0.022 (0.017)	0.019 (0.044)	0.020 (0.043)	-0.001 (0.014)
ΔZ			0.124*** (0.026)			0.080*** (0.017)
Fixed effects: Cty-Ind, Period	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1522	1,522	1,522	3,241	3,241	3,241
R-squared	0.301		0.744	0.310		0.651
Kleibergen-Paap F statistic		23.29			21.53	

- ▶ Larger W2SLS coef. consistent with measurement error, and role for technology (e.g., labor augmenting tech chg + $\sigma < 1$).
- ▶ IQR ΔFWD associated with 32% of IQR of ΔLS (manuf).

Table 6. Changes in Labor Shares and Forward GVC Integration in 1995-2014: period splits, China and assembly offshoring

	Dependent variable: Δ labor share									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Manufacturing industries					Private sector industries				
Δ forward intensity	-0.429*** (0.080)					-0.283** (0.107)				
1995-2001		-0.160 (0.247)					-0.152 (0.239)			
2001-2007		-1.038*** (0.271)					-0.815*** (0.232)			
2007-2014		0.479 (0.391)					0.181 (0.183)			
Δ forward intensity to China			-1.582** (0.698)					-1.266** (0.551)		
1995-2001				-0.616 (0.442)					-1.625*** (0.454)	
2001-2007				-1.744** (0.679)					-1.624*** (0.490)	
2007-2014				2.154 (1.519)					0.568 (0.447)	
Δ forward intensity to RoW			-0.220 (0.196)					-0.183 (0.114)		
1995-2001				-0.082 (0.279)					-0.055 (0.235)	
2001-2007				-0.769*** (0.234)					-0.649*** (0.177)	
2007-2014				0.310 (0.338)					0.087 (0.155)	
Δ forward intensity, net of assembly offshoring					-0.379*** (0.051)					-0.308*** (0.094)
Fixed effects: Cty-Ind, Period	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,522	1,522	1,522	1,522	1,483	3,241	3,241	3,241	3,241	3,160
R-squared	0.301	0.395	0.323	0.412	0.313	0.310	0.346	0.319	0.354	0.320

► Effect concentrated in 2001–2007, stronger for China.

Country level regressions

$$\Delta LS_{ct} = \gamma_1 \Delta FWD_{ct} + \gamma_2 \Delta BACK_{ct} + \gamma_3 \Delta EXP_{ct} + \gamma_4 \Delta IMP_{ct} \\ + \kappa_1 \Delta \ln q_{ct} + FEs + \varepsilon_{ct}$$

- ▶ Panel of changes: 1995–2001, 2001–2007, 2007–2014.
- ▶ WLS (VA weights), two-way clustered SEs by c and by i .
- ▶ IV constructed in the same way as above.

Table 7. Changes in Labor Shares and Forward GVC Integration in 1995-2014: Country level regressions

	Dependent variable: Δ labor share					
	(1)	(2)	(3)	(4)	(5)	(6)
A. Manufacturing industries						
	WLS				W2SLS	1st stage
Δ forward intensity	-0.652*** (0.193)	-0.560*** (0.202)	-0.802*** (0.261)	-0.679** (0.314)	-1.245*** (0.278)	
Δ backward intensity	-0.541 (0.538)	-0.595 (0.440)	-0.562 (0.624)	-0.616 (0.610)	-0.466 (0.688)	-0.213 (0.308)
Δ exports of final goods intensity	-0.085 (0.455)	-0.055 (0.453)	-0.171 (0.490)	-0.122 (0.522)	-0.070 (0.572)	0.324 (0.250)
Δ imports of final goods intensity	0.357 (0.246)	0.395* (0.223)	0.268 (0.246)	0.378* (0.196)	0.287 (0.238)	0.068 (0.100)
Δ log relative price of investment	-0.014 (0.054)	0.013 (0.063)	0.005 (0.071)	0.042 (0.079)	0.009 (0.075)	0.023 (0.020)
ΔZ						0.049*** (0.008)
Fixed effects	-	Per	Cty	Cty, Per	Cty	Cty
Observations	117	117	117	117	117	117
R-squared	0.208	0.319	0.448	0.546		0.729
Kleibergen-Paap F statistic					42.69	

- ▶ Similar results as for country \times industry-level variation.
- ▶ Larger coefficients, greater explanatory power.

Mechanisms

Is there a role for endowments?

