MIT 14.662 Spring 2018: Lecture 11 – The Importance of Place

David Autor, MIT and NBER

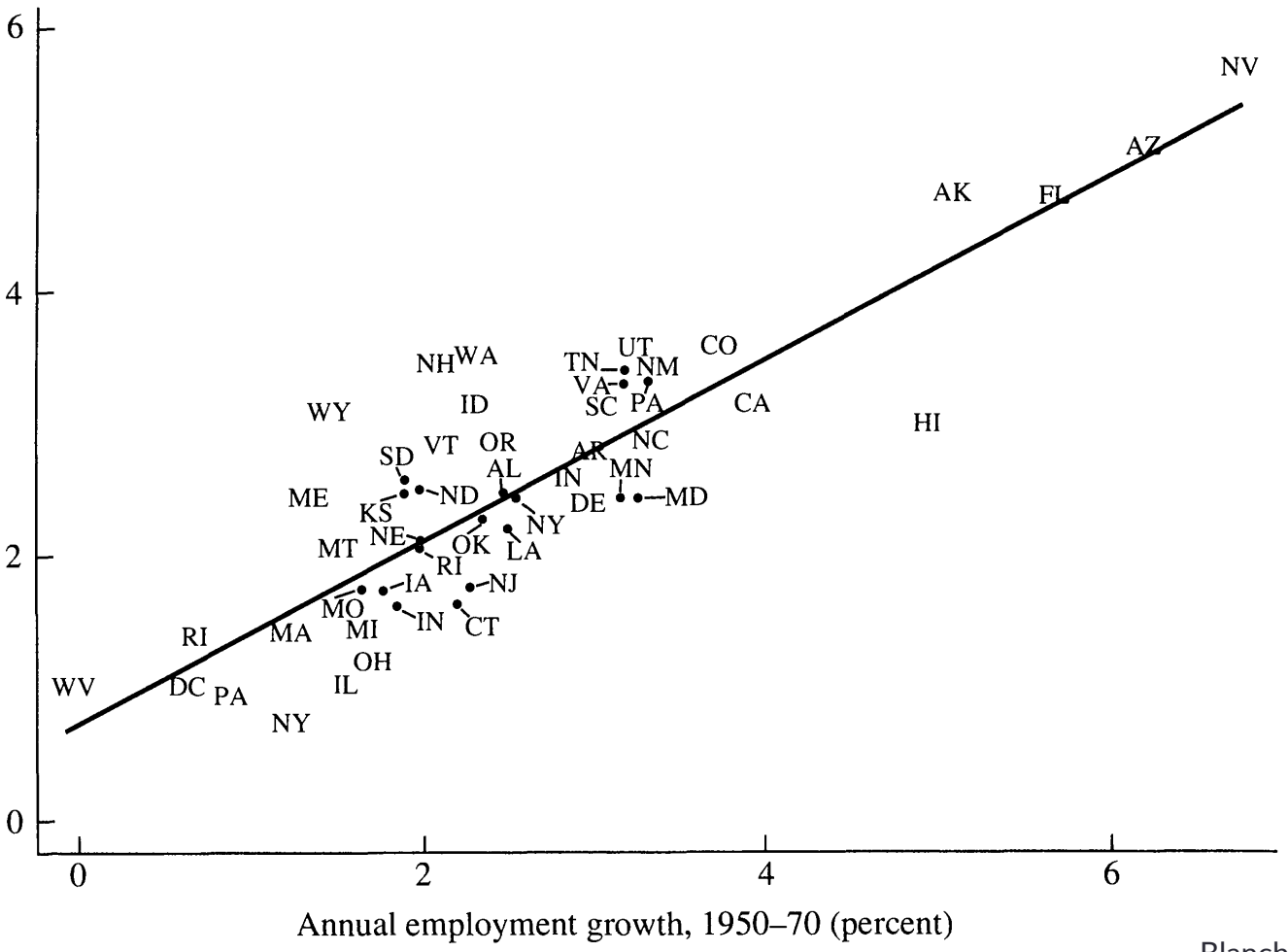
March 19, 2018

Agenda

1. **The Enduring Understanding: Blanchard and Katz, 1992**
2. The Economics of Place
3. What are the questions?
4. Agglomeration and regional equilibrium

Starting Observation: Employment Growth Rates Persistent Across States 1950 – 1990

Figure 1. Persistence of Employment Growth Rates across U.S. States, 1950–90



Blanchard and Katz 1992

Impulse Response Functions for ΔEmp, ΔUnemp, ΔLog Wage

Table 1. Univariate Models of Relative Employment, Unemployment, and Wages

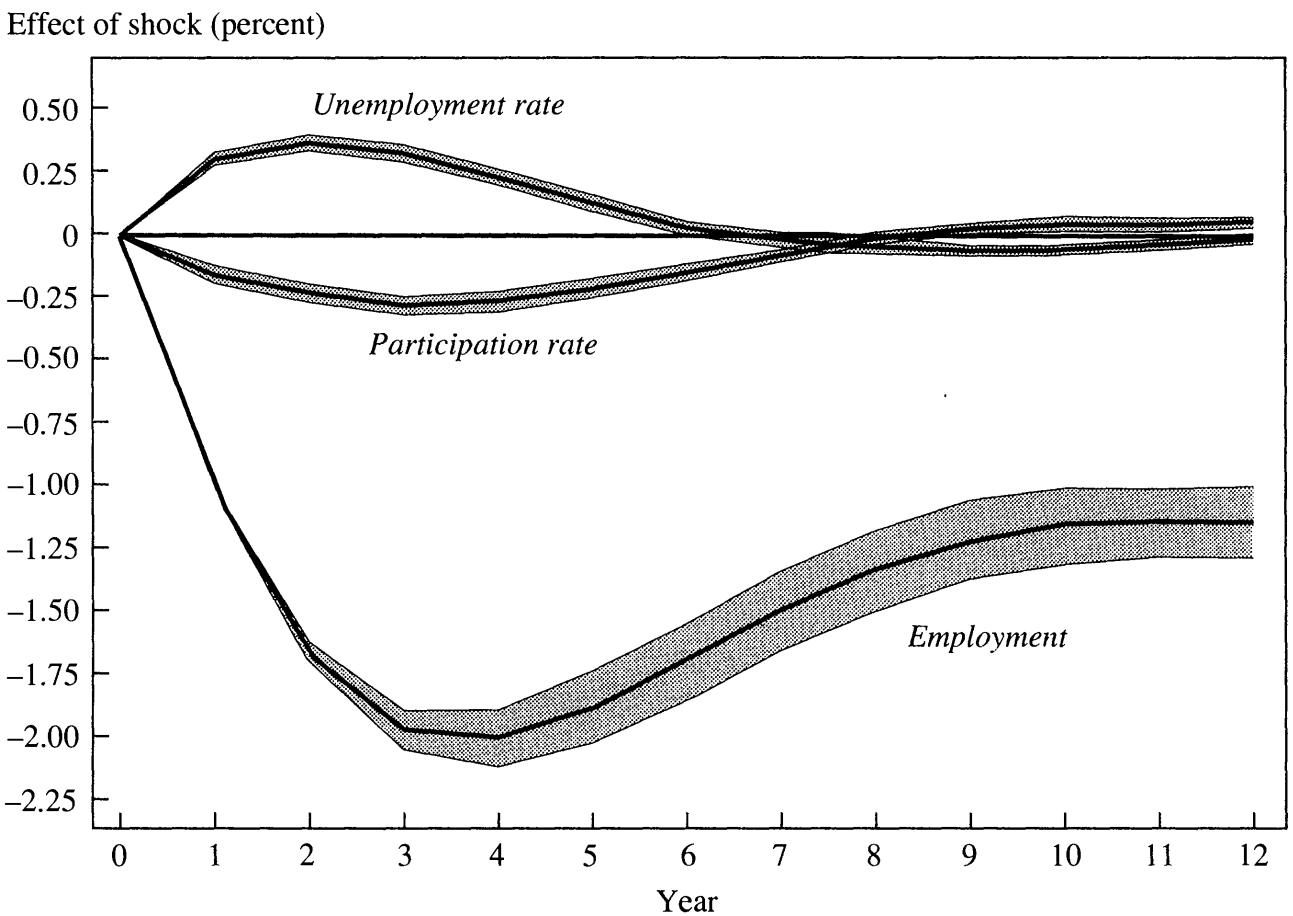
Result	*Log employment change*	*Unemployment rate*	*Log wage*
Regression results			
Coefficient on lagged dependent variable			
One lag	0.492	0.899	1.072
	(0.023)	(0.032)	(0.023)
Two lags	−0.099	−0.159	−0.129
	(0.025)	(0.033)	(0.034)
Three lags	0.010	. . .	0.057
	(0.024)		(0.034)
Four lags	−0.054	. . .	−0.074
	(0.022)		(0.024)
Standard error	0.017	0.083	0.016
Implied impulse responses			
Year 1	1.00	1.00	1.00
Year 2	1.49	0.90	1.07
Year 3	1.63	0.65	1.02
Year 4	1.67	0.44	1.01
Year 5	1.62	0.29	0.94
Year 10	1.52	0.04	0.57
Year 20	1.53	0.01	0.19

Source: Estimates of univariate equations using data described in the appendix. Periods of estimation are 1952–90 for employment and wages and 1972–90 for unemployment. Standard errors of the coefficients are in parentheses.

Blanchard and Katz 1992

Vector Auto Regressions

Figure 7. Response of Employment, Unemployment, and Labor Force Participation to an Employment Shock



Source: Authors' calculations based on the system of equations described in the text, using data described in the appendix. All 51 states are used in the estimation. The shock is a −1 percent shock to employment. Bands of one standard error are shown around each line.

Blanchard and Katz 1992

Lasting Takeaway of Blanchard and Katz

Quoting Blanchard and Katz

- Booms and slumps for states are best described as transitory accelerations or slowdowns of employment growth
- Growth eventually returns to normal, but the path of employment is permanently affected
- These transitory changes in growth lead to transitory fluctuations in relative unemployment and wages
- The dominant adjustment mechanism is labor mobility, rather than job creation or job migration
- Labor mobility, in turn, appears to be primarily a response to changes in unemployment, rather than in consumption wages

Agenda

1. The Enduring Understanding: Blanchard and Katz, 1992
2. **The Economics of Place**
3. What are the questions?
4. Agglomeration and regional equilibrium

Rationale for considering 'places' rather than people?

Many policies are targeted at 'job creation' for local residents

- Large literature estimates the local employment effects of such policies
- Usual goal: compute the number of jobs created per dollar spent
- Lit does not speak to welfare consequences: *equity* and/or *efficiency*
- Equity rationales popular among policy makers
  - By subsidizing disadvantaged areas, governments hope to help the disadvantaged residents of those areas

Rationale for considering 'places' rather than people?