- ▶ Sposi, Yi & Zhang (2020): model of within-VC specialization.
 - ▶ Extension of Antras & de Gortari (2020 *ECMA*).
 - ▶ Capital abundant countries specialize in capital intensive production.
 - ▶ When fragmentation not possible, only across final goods.
 - ▶ Once fragmentation possible, this manifests across tasks within VCs:
 - ▶ labor intensive final good assembly \implies labor abundant country.
 - ▶ capital intensive upstream inputs \implies capital abundant country.
- ▶ We show: upstream production less labor intensive.
 - ▶ GVCs account for $>100\%$ of increases in upstreamness (on avg.).
- ▶ Predictions
 - ▶ *FWD* more K-intensive when origin more K-abundant,
 - ▶ *FWD* larger (level) when origin more K-abundant,
 - ▶ and these associations should strengthen over time, with reductions in barriers to fragmentation.

- ▶ Capital intensity of *FWD* regression, OLS

$$\frac{(V_K BY)_{od} - (V_L BY)_{od}}{GDP_o} = \beta \cdot RKA_{od} + \gamma' gravity_{od} + \alpha_o + \alpha_d + \varepsilon_{od}$$

where relative capital abundance =

$$RKA_{od} = \ln \left(\frac{E_o^K}{E_o^K + E_d^K} \right) - \ln \left(\frac{E_o^L}{E_o^L + E_d^L} \right)$$

- ▶ Level regression, PPML

$$VBY_{od} = \exp\{\beta \cdot RKA_{od} + \gamma' gravity_{od} + \alpha_o + \alpha_d\} + \varepsilon_{od}$$

- ▶ Two cross sections: 2001 and 2007.
- ▶ SEs clustered by *o* and *d*.

Table 10. Factor endowments and forward GVC integration

Estimator:	(1) OLS	(2) OLS	(3) PPML	(4) PPML	(5) PPML	(6) PPML
Dependent variable:	(VKBY-VLBY)/GDP, 2001	(VKBY-VLBY)/GDP, 2007	VBY, 2001	VBY, 2007	V(Bx)Y, 2007	V(Bg)Y, 2007
Relative capital abundance	0.268** (0.113)	0.317** (0.149)	0.522** (0.229)	0.863*** (0.208)	1.067*** (0.287)	0.293*** (0.101)
Log distance	0.017 (0.022)	0.015 (0.018)	-0.484*** (0.071)	-0.526*** (0.061)	-0.635*** (0.075)	-0.175*** (0.032)
Common border	-0.093 (0.057)	-0.023 (0.073)	0.155 (0.108)	0.143 (0.107)	0.190 (0.124)	-0.302*** (0.070)
Colonial ties	-0.011 (0.057)	-0.045 (0.060)	0.174 (0.115)	0.153 (0.107)	0.213 (0.135)	0.018 (0.032)
Common language	0.038 (0.067)	0.053 (0.070)	0.242** (0.117)	0.315*** (0.116)	0.399** (0.157)	0.016 (0.038)
Free trade agreement	0.017 (0.024)	0.080* (0.043)	0.259 (0.163)	0.099 (0.121)	0.084 (0.151)	0.127*** (0.047)
Common currency	-0.032 (0.029)	-0.056* (0.028)	0.084 (0.137)	0.044 (0.145)	0.077 (0.187)	0.198*** (0.065)

- ▶ Stronger associations in 2007 vs. 2001 (no claim for stat sig).
- ▶ Level effect stronger via direct exports of inputs [B^x].
- ▶ Sensible gravity correlates: language, FTA, currency.

Measuring upstreamness

$$U_i^r = 1 \times \frac{Y_i^r}{X_i^r} + 2 \times \frac{\sum_s \sum_j a_{ij}^{rs} Y_j^s}{X_i^r} + 3 \times \frac{\sum_s \sum_j \sum_t \sum_k a_{ij}^{rs} a_{jk}^{st} Y_k^t}{X_i^r} + \dots$$

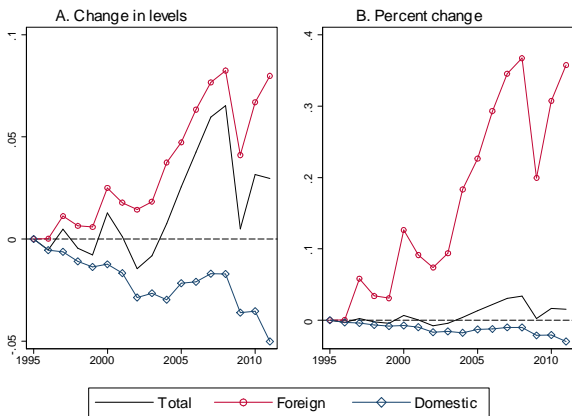
- ▶ If produce only final goods ($a_{ij}^{rs} = 0$ for all s, j), then $U_i^r = Y_i^r / X_i^r = 1$.
- ▶ If output used also for inputs ($a_{ij}^{rs} > 0$ for some s, j), then $U_i^r > 1$.
- ▶ Can split

$$U = U^D + U^F$$

- ▶ U^D = upstreamness due to domestic VCs.
- ▶ U^F = upstreamness due to GVCs.

GVCs drive upstreamness up

$$\text{WLS (GDP)} : y_{ct} = \alpha_c + \beta_t + \varepsilon_{ct} \implies \text{plot } \hat{\beta}_t - \hat{\beta}_{1995}$$



- ▶ Most of the increase due to Foreign, in 2001–2007.

Table 8. Upstreamness and Labor Shares, 2001-2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Manufacturing industries								
	Dependent variable: labor share						Dependent variable: Δ labor share	
Upstreamness	-0.041 (0.047) [-0.132]	-0.136 (0.081) [-0.438]	-0.125* (0.069) [-0.402]				-0.128* (0.064) [-0.210]	
Domestic				-0.085** (0.038) [-0.217]	-0.020 (0.042) [-0.052]	-0.028 (0.049) [-0.071]		0.036 (0.041) [0.055]
Foreign				0.059 (0.065) [0.141]	-0.240*** (0.060) [-0.575]	-0.232*** (0.064) [-0.555]		-0.227*** (0.043) [-0.347]
Downstreamness	-0.109 (0.100) [-0.153]	-0.007 (0.083) [-0.010]	0.042 (0.089) [0.058]	-0.091 (0.089) [-0.126]	0.029 (0.070) [0.041]	0.035 (0.078) [0.049]	-0.035 (0.078) [-0.046]	-0.059 (0.065) [-0.077]
Fixed effects	Year	Cty X Ind	Cty X Ind, Yr	Year	Cty X Ind	Cty X Ind, Yr	-	-
Observations	3,727	3,725	3,725	3,727	3,725	3,725	530	530
R-squared	0.069	0.952	0.954	0.130	0.956	0.956	0.081	0.182

- ▶ U^D associated with lower LS in cross section (also Antras *et al.* 2012).
- ▶ Increases in U^F associated with reductions LS (new): over time within industries, and long changes.

Functional specialization

- ▶ Timmer, Miroudot & de Vries (2019) split labor payments into: management (MGT), R&D, fabrication (FAB), and marketing (MKT),

$$\Delta LS_{ic} = \Delta MGT_{ic} + \Delta R\&D_{ic} + \Delta FAB_{ic} + \Delta MAR_{ic}$$

- ▶ Inspection of underlying data: particularly meaningful in manufacturing, less so services (*MAR* is a residual).
- ▶ Estimate over 2001–2007

$$\Delta FUNCTION_{ic} = \beta^D \Delta U_{ic}^D + \beta^F \Delta U_{ic}^F + \delta \Delta D_{ic} + \text{fixed effects} + \varepsilon_{ic}$$

$$\Delta FUNCTION_{ic} = \gamma_1 \Delta FWD_{ic} + \gamma_2 \Delta OFF_{ic} + \gamma_3 \Delta EXP_{ic} + \gamma_4 \Delta IMP_{ic} + \kappa_1 \Delta \ln q_c + \text{fixed effects} + \varepsilon_{ic}$$

- ▶ D_{ic} is downstreamness, $FUNCTION \in \{MGT, R\&D, FAB, MAR\}$.