Reason for skepticism on equity-based arguments

1. Location used to serve a fundamentally *person-based* motive: subsidizing poor households
2. Can't this be done more directly by making the tax system more progressive or strengthening means-tested transfer programs?
3. Worse, spatial targeting might fail due to worker and firm mobility

A simple equilibrium place-based model (Kline-Moretti '14)

Policy: A subsidy to the wagebill of firms in a targeted location

- Two cities a and b
- Continuum of workers of measure one
  - Each worker supplies a unit of labor, rents a unit of housing
  - Workers free to move cities, but must work in city where they live
- Workers' indirect utility in a location depends on nominal wages, the cost of housing, taxes, and local amenities

$$U_{ic} = w_c - r_c + A_c - t + e_{ic}$$

where w_c is the nominal wage in city c, r_c is housing cost, A_c is a local amenity, t is a lumpsum tax, and e_{ic} is worker $i's$ idiosyncratic preference

A simple equilibrium place-based model (Kline-Moretti '14)

Preferences

- Worker's utility of city c is sum of $\nu_c \equiv w_c - r_c + A_c - t$ and e_{ic}
- Preferences e_{ic} assumed to be iid type I extreme value distribution with scale parameter s and $E[e_{ic}] = 0$
- Difference in idiosyncratic preferences for a and b is $\therefore$ distributed across workers by logistic distribution

$$\frac{(e_{ia} - e_{ib})}{s} \sim \text{Logistic}(0, 1)$$

where s governs the strength of idiosyncratic preferences

Housing supply

Land is fixed, so housing cost has upward slope

$$r_c = z_c N_c^{k_c}$$

- where $k_c \geq 0$ is the *inverse* supply elasticity

Landlord profits

$$\Pi_c = \int_0^{N_c} \left(r_c - z_c x_c^{k_c} \right) dx = \frac{k_c}{k_c + 1} r_c N_c,$$

- The more elastic is *inverse* housing supply—the less elastic is housing supply—the greater are landlord profits
- Assumption: Workers are renters, distinct from landowners

Production

Production

- Firms in each city produce a single good Y_c using labor and a local amenity
- Y_c is a traded good sold on international markets at price one
- Production is

$$Y_c = X_c N_c^{\alpha} K_c^{1-\alpha},$$

where

  - X_c is a local productivity shifter
  - N_c is the number of workers in c
  - K_c is local supply of capital
  - Capital elastically supplied at price ρ on global markets

Wage subsidy

Here's the policy:

- Government provides an ad valorem wage credit τ_c to employers in community c
- This subsidy will be financed by lumpsum tax t with balanced budget

$$w_a \tau_a N_a + w_b \tau_b N_b = t$$

Wages and rental rates

Wages and capital rental rate

$$w_c\left(1-\tau_c\right)=\frac{\alpha Y_c}{N_c}$$

$$\rho=\frac{\left(1-\alpha\right)Y_c}{K_c}$$

$$\Rightarrow \ln w_c = C+\frac{\ln X_c}{\alpha}+\left(\frac{1-\alpha}{\alpha}\right)\ln\rho-\ln(1-\tau_c)$$

$$\text{where } C=\ln\alpha-\left(\left(1-\alpha\right)/\alpha\right)\ln\left(1-\alpha\right)$$

1. *Why is W_c independent of N_c?*
2. *Why doesn't K receive any of the incidence of the subsidy $(1-\tau_c)$?*
3. *What is X_c doing here?*
4. *Why doesn't housing cost appear in this equation?*

Wages and rental rates

1. *Why is W_c independent of N_c?*
   - Because supply of K perfectly elastic at price ρ, no diminishing marginal product of labor
2. *Why doesn't K receive any of the incidence of the subsidy $(1 - \tau_c)$?*
   - Again b/c of perfectly elastic supply. Cannot bear subsidy or benefit from it
3. *What is X_c doing here?*
   - It's like local TFP
4. *Why doesn't housing cost appear in this equation?*
   - This the *producer wage* not the *consumer wage*. It's the marginal product of labor, not the real cost of living. Firms pay the *MRPL*: cannot pay a different wage simply because a worker's cost of living is higher

[Aside: Eliminating K and N from Wage Equation]

$$\rho = \frac{(1-\alpha)\, Y_c}{K_c}$$

$$K_c = \frac{(1-\alpha)\, Y_c}{\rho} = \frac{(1-\alpha)\, X_c N_c^{\alpha} K_c^{1-\alpha}}{\rho}$$

$$K_c^{\alpha} = \frac{(1-\alpha)\, X_c N_c^{\alpha}}{\rho} K_c = \frac{(1-\alpha)\, X_c^{1/\alpha} N_c}{\rho^{1/\alpha}}$$

$$K_c = \frac{(1-\alpha)\, X_c^{1/\alpha} N_c}{\rho^{1/\alpha}}$$

$$w_c\,(1-\tau_c) = \frac{\alpha Y_c}{N_c} = \frac{\alpha_c \rho K_c}{N_c\,(1-\alpha)} = \frac{\alpha_c \rho\,(1-\alpha)\, X_c^{1/\alpha} N_c}{N_c\,(1-\alpha)\,\rho^{1/\alpha}} = \alpha_c \rho^{\left(\frac{\alpha-1}{\alpha}\right)} X_c^{1/\alpha}$$

$$w_c\,(1-\tau_c) = \frac{\alpha_c \rho^{\left(\frac{\alpha-1}{\alpha}\right)} X_c^{1/\alpha}}{(1-\tau_c)}$$

Equilibrium: Where do workers choose to live?

Workers choose city a or b to maximize individual utility

$$N_a = \Lambda\left(\frac{\nu_a - \nu_b}{s}\right) \Lambda(\cdot) = \exp(\cdot) / (1 - \exp(\cdot))$$

- N_a is increasing in $[(w_a - r_a) - (w_b - r_b)]$ and in $A_a - A_b$
- With population elasticity

$$\frac{d \ln N_a}{d \ln (\nu_a - \nu_b)} = \frac{N_b}{s} (\nu_a - \nu_b)$$

Equilibrium size of city a

Equilibrium population of a is

$$s\Lambda^{-1}(N_a) = (w_a - r_a) - (w_b - r_b) + (A_a - A_b)$$

Rewrite in terms of primitives

$$s\Lambda^{-1}(N_a) = \frac{\exp C}{\rho^{\frac{1-\alpha}{\alpha}}}\left(\frac{X_a^{\frac{1}{\alpha}}}{1-\tau_a} - \frac{X_b^{\frac{1}{\alpha}}}{1-\tau_b}\right) + \{A_a - A_b\}$$
$$- \left(z_1 N_a^{k_a} - z_a (1 - N_b)^{k_b}\right)$$

Spatial equilibrium—(1) Laissez-Faire; and (2) $\tau_a = 0.25$

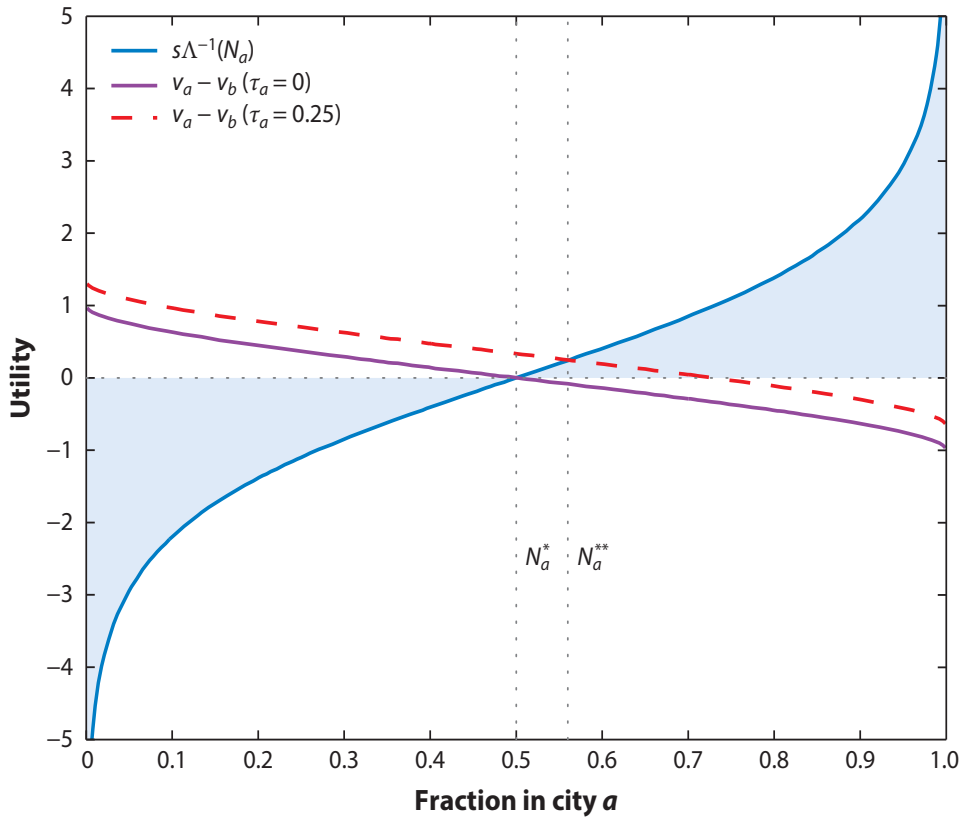


Figure 1

Equilibrium in the two-city example. This figure was constructed by setting $s = 1$, $k_a = k_b = 0.5$, $z_a = z_b = 1$, $A_a = A_b = 0$, $X_a^{1/\alpha} = X_b^{1/\alpha} = 1$, and $\tau_b = 0$.

Q: What gives the purple line its downward slope?

Kline-Moretti '14

How do subsidies affect wages, housing costs

Nominal wage effects

$$\frac{dw_a}{\tau_a} = \frac{w_a}{1-\tau_a} \textbf{ and } \frac{dw_b}{\tau_a} = 0 \textbf{ Why?}$$

Rents

$$\frac{dr_a}{d\tau_a} = \frac{k_a r_a N_b}{s + k_b r_b N_a + k_b r_b N_a} \times \frac{w_a}{1-\tau_a} > 0,$$
$$\frac{dr_b}{d\tau_a} = -\frac{k_b r_b N_a}{s + k_b r_b N_a + k_b r_b N_a} \times \frac{w_a}{1-\tau_a} < 0$$

Notice that $\frac{k_a r_a N_b}{s+k_b r_b N_a + k_b r_b N_a} < 1$, **meaning that**

$$\frac{dw_a}{d\tau_a} > \frac{dr_a}{d\tau_a} \Rightarrow \frac{d\left(w_a - r_a\right)}{d\tau_a} > 0 \textbf{ and } \frac{dw_b}{d\tau_a} > \frac{dr_b}{d\tau_a} \Rightarrow \frac{d\left(w_b - r_b\right)}{d\tau_a} > 0$$

If subsidy raises $(w - r)$ **in <u>both</u> cities, what are we overlooking?**

Wage subsidies cannot improve welfare in the basic model

Why can't wage subsidies improve welfare in basic model?

Wage subsidies cannot improve welfare in the basic model

Why can't wage subsidies improve welfare in basic model?

- *The distortion is in the housing market*
  - Wages go up in both *a* and *b*
  - The marginal cost of producing housing is not equated across cities
  - The increase in the lumpsum tax means that real wage falls in city *b*
  - Total landlord profits rise
  - Welfare rises in city *a* in absolute (and relative) terms but at the expense of city *b*
- *Why might you even consider this policy?*
  - Perhaps for reasons outside the model, you want to assist residents of city *a*

Welfare maximized when city populations equalized

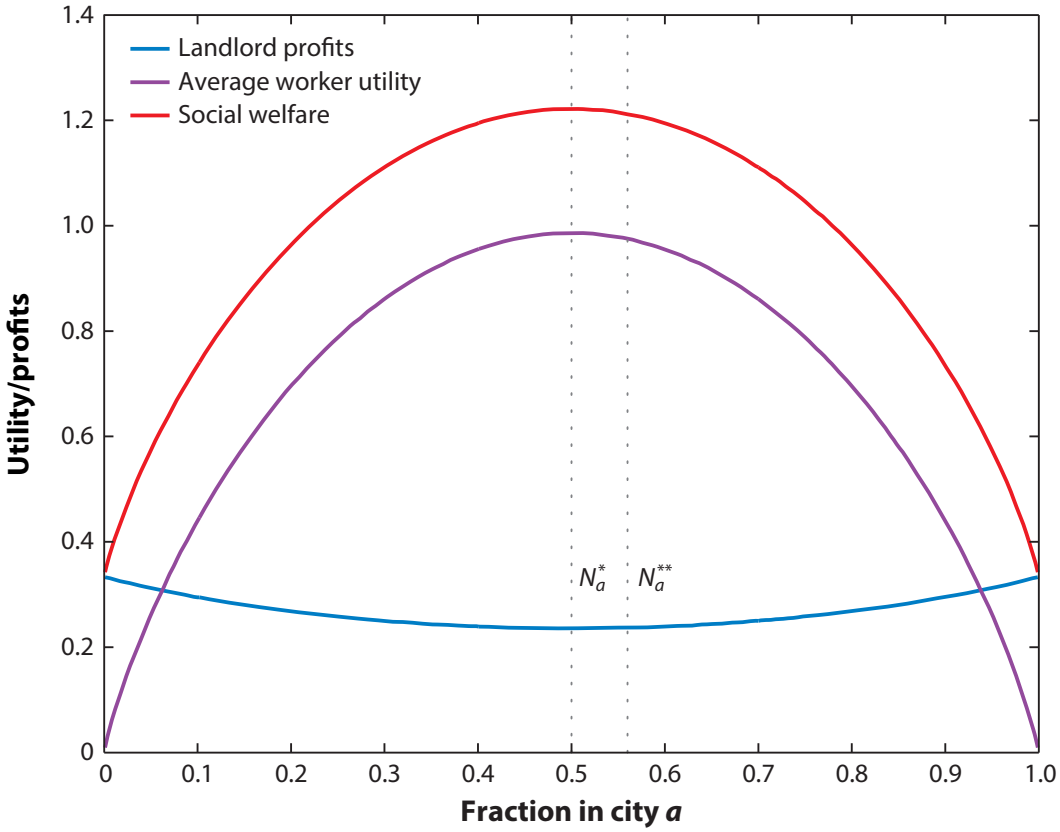


Figure 2

Welfare as a function of city *a*'s share in the two-city example.