Table 9. Functional Specialization, Upstreamness and Forward Foreign GVC Integration, 2001-2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
A. Manufacturing												
Dependent variable:	Δ MGT	Δ R&D	Δ FAB	Δ MAR	Δ MGT	Δ R&D	Δ FAB	Δ MAR	Δ MGT	Δ R&D	Δ FAB	Δ MAR
Δ upstreamness, foreign	-0.043*** (0.014)	-0.009 (0.015)	-0.140*** (0.038)	-0.035*** (0.010)	-0.042** (0.016)	0.006 (0.017)	-0.112*** (0.035)	-0.020** (0.008)	-0.038*** (0.009)	-0.018 (0.015)	-0.143** (0.057)	-0.029** (0.012)
Δ upstreamness, domestic	0.003 (0.010)	-0.006 (0.014)	0.029 (0.029)	0.010 (0.010)	0.009 (0.011)	0.004 (0.013)	-0.029 (0.029)	-0.002 (0.010)	-0.003 (0.009)	-0.010 (0.013)	0.026 (0.037)	0.013 (0.014)
Δ downstreamness	-0.040* (0.022)	0.016 (0.014)	-0.000 (0.043)	-0.034** (0.015)	-0.041 (0.025)	0.009 (0.017)	0.041 (0.045)	-0.024 (0.017)	-0.011* (0.006)	0.027*** (0.008)	0.026 (0.054)	-0.027 (0.028)
Δ forward intensity	-0.167*** (0.049)	-0.019 (0.047)	-0.398*** (0.101)	-0.141*** (0.038)	-0.181** (0.066)	-0.007 (0.058)	-0.256*** (0.071)	-0.102*** (0.029)	-0.091*** (0.026)	-0.018 (0.032)	-0.368* (0.194)	-0.093* (0.045)
Fixed effects	-	-	-	-	Ind	Ind	Ind	Ind	Cty	Cty	Cty	Cty

- ▶ ΔU^F and ΔFWD associated with declines in FAB , roughly $\times 2$ the combined effect on $MGT + MAR$.
 - ▶ Baldwin (2016): GVC integration, moving production stages within VC across borders involves technology and management transfer.
 - ▶ Alternative interpretation: final good production requires more management of VC + marketing for consumers.
- ▶ R&D not affected by U , but small effect of downstreamness (10).

Role of multinationals, direction of offshoring

- ▶ What is the likely ownership structure of offshoring?
- ▶ Are exports of intermediate inputs from o to d associated with
 - ▶ MNEs in d outsourcing upstream input production to affiliates in o ?
 - ▶ MNEs in o outsourcing downstream assembly to affiliates in d ?

$$VBY_{od} = \exp\{\beta \cdot \operatorname{arcsinh}(\operatorname{affiliates}_{od}) + \delta \cdot \operatorname{arcsinh}(\operatorname{affiliates}_{do}) + \gamma' \operatorname{gravity}_{od} + \alpha_o + \alpha_d\} + \varepsilon_{od}$$

- ▶ Estimate by PPML, one cross section in 2001.
 - ▶ $\operatorname{affiliates}_{od}$ = no. affiliates located in o with parents in (owned by) d .
 - ▶ $\operatorname{affiliates}_{do}$ = no. affiliates located in d with parents in (owned by) o .
 - ▶ Affiliates from RR&T (2015), average in 1996–2001.
 - ▶ $\operatorname{arcsinh}(x) = \ln[x + (1 + x^2)^{1/2}]$ ($\ln(1 + x)$ yields similar results).

Table 11. Multinationals and forward GVC integration

Dependent variable:	(3) Forward GVC integration $VBY(o,d) = V(Bx)Y(o,d)$	(6) Direct bilateral exports of intermediate inputs $V(Bx)Y(o,d)$	(9) Complex global value chains $V(Bg)Y(o,d)$
arcsinh no. of affiliates in o with parents in d	0.099*** (0.024)	0.127*** (0.031)	0.035** (0.014)
arcsinh no. of affiliates in d with parents in o	0.112*** (0.038)	0.141*** (0.050)	0.043*** (0.014)
Log distance	-0.357*** (0.057)	-0.419*** (0.071)	-0.115*** (0.033)
Common border	0.206** (0.091)	0.267** (0.108)	-0.267*** (0.063)
Colonial ties	0.041 (0.100)	0.068 (0.124)	0.000 (0.033)
Common language	0.208** (0.106)	0.263* (0.144)	-0.021 (0.041)
Free trade agreement	0.242** (0.119)	0.270* (0.148)	0.184*** (0.050)
Common currency	-0.023 (0.139)	-0.014 (0.179)	0.159** (0.065)

- ▶ MNEs associated in both types of offshoring.
- ▶ Sensible gravity correlates: border, language, FTA.