Kline-Moretti '14

What are the welfare costs of subsidies?

Welfare costs of subsidies?

- Average worker utility given optimization is

$$V \equiv E \max \{U_{ia}, U_{ib}\} = s \left[\exp\left(\nu_a/s\right) + \exp\left(\nu_b/s\right)\right]$$

- Effect of subsidy to a on expected welfare

$$\frac{dV}{d\tau_a} = N_a \frac{d}{d\tau_a}\left(w_a - r_a\right) + N_b \frac{d}{d\tau_a}\left(w_b - r_b\right) - \frac{dt}{d\tau_a}$$

- Welfare benefit to 1^{st} approximation is wage gains minus rent increases evaluated at initial allocation of workers to a and b
- Movers don't show up in expression b/c they were indifferent at margin (envelope thm)

Welfare costs of subsidies: Full solution

$$\frac{dV}{d\tau_a} = N_a \frac{d}{d\tau_a}(w_a - r_a) + N_b \frac{d}{d\tau_a}(w_b - r_b) - \frac{dt}{d\tau_a}$$

$$= \underbrace{\left(\frac{\tau_a w_a N_a}{1-\tau_a}\right)}_{\text{Wage subsidy}}$$

$$\underbrace{- \frac{1}{1-\tau_a}\left[\frac{k_a r_a N_a N_b}{s + k_a r_a N_b + k_b r_b N_a} - \frac{k_b r_b N_a N_b}{s + k_a r_a N_b + k_b r_b N_a}\right]}_{\text{Rent changes}}$$

$$\underbrace{- \frac{dw_a}{d\tau_a} N_a \tau_a}_{\text{Tax hikes incuments}} \quad \underbrace{- \tau_a w_a \frac{dN_a}{d\tau_a}}_{\text{Tax hikes movers}}$$

Gains and losses for movers and stayers from increment to τ_a

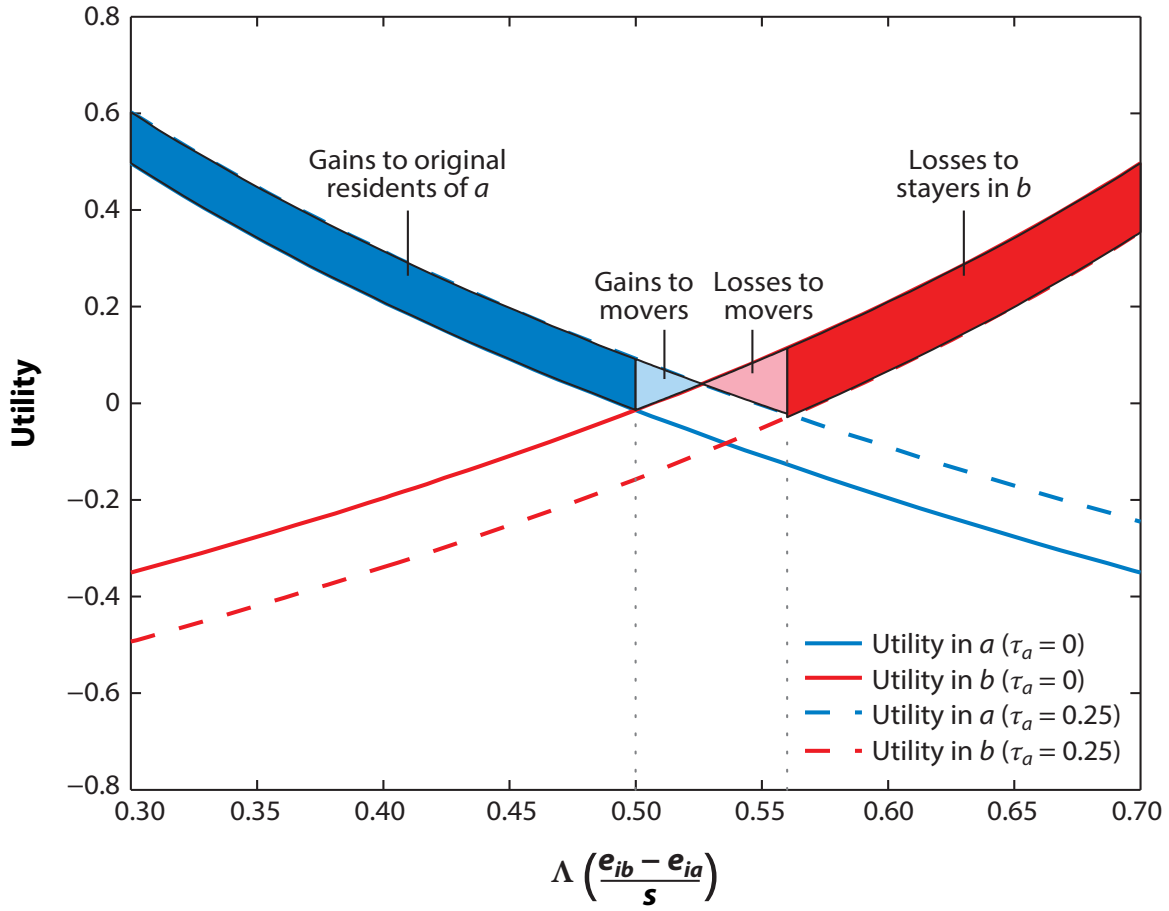


Figure 3

Worker utility by city in the two-city example.

Kline-Moretti '14

Welfare costs of subsidies: Full solution (simplified)

$$\frac{dV}{d\tau_a} = N_a \frac{d}{d\tau_a}(w_a - r_a) + N_b \frac{d}{d\tau_a}(w_b - r_b) - \frac{dt}{d\tau_a}$$

$$= -\underbrace{[k_a r_a - k_b r_b]\left[\frac{N_a N_b}{s + k_a r_a N_b + k_b r_b N_a}\right]}_{\text{Cost of living increase}} \frac{1}{1-\tau_a}$$

$$\underbrace{- w_a \tau_a \left[\frac{N_a N_b}{s + k_a r_a N_b + k_b r_b N_a}\right]}_{\text{DWL}}$$

1. Wage gains are a wash net of taxes
2. But: this policy is a transfer to landlords
3. And: it yields a *DWL* due to distorting housing market

Irony: as $s \to \infty$, $DWL \to 0$. Why?

Is that it? What else we can do with this model

1. Local public goods

- Suppose that consumption amenities are produced via a linear technology where a λ dollar increase in government investment t yields a dollar increase in the local amenity level
- A small government-driven increase in city a's amenity level yields

$$\begin{aligned}\frac{dV}{dA_a} &= N_a\left(1-\frac{dr_a}{dA_a}\right)-N_b\frac{dr_b}{r_{A_a}}-\frac{dt}{dA_a}\\ &= \frac{(s+k_b r_b)\,N_a}{s+k_a r_a N_b+k_b r_b N_a}-\lambda\end{aligned}$$

Local public goods

- A small government-driven increase in city a's amenity level yields

$$\frac{dV}{dA_a} = N_a \left(1 - \frac{dr_a}{dA_a}\right) - N_b \frac{dr_b}{r_{A_a}} - \frac{dt}{dA_a}$$
$$= \frac{(s + k_b r_b) N_a}{s + k_a r_a N_b + k_b r_b N_a} - \lambda$$

- If workers are immobile ($s = \infty$), then

$$\frac{dV}{dA_a} = 1 - \lambda,$$

  So local public goods provision raises welfare if $\lambda < 1$

- If workers perfectly mobile ($s = 0$), then worker welfare rises if

$$\frac{k_b r_b N_a}{k r_a N_b + k_b r_b N_a} > \lambda$$

Agglomeration economies

2. Agglomeration economies

- A common rationale for location-based incentives is to foster local agglomeration externalities
- Common way to model agglomeration

$$\ln X_c = g\left(\frac{N_c}{R_c}\right),$$

  where N_c is population, R_c is land area (e.g., square mileage) and $g'(\cdot) > 0$
- If agglomeration is strong enough, can produce multiple equilibria
- Would provide a rationale for place-based subsidy—even though this also distorts prices

Multiple equilibria absent subsidy – but subsidy τ_a yields high N_a equilibrium

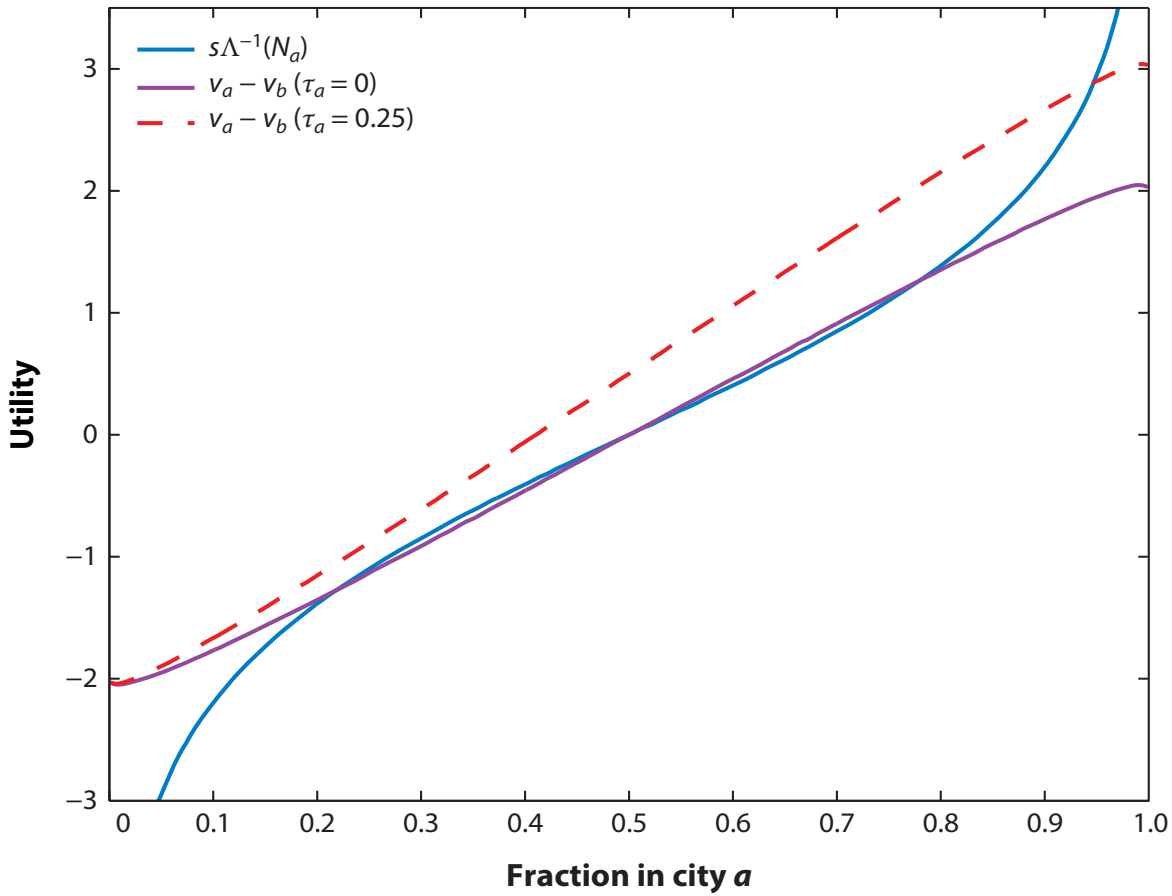


Figure 4

Equilibrium with agglomeration in the two-city example.

Kline-Moretti '14

In general, either extreme preferable to mid-point

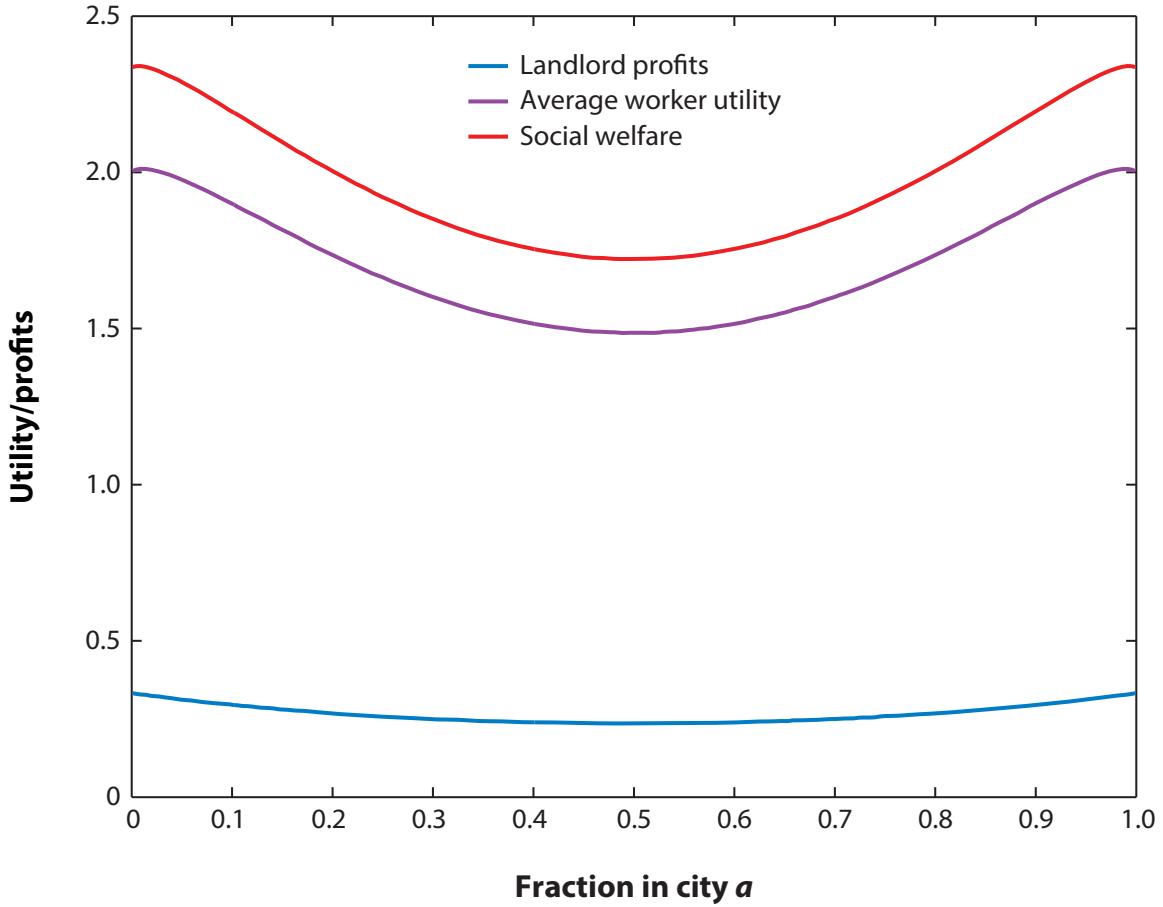


Figure 5

Welfare with agglomeration in the two-city example.

Kline-Moretti '14

Agglomeration can also be inefficient

Agglomeration gain in one locale is a loss in another

- Need a non-linearity to make agglomeration efficient
- 'Agglomeration elasticity'

$$\sigma_c\left(\frac{N_c}{R_c}\right) \equiv \frac{d\ln X_c}{d\ln\left(\frac{N_c}{R_c}\right)} = g'\left(\frac{N_c}{R_c}\right) \times \frac{N_c}{R_c}$$

- If σ_c is constant, then losses from de-agglomeration equal gains from agglomeration—no net gain

Kline-Moretti '14 QJE "Big Push"

- Their finding: manufacturing has this property, i.e, $\sigma_c \approx$ constant
- Big Push benefited Tennessee Valley but not nation as a whole

Human capital externalities

More interesting if posit that human capital amplifies externalities

$$\ln X_c = g\left(\frac{N_c}{R_c}, HC_c\right),$$

with

- $g_1 > 0$
- $g_2 > 0$
- $g_{12} > 0$

Agenda

1. The Enduring Understanding: Blanchard and Katz, 1992
2. The Economics of Place
3. **What are the questions?**
4. Agglomeration and regional equilibrium

What are the big questions?

1. Are places more productive for any intrinsic reason?
2. Path dependence and multiple equilibria?
3. Regional divergence?
4. Are Blanchard-Katz conclusions still relevant?
5. How does the Blanchard-Katz mechanism work in practice?
6. What is the role of sectors/industries on outcomes of places?
7. What are the causal effects of places on residents?

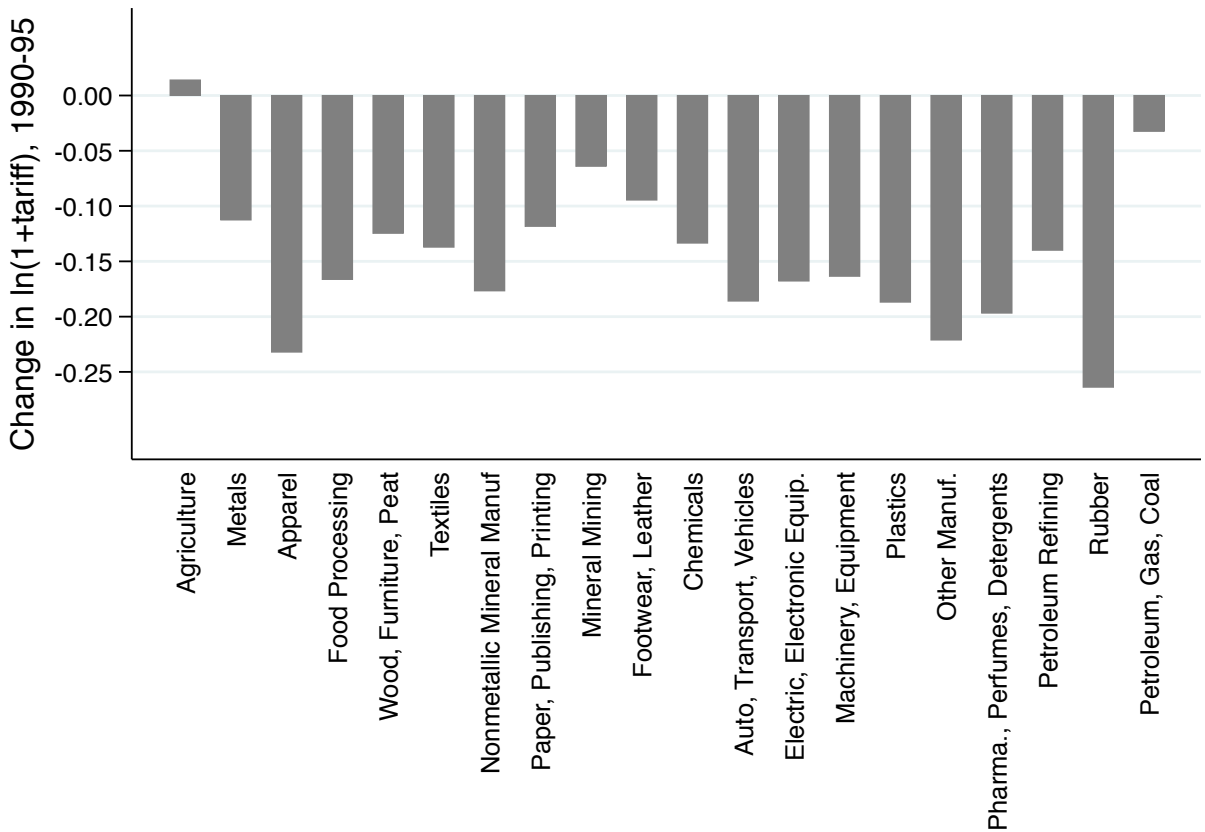
Agenda

1. The Enduring Understanding: Blanchard and Katz, 1992
2. The Economics of Place
3. What are the questions?
4. **Agglomeration and regional equilibrium**

Sector-level tariff changes in Brazil, 1990 – 1995

"Trade liberalization and regional dynamics," Dix-Carneiro & Kovak, AER '16

Figure 1: Tariff Changes



Dix-Carneiro and Kovak 2017

Exposure map

$$RTC_r = -\sum_i \beta_{ri} d\ln(1+\tau_i)$$

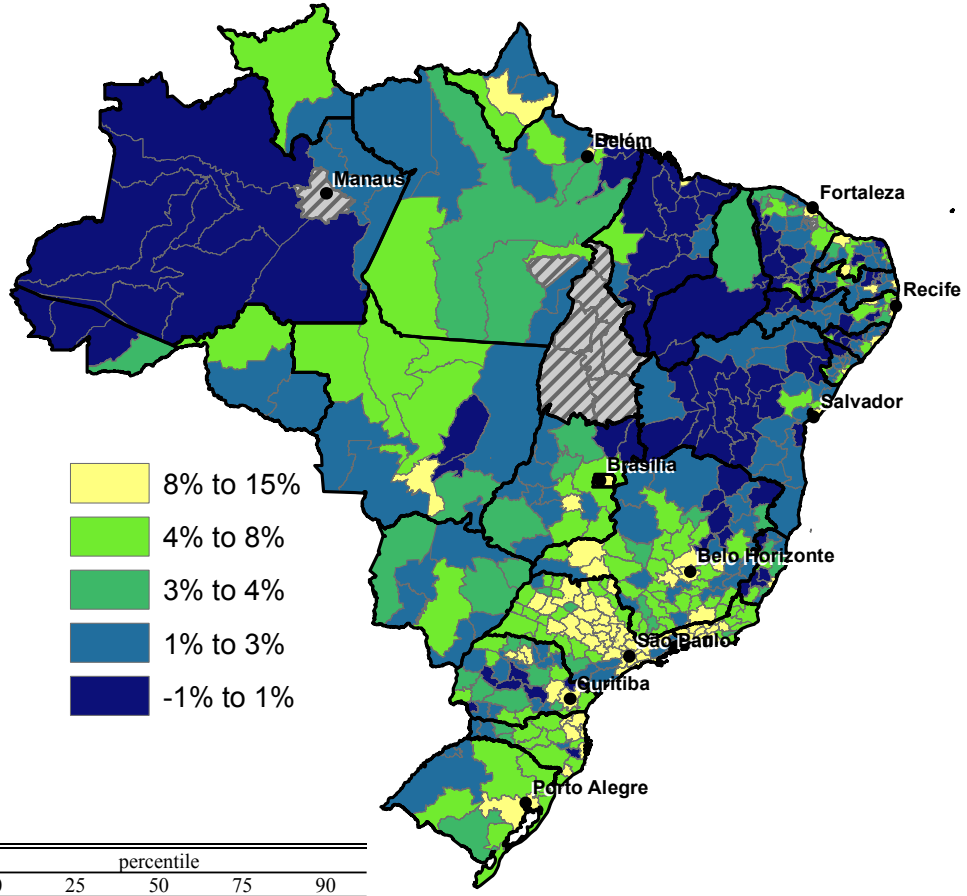
$$\beta_{ri} \equiv \frac{\lambda_{ri}\frac{1}{\varphi_i}}{\sum_j \lambda_{rj}\frac{1}{\varphi_j}}$$