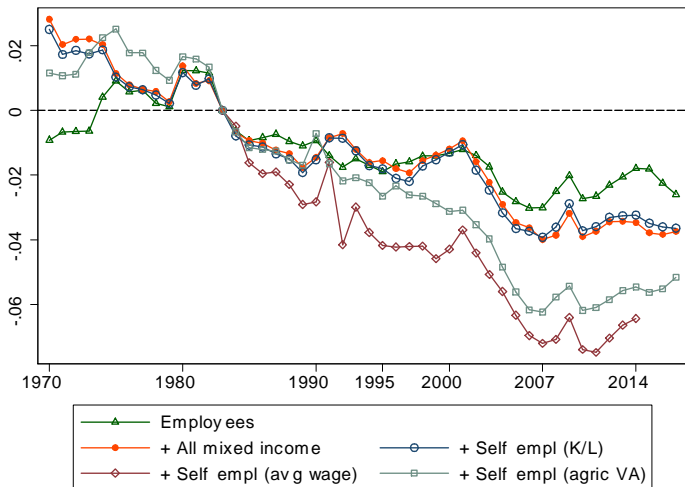
Conclusions, takeaway messages

Conclusions, takeaway messages

- ▶ LSs decline significantly in 1995–2007, level-off in 2007–2014;
 - ▶ *Skilled* labor shares increase strongly and uniformly throughout.
 - ▶ Corollary: unskilled labor bears the burden (reminiscent of Wood 1995, Richardson 1995).
- ▶ Forward GVC integration explains part of 2001–2007 acceleration in decline in LSs.
 - ▶ Greater upstream, capital intensive intermediate input trade.
 - ▶ Changes in functional specialization.
- ▶ China accounts for much of this.
- ▶ Evidence for within-VC HO mechanics.
- ▶ Tasks not affected equally: mostly FAB, but also MGT and MKT.
- ▶ MNEs offshore both upstream input production and downstream assembly.

Bonus Slides

WLS (GDP) $y_{ct} = \alpha_c + \beta_t + \varepsilon_{ct}$: figure plots $\hat{\beta}_t, \hat{\beta}_{1983} = 0$

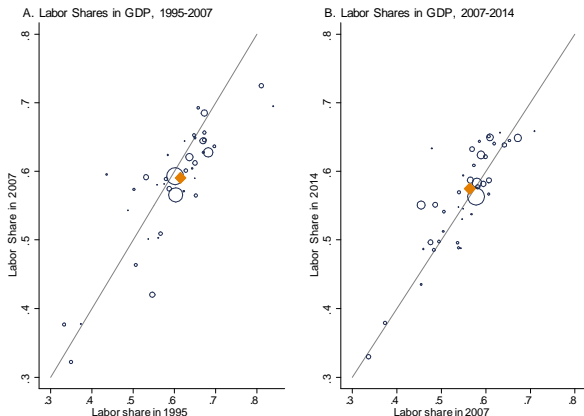


Proportionality assumptions in WIOD

$$V_f X = F_f V B Y = F_f V (I - A)^{-1} Y$$

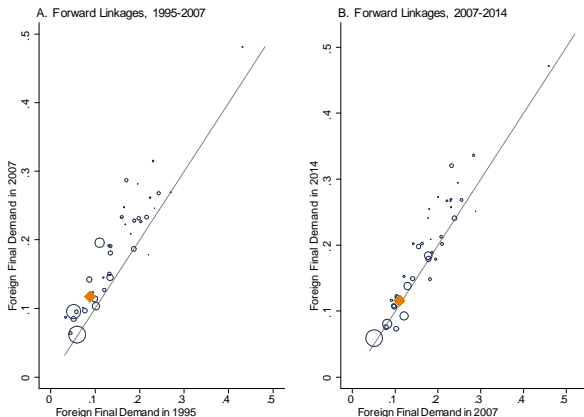
- ▶ Imports of inputs allocated across industries in A using same proportions as domestic IO tables.
- ▶ VA intensity V does not depend on end use, global sourcing, *etc.*
 - ▶ de Gortari (2019): can have significant quantitative implications.
 - ▶ Puzzello (2012): not so much.
- ▶ Factor intensity F_f does not depend on end use, global sourcing, *etc.*
 - ▶ We know: exporters more capital intensive, skill intensive.
 - ▶ Ignoring this may under-estimate the role of globalization (lots of lit.).

Labor shares: 1995–2007 decrease, 2007–2014 increase



- ▶ 1995–2007: avg decline 2.5pp. 2007–2014: avg increase 1pp.
- ▶ Very similar pattern in PWT data.