τ_i is industry $i's$ tariff

λ_{ri} is $i's$ share of traded-sector employment in r

φ is the non-labor share of value-added in industry i

Figure 2: Regional Tariff Reductions



	percentile				
mean	10	25	50	75	90
0.044	0.002	0.012	0.031	0.066	0.107

Dix-Carneiro and Kovak 2017

Conceptual model: 'Specific factors' with agglomeration Economies

$$Y_{ri} = A_{ri} L_{ri}^{1-\varphi_i} \left(T_{ri}^{\zeta_i} K_{ri}^{1-\zeta_i} \right)^{\varphi_i}$$

- Y_{ri} is output of industry i in region r
- $\varphi_i, \zeta_i \in (0, 1)$: $1 - \varphi_i$ is labor's share in industry i
- L_r is labor perfectly mobile across industries i within a region r
- T_{ri} is specific factor usable only in its region and industry and is *fixed*
- K_{ri} is capital usable only in its region and industry but *not* fixed
- A_{ri}, L_r, and K_{ri} can change over time
- [Ignore agglomeration initially]

Conceptual model: 'Specific factors' with agglomeration

$$Y_{ri} = A_{ri} L_{ri}^{1-\varphi_i} \left(T_{ri}^{\zeta_i} K_{ri}^{1-\zeta_i} \right)^{\varphi_i}$$

- Let a_{Li}, a_{Ti}, a_{Ki} be the unit demands for Labor, Specific Factor, and Capital for producing one unit Y_i. (Suppress region r)

$$\begin{aligned} \sum_i a_{Li} Y_i &= L, \\ a_{Ti} Y_i &= T_i \; \forall i, \\ a_{K_i} Y_i &= K_i \; \forall i \\ a_{Li} w + a_{Ti} s_i + a_{Ki} R_i &= P_i \; \forall i \end{aligned}$$

- Using hats to denote log changes, cost minimization implies

$$(1-\varphi_i)\hat{w} + \varphi_i \zeta_i \hat{s}_i + \varphi_i (1-\zeta_i) \hat{R}_i = \hat{P}_i + \hat{A}_i \; \forall i$$

Impact of tariff change on regional wage premium

$$\hat{w}_r = \sum_i \beta_{ri} \hat{P}_i + \sum_i \beta_{ri} \hat{A}_{ri} - \delta_r \left(\hat{L}_r - \sum_i \lambda_{ri} \left(1 - \zeta_i\right) \hat{K}_{ri} \right)$$

where $\lambda_{ri} = \dfrac{L_{ir}}{L_r}$, $\beta_{ri} \equiv \dfrac{\lambda_{ri} \frac{1}{\varphi_i}}{\sum_j \lambda_{ri} \frac{1}{\varphi_i}}$, $\delta_r \equiv \dfrac{1}{\sum_j \lambda_{ri} \frac{1}{\varphi_i}}$

1. Increasing in share of regional labor λ_{ri} allocated to affected industries
2. Increasing in labor's share of output $(1 - \varphi_i)$ in affected industries
3. Declining in specific factor-shares of affected industries ζ_i. **Why?**

Impact of tariff change on regional wage premium

$$\hat{w}_r = \sum_i \beta_{ri} \hat{P}_i + \sum_i \beta_{ri} \hat{A}_{ri} - \delta_r \left(\hat{L}_r - \sum_i \lambda_{ri} \left(1-\zeta_i\right) \hat{K}_{ri} \right)$$

where $\lambda_{ri} = \frac{L_{ir}}{L_r}$, $\beta_{ri} \equiv \frac{\lambda_{ri} \frac{1}{\varphi_i}}{\sum_j \lambda_{ri} \frac{1}{\varphi_i}}$, $\delta_r \equiv \frac{1}{\sum_j \lambda_{ri} \frac{1}{\varphi_i}}$

1. Increasing in share of regional labor λ_{ri} allocated to affected industries
2. Increasing in labor's share of output $(1 - \varphi_i)$ in affected industries
3. Declining in specific factor-shares of affected industries ζ_i
    - Specific factors bear some incidence because immobile
    - Note that absent specific factors, there would be no differences in industry structure across regions

Exposure map

$$RTC_r = -\sum_i \beta_{ri} d\ln(1+\tau_i)$$

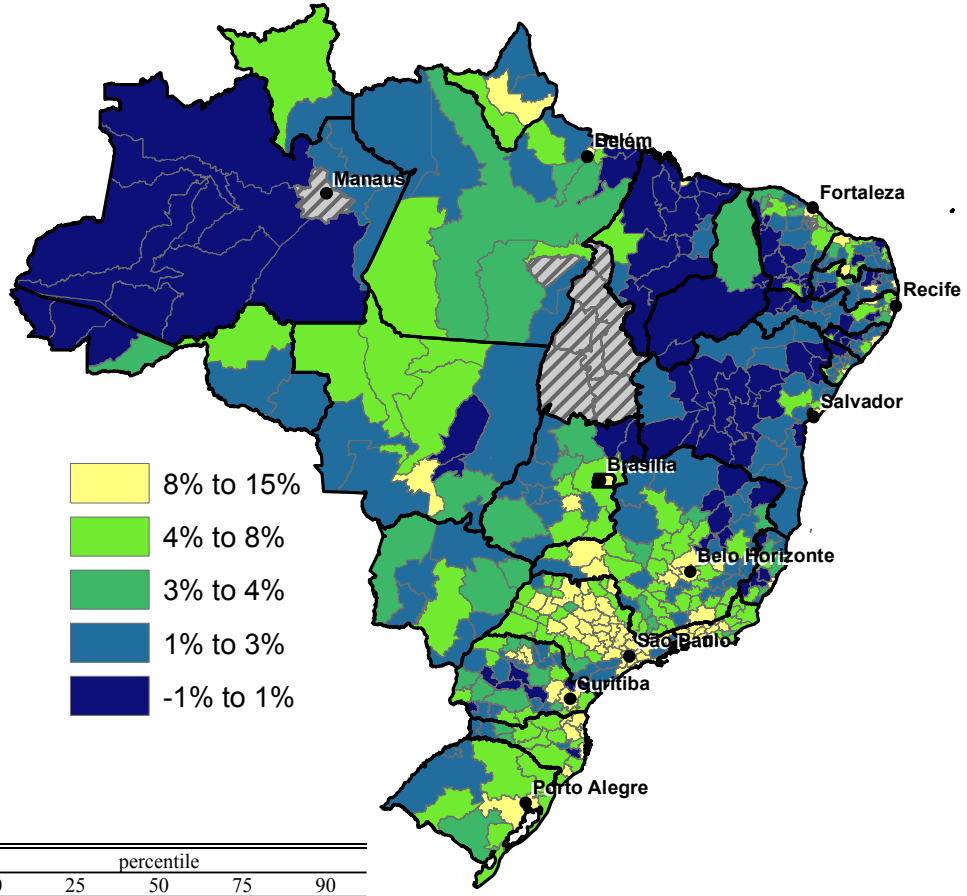
$$\beta_{ri} \equiv \frac{\lambda_{ri}\frac{1}{\varphi_i}}{\sum_j \lambda_{rj}\frac{1}{\varphi_j}}$$