GVCs: 1995–2007 deepening, 2007–2014 slowdown



- ▶ $forward^o$ = share of payments to domestic factors in o that originate from supplying inputs to foreign industries (forward algebra).
- ▶ 1995–2007 deepening +3pp; 2007–2014 slowdown +0.5pp.

Forward foreign GVC intensity

- ▶ Define $vby^{od} = \sum_i \sum_j (vby)_{ij}^{od}$.
- ▶ $forward^o =$ share of payments to domestic factors in o that originate in foreign industries

$$forward^o = \sum_{d \neq o} \frac{(vby)^{od}}{GDP^o} = \sum_{d \neq o} \frac{(vby)^{od}}{\sum_d (vby)^{od}}$$

- ▶ $GDP^o =$ total payments to primary factors *located* in o , originating from supplying services to anywhere in the world.
- ▶ Similar trends for $\Delta backward^o$ (offshoring in VA terms).

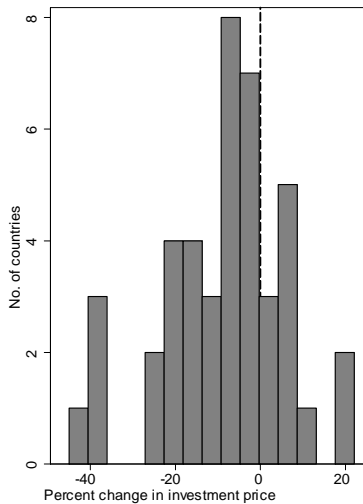
Back to forward GVC figure

Technical change

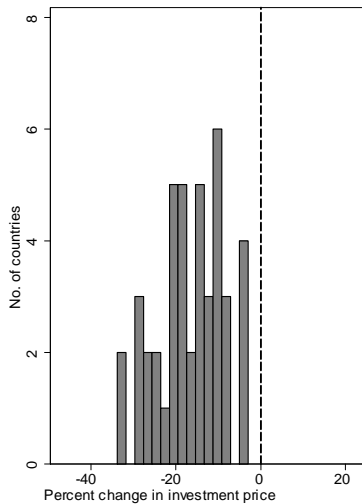
- ▶ Price of investment declines [P_{inv} figure](#).
- ▶ Karababounis & Nieman (2014): $P_{inv} \downarrow + \widehat{EoS}_{K,N} > 1 \implies LS \downarrow$.
- ▶ Oberfield & Raval (2014): $\widehat{EoS}_{K,N} < 1$ in manufacturing \implies KN mechanism cannot explain decline in LS in manufacturing.
- ▶ Glover & Short (2020): KN miscalculate rental rate; correction gives $\widehat{EoS}_{K,N} < 1$.
- ▶ We don't take a stand in this debate; we just control for changes in price of investment.

[Back to endogeneity](#)

A. 1995-2007



B. 2007-2014



Payments to Domestic Factors (Forward Linkages), 1995-2007

	Percent in GDP							
	K income from domestic industries	L income from domestic industries	K income from foreign industries	L income from foreign industries	K income (domestic + foreign)	L income (domestic + foreign)	Income from domestic industries	Income from foreign industries
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1995	35.01	56.11	3.48	5.40	38.49	61.51	91.12	8.88
2007	35.88	52.39	5.06	6.67	40.94	59.06	88.27	11.73
<i>Change</i>	0.87	-3.72	1.57	1.27	2.45	-2.45	-2.84	2.84

- ▶ Factor payments become more reliant on GVC participation (7,8).
- ▶ K-intensity increases both in domestic VCs (1,2) and GVCs (3,4).
- ▶ Of $\Delta LS = -2.45$:
 - ▶ $\Delta V_f \implies -1.06$, within-industry changes.
 - ▶ $\Delta Y \implies -0.44$, due to shift towards foreign demand.
 - ▶ $\Delta B \implies -0.47$, due to changes in supply chains.

	1995			$\Delta 1995-2007$		
	from domestic industries (1)	from foreign industries (2)	Domestic + foreign (3)	from domestic industries (4)	from foreign industries (5)	Domestic + foreign (6)
Value chains (B)						
Domestic	55.99	0	55.99	-1.59	0	-1.59
Bilateral trade	0	4.52	4.52	0	0.42	0.42
Complex GVCs	0.12	0.88	1.00	0.05	0.64	0.70
Total	56.11	5.40	61.51	-1.53	1.07	-0.47

- ▶ $\Delta B = -0.47$ (changes in supply chains) :
 - ▶ Due to shift from domestic VCs ($\Delta B^d = -1.59$)
 - ▶ to foreign VCs ($\Delta B^x + \Delta B^g = 0.42 + 0.70$).
 - ▶ Within foreign VCs, $\Delta B^g = 62\%$ of $\Delta B^x + \Delta B^g$.