τ_i is industry $i's$ tariff

λ_{ri} is $i's$ share of traded-sector employment in r

φ is the non-labor share of value-added in industry i

Figure 2: Regional Tariff Reductions

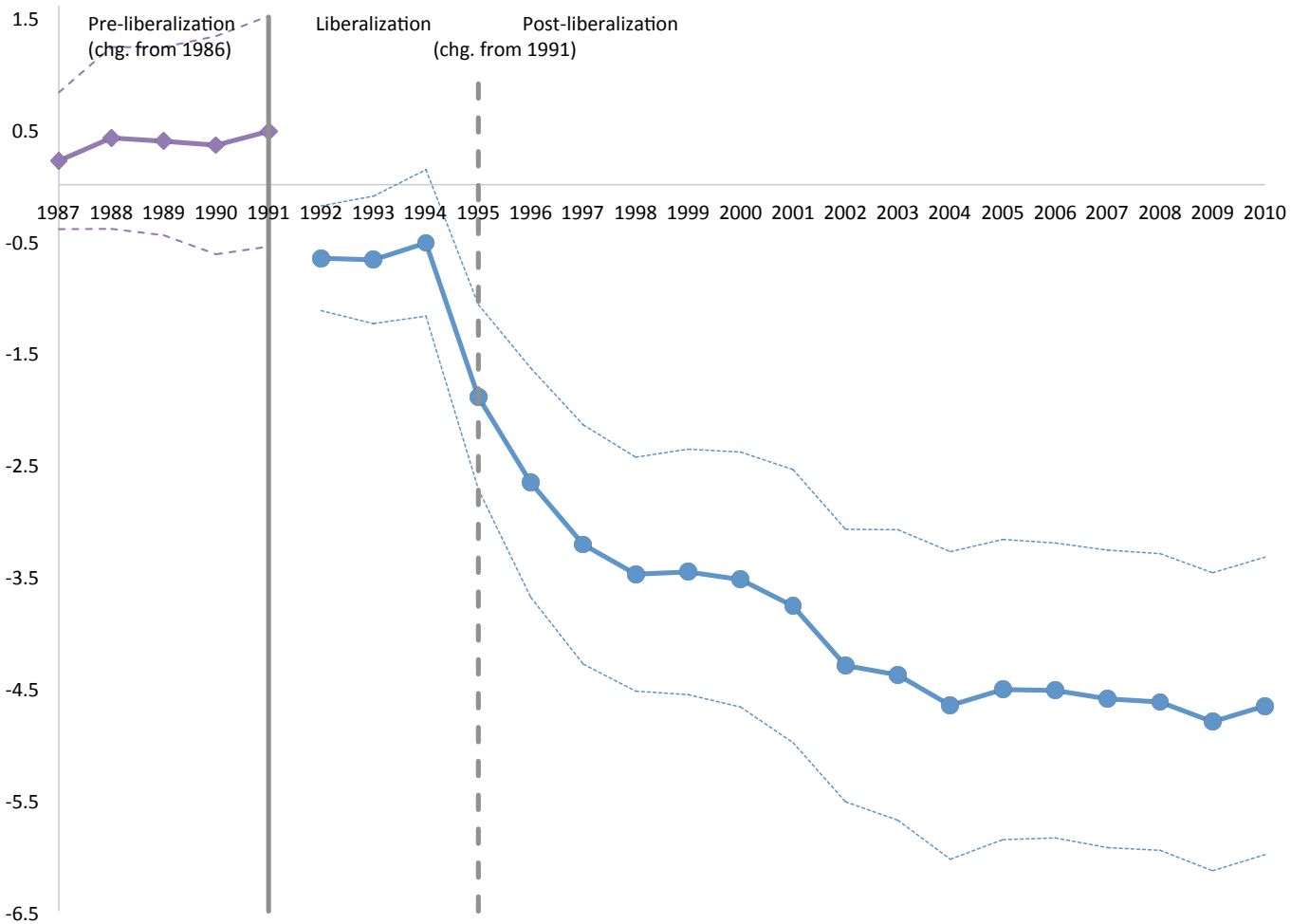


	percentile				
mean	10	25	50	75	90
0.044	0.002	0.012	0.031	0.066	0.107

Dix-Carneiro and Kovak 2017

Tariff change vs. cumulative change in log formal sector employment, 1987 – 2010

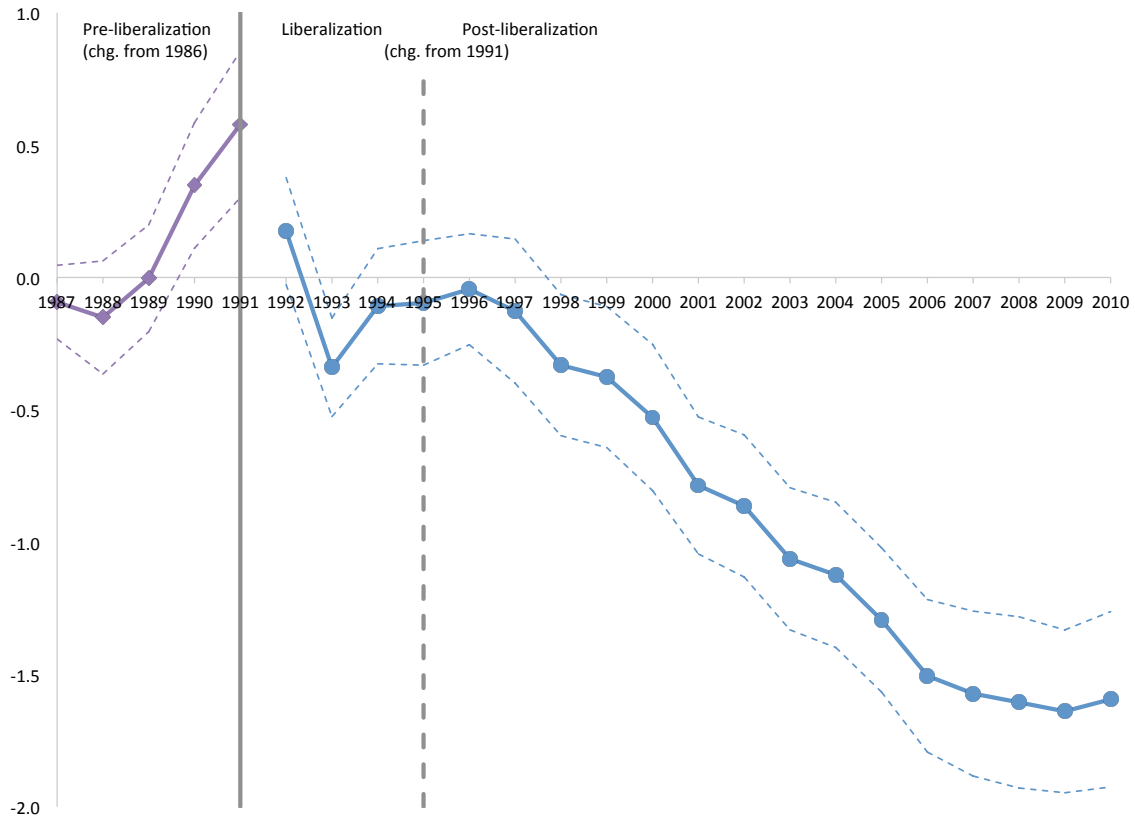
Figure 4: Regional log Formal Employment - 1987-2010



Dix-Carneiro and Kovak 2017

Tariff change vs. cumulative changes in formal sector regional earnings premium, 1987 – 2010

Figure 3: Regional log Formal Earnings Premia - 1987-2010



Each point reflects an individual regression coefficient, $\hat{\theta}_t$, following (3), where the dependent variable is the change in regional log formal earnings premium and the independent variable is the regional tariff reduction (RTR_r), defined in (2). Note that RTR_r always reflects tariff reductions from 1990-1995. For blue circles, the earnings changes are from 1991 to the year listed on the x-axis. For purple diamonds, the changes are from 1986 to the year listed. All regressions include state fixed effects, and post-liberalization regressions control for the 1986-1990 outcome pre-trend. Negative estimates imply larger earnings declines in regions facing larger tariff reductions. Vertical bars indicate that liberalization began in 1991 and was complete by 1995. Dashed lines show 95 percent confidence intervals. Standard errors adjusted for 112 mesoregion clusters.

Dix-Carneiro and Kovak 2017

What could be going on?

Some possibilities

1.
2.
3.
4.

What could be going on?

Some possibilities

1. Urban decline [Glaeser Gyourko '05, Noto '13)], AKA 'specific factors'
2. Changing worker composition (adverse selection)
3. Slow response of imports or exports
4. Dynamic labor demand adjustment

'Putty-clay:' House prices rise & fall asymmetrically with population growth v. contraction

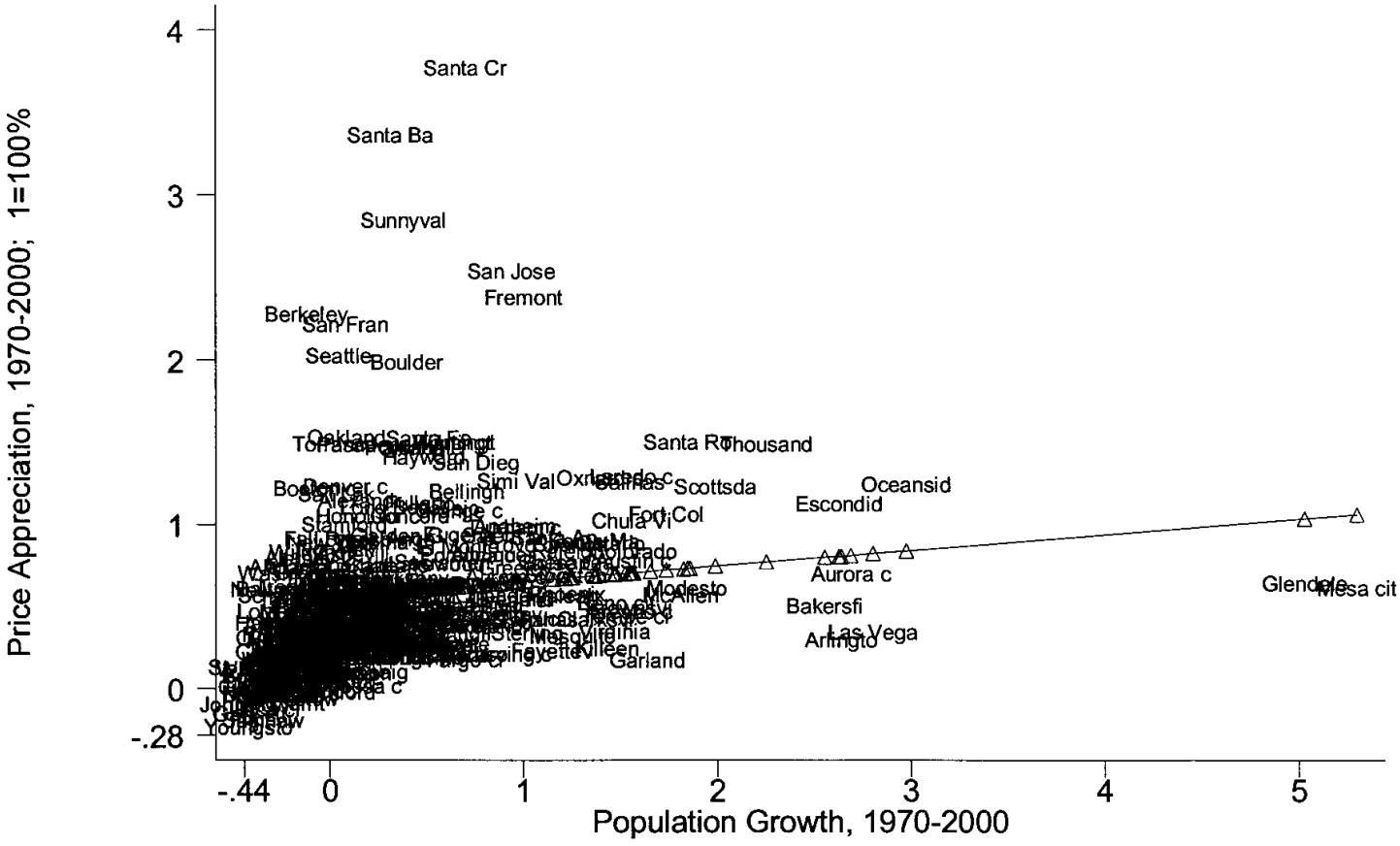


FIG. 3.—Price appreciation and urban growth

Glaeser and Gyourko, *JPE* 2005

Fall in the regional earnings premium is somewhat smaller after accounting for regional cost of living changes

Table 2: Regional log Formal Earnings Premia and Employment - 2000, 2010

Change in outcome:	1991-2000			1991-2010		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: log Formal Earnings Premia						
Regional tariff reduction (RTR)	-0.451***	-0.638***	-0.529***	-1.885***	-1.736***	-1.594***
	(0.152)	(0.154)	(0.141)	(0.316)	(0.184)	(0.169)
Formal earnings pre-trend (86-90)			-0.312**			-0.418***
			(0.149)			(0.144)
State fixed effects (26)		✓	✓		✓	✓
R-squared	0.040	0.225	0.268	0.320	0.501	0.537
Panel B: log Formal Real Earnings Premia (regional deflators following Moretti (2013))						
Regional tariff reduction (RTR)				-1.594***	-1.382***	-1.260***
				(0.306)	(0.180)	(0.168)
Formal earnings pre-trend (86-90)						-0.359***
						(0.133)
State fixed effects (26)					✓	✓
R-squared				0.238	0.449	0.477

Dix-Carneiro and Kovak 2017

Formal employment falls by proportionately more than earnings

Table 2: Regional log Formal Earnings Premia and Employment - 2000, 2010

Panel C: log Formal Employment						
Regional tariff reduction (RTR)	-3.748***	-3.545***	-3.533***	-6.059***	-4.675***	-4.663***
	(0.516)	(0.563)	(0.582)	(0.560)	(0.660)	(0.679)
Formal employment pre-trend (86-90)			-0.0331			-0.0319
			(0.147)			(0.156)
State fixed effects (26)		✓	✓		✓	✓
R-squared	0.072	0.291	0.291	0.149	0.409	0.410

Dix-Carneiro and Kovak 2017

No measurable impact on size of working-age population

Table 3: Regional log Working-Age Population - 2000, 2010

Change in log Working-Age Population:	1991-2000			1991-2010		
	(1)	(2)	(3)	(4)	(5)	(6)
Regional tariff reduction (RTR)	0.333	-0.061	0.018	0.392	-0.175	-0.059
	(0.243)	(0.330)	(0.204)	(0.319)	(0.473)	(0.294)
Population pre-trend (80-91)	0.406**		0.328*	0.632***		0.531**
	(0.164)		(0.171)	(0.225)		(0.235)
Population pre-trend (70-80)		0.297***	0.137***		0.445***	0.190**
		(0.072)	(0.047)		(0.087)	(0.073)
State fixed effects (26)	✓	✓	✓	✓	✓	✓
R-squared	0.654	0.557	0.678	0.666	0.554	0.685

Dix-Carneiro and Kovak 2017

Informal employment rises but informal sector earnings are unaffected

Table 4: Regional log Informal Employment and Earnings Premia - 2000, 2010

Change in outcome:	1991-2000			1991-2010		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: log Informal Employment						
Regional tariff reduction (RTR)	2.017***	1.706***	1.593***	2.122***	1.448***	1.196*
	(0.431)	(0.344)	(0.532)	(0.468)	(0.491)	(0.705)
Informal employment pre-trend (80-91)	0.069		0.050	0.149		0.109
	(0.115)		(0.114)	(0.132)		(0.126)
All employment pre-trend (70-80)		0.121**	0.110**		0.263***	0.239***
		(0.056)	(0.044)		(0.080)	(0.063)
State fixed effects (26)	✓	✓	✓	✓	✓	✓
R-squared	0.579	0.589	0.592	0.524	0.552	0.562
Panel B: log Informal Earnings Premia						
Regional tariff reduction (RTR)	-0.027	-0.217	-0.034	0.352	0.054	0.338
	(0.161)	(0.160)	(0.163)	(0.256)	(0.298)	(0.251)
Informal earnings pre-trend (80-91)	-0.191***		-0.193***	-0.288***		-0.291***
	(0.049)		(0.048)	(0.086)		(0.084)
All workers' earnings pre-trend (70-80)		0.008	-0.016		0.001	-0.035
		(0.064)	(0.060)		(0.109)	(0.102)
State fixed effects (26)	✓	✓	✓	✓	✓	✓
R-squared	0.676	0.654	0.676	0.690	0.667	0.690

Dix-Carneiro and Kovak 2017

What could be going on?

Some possibilities

1. Urban decline [Glaeser Gyourko '05, Noto '13)], AKA 'specific factors'
2. **Changing worker composition (adverse selection)**
3. **Slow response of imports or exports**
4. **Dynamic labor demand adjustment**

Testing for Compositional Changes in Worker 'Skill' Using Worker Fixed Effects

Table 5: Mechanisms: Changing Worker Composition - 1995, 2000, 2005, 2010

Change in log Formal Earnings Premia:	1991-1995	1991-2000	1991-2005	1991-2010
	(1)	(2)	(3)	(4)
Panel A: Main specification				
Regional tariff reduction (RTR)	-0.096	-0.529***	-1.294***	-1.594***
	(0.120)	(0.141)	(0.139)	(0.169)
Panel B: Earnings premia controlling for individual fixed effects (fixed returns)				
Regional tariff reduction (RTR)	-0.193*	-0.514***	-1.119***	-1.271***
	(0.115)	(0.144)	(0.147)	(0.172)
Panel C: Earnigns premia controlling for individual fixed effects (time-varying returns)				
Regional tariff reduction (RTR)	-0.230**	-0.551***	-1.322***	-1.454***
	(0.093)	(0.098)	(0.094)	(0.119)
Formal earnings pre-trend (86-90)	✓	✓	✓	✓
State fixed effects (26)	✓	✓	✓	✓

Dix-Carneiro and Kovak 2017

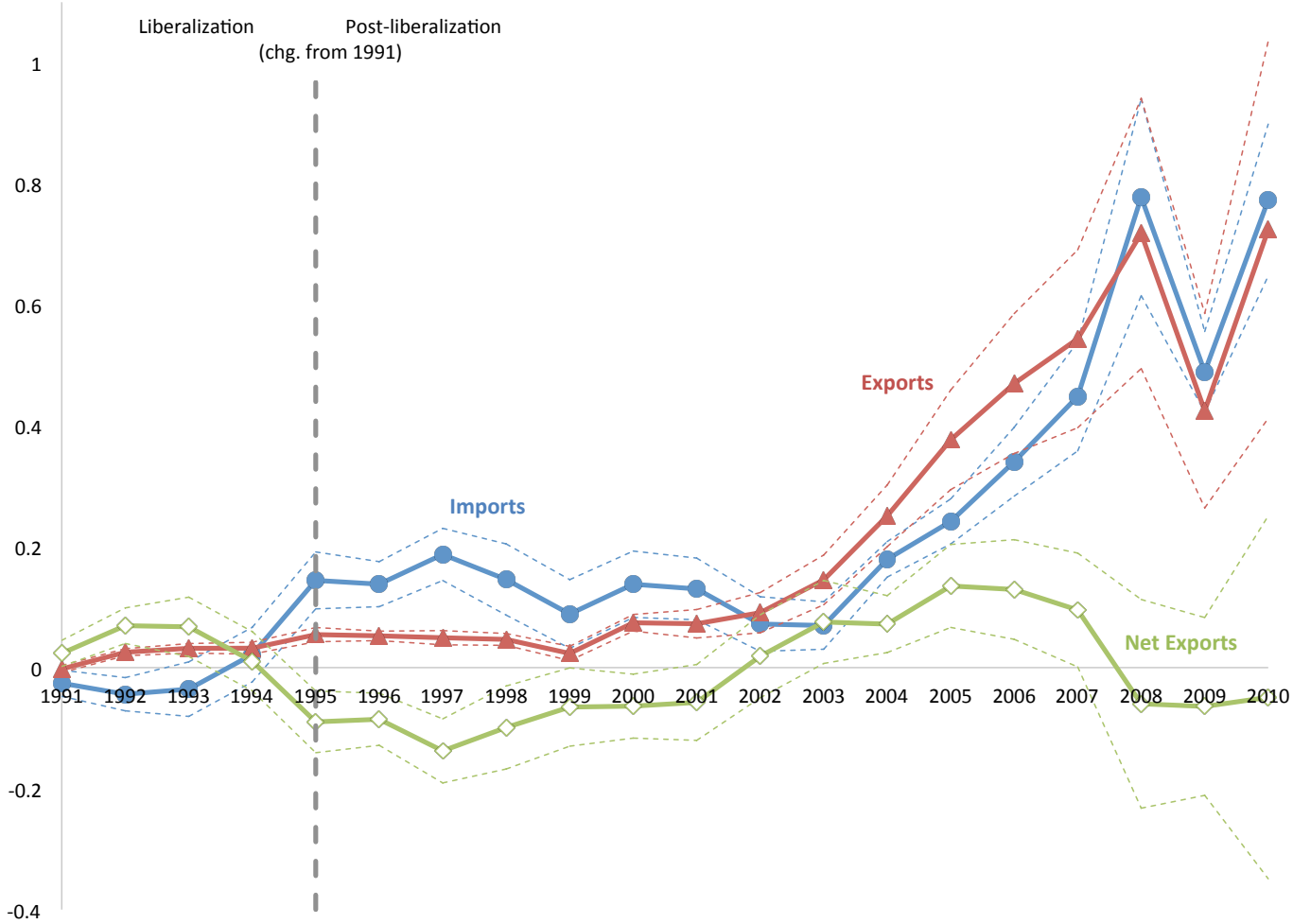
What could be going on?

Some possibilities

1. Urban decline [Glaeser Gyourko '05, Noto '13)], AKA 'specific factors'
2. Changing worker composition (adverse selection)
3. **Slow response of imports or exports**
4. **Dynamic labor demand adjustment**

Tariff change vs. regional imports, exports, and net exports per worker, 1987 – 2010

Figure 5: Regional Imports, Exports, and Net Exports Per Worker - 1991-2010

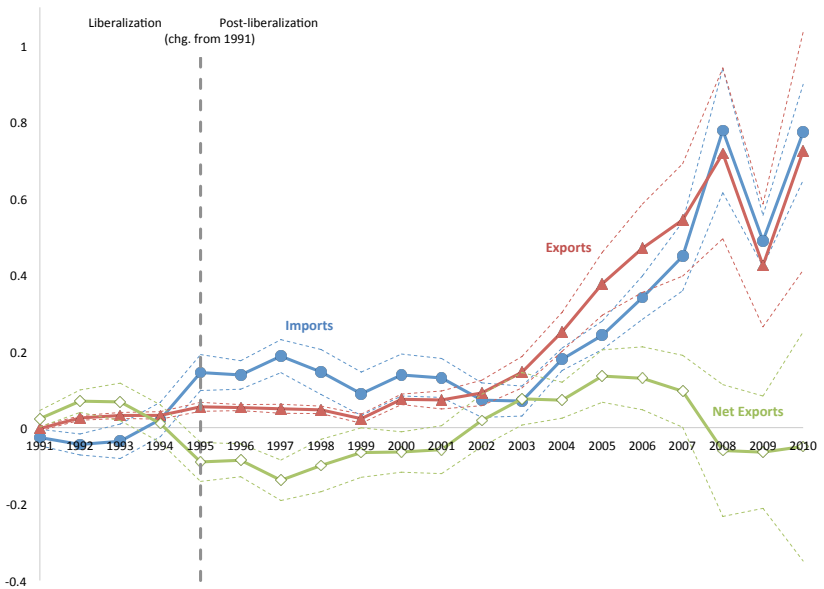


Dix-Carneiro and Kovak 2017

Timing of import/export changes does not seem to line up with timing of wage changes

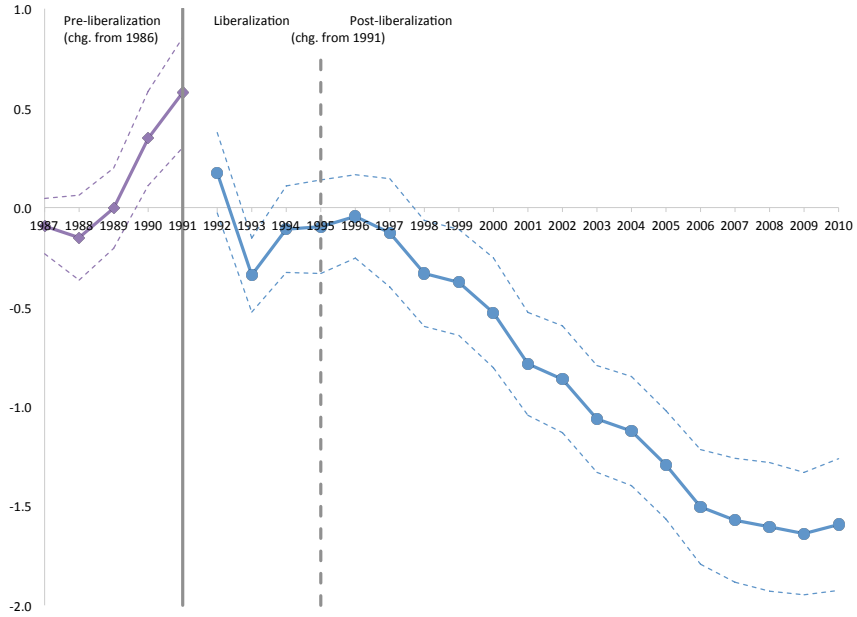
Imports/Exports

Figure 5: Regional Imports, Exports, and Net Exports Per Worker - 1991-2010



Formal Earnings Premium

Figure 3: Regional log Formal Earnings Premia - 1987-2010



Dix-Carneiro and Kovak 2017

What could be going on?

Some possibilities

1. Urban decline [Glaeser Gyourko '05, Noto '13)], AKA 'specific factors'
2. Changing worker composition (adverse selection)
3. Slow response of imports or exports
4. **Dynamic labor demand adjustment**

Impact of tariff change on regional wage premium

$$\hat{w}_r = \sum_i \beta_{ri} \hat{P}_i + \sum_i \beta_{ri} \hat{A}_{ri} - \delta_r \left(\hat{L}_r - \sum_i \lambda_{ri} \left(1-\zeta_i\right) \hat{K}_{ri} \right)$$

where $\lambda_{ri} = \dfrac{L_{ir}}{L_r}$, $\beta_{ri} \equiv \dfrac{\lambda_{ri} \frac{1}{\varphi_i}}{\sum_j \lambda_{ri} \frac{1}{\varphi_i}}$, $\delta_r \equiv \dfrac{1}{\sum_j \lambda_{ri} \frac{1}{\varphi_i}}$

1. Increasing in share of regional labor λ_{ri} allocated to affected industries
2. Increasing in labor's share of output $(1 - \varphi_i)$ in affected industries
3. Declining in specific factor-shares of affected industries ζ_i
    - Specific factors bear some incidence
    - *Absent specific factors, no differences in industry structure across regions*

Adding agglomeration economies

Simplify by assuming

1. Identical changes in capital rental rate across regions $\hat{R} = \hat{R}_{ri}\ \forall r, i$
2. Identical technologies across industries ($\varphi_i = \varphi\ \forall i$ and $\zeta_i = \zeta\ \forall i$)

Perfectly mobile capital

- $\therefore$ substitute change in capital, $\hat{K}_{ri}$, for the change in capital's price

Two additional elasticities needed

1. η labor supply elasticity
2. agglomeration elasticity of *formal employment*: $\hat{A}_{ri} = \kappa \hat{L}_r$, $\kappa \geq 0$

Adding agglomeration economies

Two additional elasticities

1. η labor supply elasticity
2. agglomeration elasticity of *formal employment*: $\hat{A}_{ri} = \kappa \hat{L}_r$, $\kappa \geq 0$

After a lot of algebra

$$\hat{w}_r = \sum_i \beta_{ri} \hat{P}_i \frac{\eta}{\eta\left[1 - \varphi\left(1 - \zeta\right) - \kappa + \varphi\zeta\right]} - \frac{\varphi\left(1 - \zeta\right)\eta}{\eta\left[1 - \varphi\left(1 - \zeta\right) - \kappa + \varphi\zeta\right]} \hat{R}$$