- ▶ Upshot: study both within-industry and aggregate ΔLS .

Composition or within-industry variation?

- ▶ Decompose true changes in factor shares $\Delta(V_f B Y)$

$$\begin{aligned} V_{f2} B_2 Y_2 - V_{f1} B_1 Y_1 &= \Delta V_f B_1 Y_1 + V_{f1} \Delta B Y_1 + V_{f1} B_1 \Delta Y \\ &\quad + V_{f1} \Delta B \Delta Y + \Delta V_f B_1 \Delta Y + \Delta V_f \Delta B Y_1 \\ &\quad + \Delta V_f \Delta B \Delta Y \end{aligned}$$

- ▶ Δ denotes the element-by-element change operator.
- ▶ Counterfactuals:
 - ▶ Changes only in V_f (within-industry): $\Delta \mathbf{V}_f B_1 Y_1$
 - ▶ Changes only in B (composition, I/O): $V_{f1} \Delta \mathbf{B} Y_1$
 - ▶ Changes only in Y (composition, demand): $V_{f1} B_1 \Delta \mathbf{Y}$
 - ▶ Changes only in BY (composition, overall):

$$V_{f1} \Delta(\mathbf{B} \mathbf{Y}) = V_{f1} \Delta \mathbf{B} Y_1 + V_{f1} B_1 \Delta \mathbf{Y} + V_{f1} \Delta \mathbf{B} \Delta \mathbf{Y}$$

- ▶ Report weighted (by GDP) averages of true and counterfactuals.

Sources of declines in labor shares, 1995–2007

	Shares in GDP							
	K income from domestic industries (1)	L income from domestic industries (2)	K income from foreign industries (3)	L income from foreign industries (4)	K income (domestic + foreign) (5)	L income (domestic + foreign) (6)	Income from domestic industries (7)	Income from foreign industries (8)
Levels								
VBY 1995	35.01	56.11	3.48	5.40	38.49	61.51	91.12	8.88
VBY 2007	35.88	52.39	5.06	6.67	40.94	59.06	88.27	11.73
Changes								
V2007*B1995*Y1995 - VBY 1995	0.95	-0.77	0.11	-0.29	1.06	-1.06	0.18	-0.18
V1995*B2007*Y1995 - VBY 1995	-0.66	-1.53	1.13	1.07	0.47	-0.47	-2.19	2.19
V1995*B1995*Y2007 - VBY 1995	-0.12	-1.65	0.56	1.21	0.44	-0.44	-1.77	1.77
V1995*B2007*Y2007 - VBY 1995	-0.42	-2.71	1.28	1.85	0.86	-0.86	-3.13	3.13
VBY 2007 - VBY 1995	0.87	-3.72	1.57	1.27	2.45	-2.45	-2.84	2.84

- ▶ Globalization = increase in foreign-sourced income (col. 8, $\Delta forward$).
 - ▶ Globalization associated with composition ΔBY , not ΔV .
 - ▶ *forward* (level) and $\Delta forward$ more capital intensive (cols 1–4).
- ▶ Decline in LS associated with
 - ▶ within-industry $\Delta V = -1.06\text{pp}$, 46% of drop in LS.
 - ▶ composition/globalization $\Delta BY = -0.86\text{pp}$, 38%.

Sources of increases in labor shares, 2007–2014

	Shares in GDP							
	K income from domestic industries (1)	L income from domestic industries (2)	K income from foreign industries (3)	L income from foreign industries (4)	K income (domestic + foreign) (5)	L income (domestic + foreign) (6)	Income from domestic industries (7)	Income from foreign industries (8)
Levels								
VBY 2007	38.17	50.68	5.43	5.71	43.61	56.39	88.85	11.15
VBY 2014	37.20	51.10	5.33	6.37	42.53	57.47	88.30	11.70
Changes								
V2014*B2007*Y2007 - VBY 2007	-1.02	1.04	-0.35	0.33	-1.37	1.37	0.02	-0.02
V2007*B2014*Y2007 - VBY 2007	-0.30	-0.06	0.27	0.09	-0.03	0.03	-0.36	0.36
V2007*B2007*Y2014 - VBY 2007	-0.17	-0.81	0.31	0.66	0.15	-0.15	-0.97	0.97
V2007*B2014*Y2014 - VBY 2007	-0.14	-0.46	0.22	0.37	0.08	-0.08	-0.59	0.59
VBY 2014 - VBY 2007	-0.97	0.42	-0.10	0.65	-1.07	1.07	-0.55	0.55

- ▶ Increase in LS = +1.07pp, in contrast to decline in 1995–2007.
- ▶ Most of this not related to composition/globalization.
 - ▶ ΔV accounts for more than 100% of increase in LS.
 - ▶ ΔBY accounts for -8% of increase; globalization still associated with decline in LS, but much less due to slowdown in GVC deepening.

Sources of increases in skilled labor shares, 1995–2007

Levels	Shares in GDP						Shares in payments to labor (domestic + foreign)	
	High skill labor income from domestic industries (1)	Low skill labor income from domestic industries (2)	High skill labor income from foreign industries (3)	Low skill labor income from foreign industries (4)	High skill labor income (domestic + foreign) (5)	Low skill labor income (domestic + foreign) (6)	High skill labor income (7)	Low skill labor income (8)
	VBY 1995	17.44	38.67	1.40	4.00	18.83	42.68	30.62
VBY 2007	20.76	31.63	2.33	4.34	23.09	35.97	39.10	60.90
Changes								
V2007*B1995*Y1995 - VBY 1995	3.64	-4.42	0.33	-0.62	3.97	-5.03	7.11	-7.11
V1995* B2007*Y1995 - VBY 1995	0.01	-1.54	0.27	0.80	0.27	-0.74	0.68	-0.68
V1995*B1995* Y2007 - VBY 1995	-0.18	-1.46	0.35	0.86	0.17	-0.61	0.50	-0.50
V1995* B2007*Y2007 - VBY 1995	-0.12	-2.59	0.55	1.29	0.43	-1.30	1.15	-1.15
VBY 2007 - VBY 1995	3.33	-7.04	0.93	0.34	4.26	-6.70	8.48	-8.48

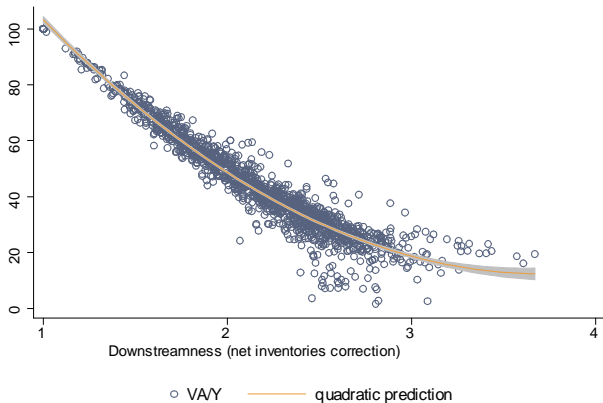
- ▶ Increase in skilled labor share in GDP (col. 5), in labor income (col. 7).
- ▶ Most of this not related to composition/globalization.
 - ▶ ΔV accounts for 93% (GDP) or 83% (labor income).
 - ▶ ΔBY accounts for 10% (GDP) or 19% (labor income).
 - ▶ *forward*, Δ *forward* and domestic counterparts roughly equally skill intensive (not shown).

Taking stock of decompositions/counterfactuals

- ▶ Composition (Δ GVCs, Δ global demand patterns) accounts for similar share of drop in LS in 1995–2007 as within industries changes.
- ▶ Within industries changes account for increase in LS in 2007–2014.
 - ▶ Globalization still pushes LS down in 2007–2014, but not much.
- ▶ Within industries changes account for increase in skilled LS.
- ▶ Magnitudes of changes within manufacturing larger, but similar relative importance of various dimensions (dropped to ease presentation).
- ▶ China accounts for much of compositional changes, but not within-industry changes (omitted for brevity).

VA share in gross output and downstreamness

$$vash_{ic} = \delta_1 D_{ic} + \delta_2 D_{ic}^2 + \lambda_1 U_{ic} + \lambda_2 U_{ic}^2 + \mu_i + \mu_c + \varepsilon_{ic}$$



year 2007