If agglomeration elasticity $\kappa > 0$, amplifies the wage impact of changes in regional labor supply or changes in the rental rate of capital

Scenarios for wage adjustment

$$\hat{w}_r = \sum_i \beta_{ri} \hat{P}_i + \sum_i \beta_{ri} \hat{A}_{ri} - \delta_r \left(\hat{L}_r - \sum_i \lambda_{ri} \left(1 - \zeta_i\right) \hat{K}_{ri} \right)$$

1. **Regional labor supply only factor to respond to liberalization:** $\hat{A}_{ri} = \hat{K}_{ri} = 0$. $\hat{w}_r$ falls following liberalization. Decline in L_r in formal sector buffers wage losses because $\delta_r > 0$. *Shock dies out over time (at lower wage levels)*
2. **Both $\hat{L}_r$ and $\hat{K}_{ri}$ adjust**: Sign $(\hat{w}_r)$ depends on relative speed of L, K adjustment. If L_r fixed and K_{ri} falls, *MRPL* falls, $\rightarrow \hat{w}_r$ falls further. *Adverse earnings impacts can rise over time*
3. **Add agglomeration of formal employment**: $\hat{A}_{ri} = \kappa \hat{L}_r$. Trade shock decreases wages on impact. Formal employment falls due to η. *Regional productivity drops due to de-agglomeration. $\hat{w}_r, \hat{L}_r$ fall further*

Interesting testable implication

Negative cross-industry employment spillovers?

$$\hat{L}_{ri} = \underbrace{\frac{1}{\varphi\zeta}\hat{P}_i}_{\text{Own-Ind Effect}} - \frac{1}{\varphi\zeta} \times \underbrace{\frac{\eta\left[1-\varphi\left(1-\zeta\right)\right]-\kappa}{\eta\left[1-\varphi\left(1-\zeta\right)-\kappa+\varphi\zeta\right]}\sum_i \beta_{ri}\hat{P}_i}_{\text{Cross-Industry Employment effects}}$$

$$- \frac{\varphi\left(1-\zeta\right)\eta}{\eta\left[1-\varphi\left(1-\zeta\right)-\kappa+\varphi\zeta\right]}\hat{R}$$

Own price effect on industry employment is positive $\frac{1}{\varphi\zeta}\hat{P}_i$

Interesting testable implication

Cross industry employment effects

$$-\frac{1}{\varphi\zeta} \times \underbrace{\frac{\eta\left[1-\varphi\left(1-\zeta\right)\right]-\kappa}{\eta\left[1-\varphi\left(1-\zeta\right)-\kappa+\varphi\zeta\right]} \sum_{i} \beta_{ri} \hat{P}_i}_{\text{Cross-Industry Employment effects}}$$

- **If $\kappa = 0$, decline in price of sector i' causes labor to flow into sector i**
- **If $\kappa > 0$, possible for this expression to be positive—so flows not offsetting**
  - *De-agglomeration more than offsets the buffering mechanism of elastic labor demand in non-shocked sectors*

Testing for agglomeration economies: Impact of other industry tariff reductions on own industry employment

$$\hat{L}_{ri} = \gamma_0 + \gamma_1 \hat{P}_i + \gamma_2 RTR_r + \epsilon_{ri}$$

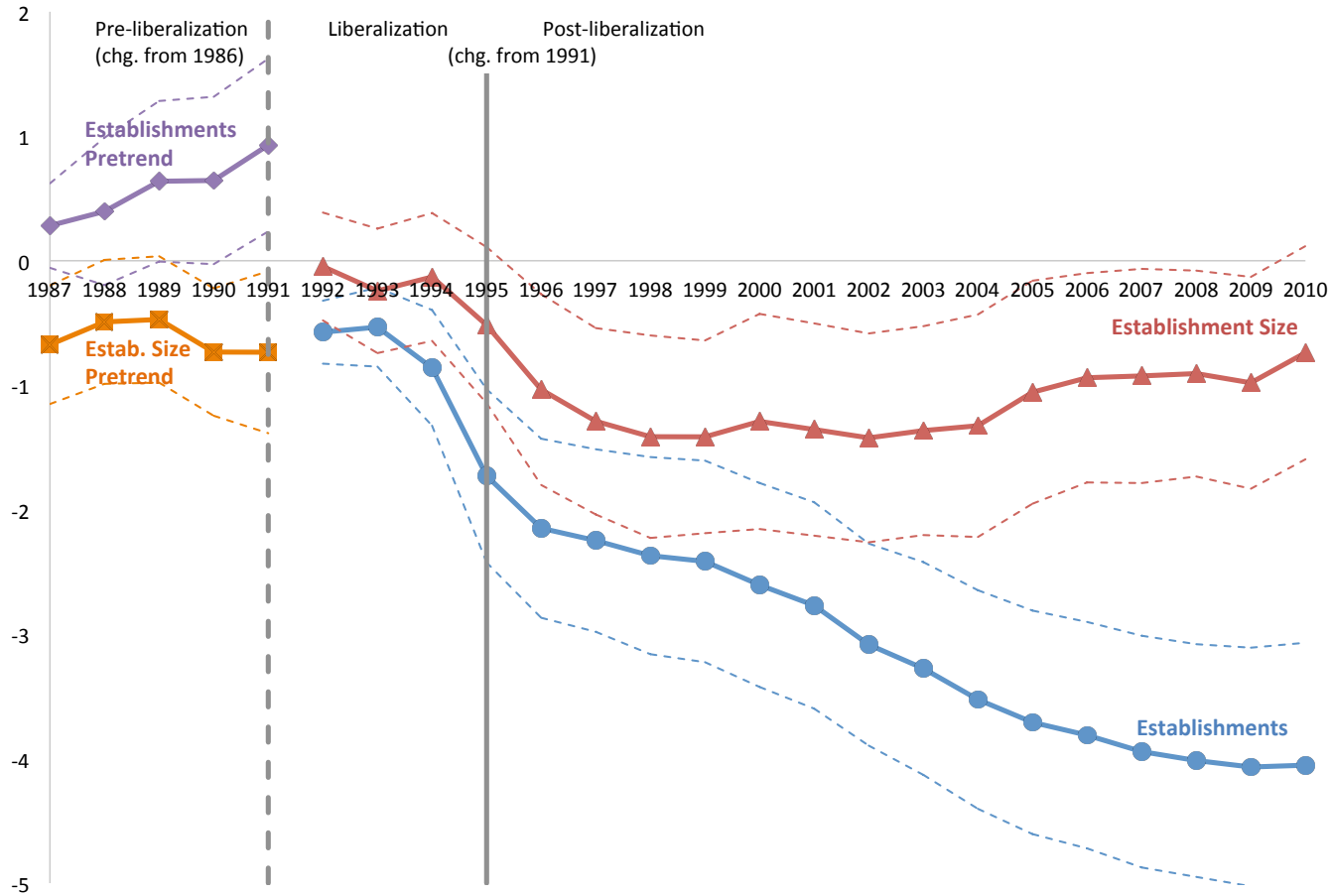
Table 7: Test for Agglomeration Economies

Change in log Region × Industry Employment:	All Industries				Tradable Industries	
	(1)	(2)	(3)	(4)	(5)	(6)
Regional tariff reduction (RTR)	-7.751***	-6.084***	-6.183***	-6.333***	-6.708***	-6.704***
	(0.625)	(0.623)	(0.631)	(0.646)	(0.675)	(0.694)
Industry tariff reduction	-1.790***	-1.666***	-1.669***		-2.017***	
	(0.294)	(0.290)	(0.291)		(0.332)	
Formal employment pre-trend (86-90)			-0.106***	-0.147***	-0.110***	-0.150***
			(0.036)	(0.032)	(0.037)	(0.032)
Industry fixed effects (20)				✓		✓
State fixed effects (26)		✓	✓	✓	✓	✓

Dix-Carneiro and Kovak 2017

Log # of formal establishments and log average formal establishment size (workers), 1987 – 2010

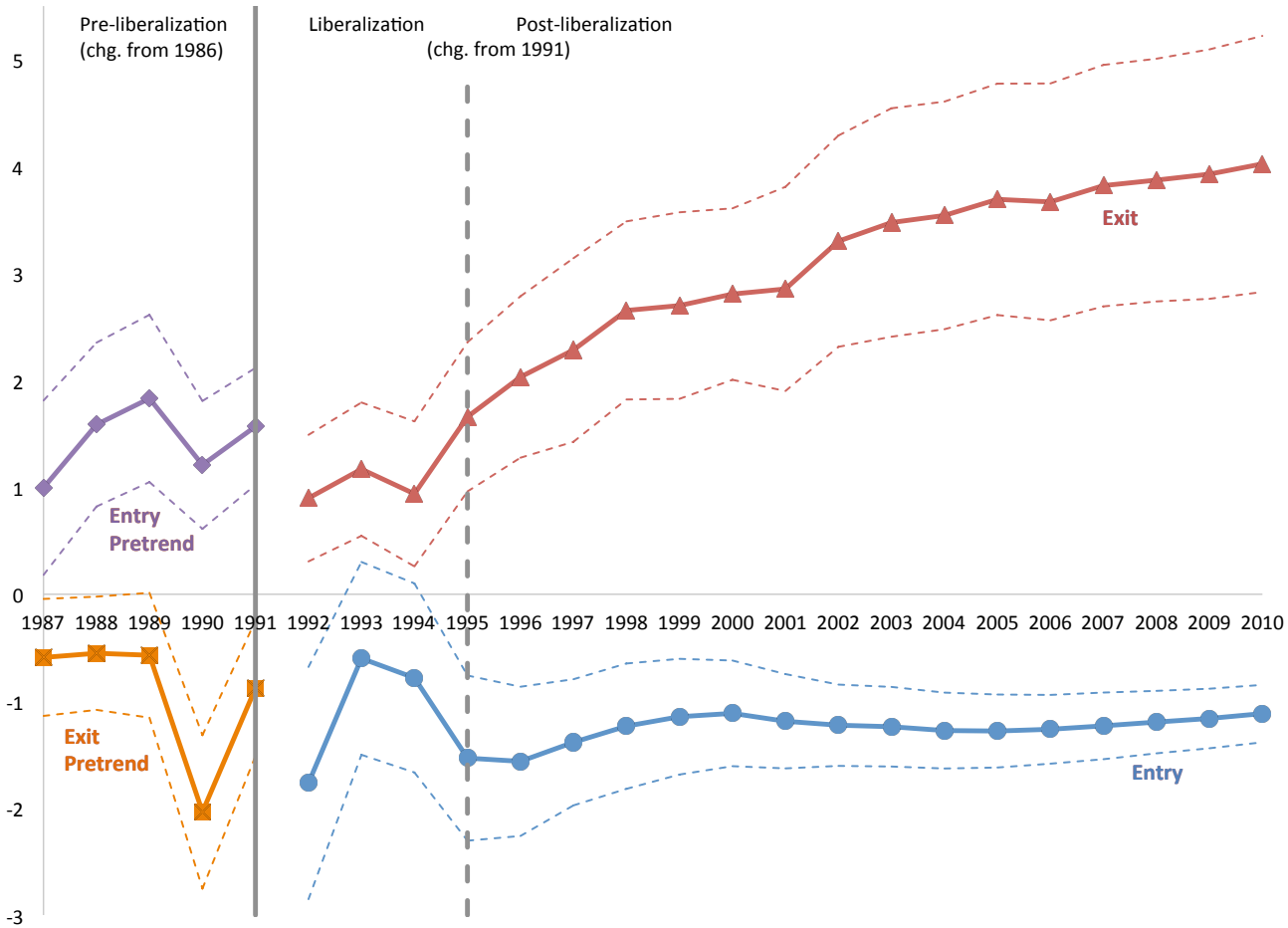
Figure 7: Regional log Number of Formal Establishments and log Average Formal Establishment Size (Number of Workers) - 1987-2010



Dix-Carneiro and Kovak 2017

Log formal establishment exit and entry, 1987 – 2010: Suggests slow capital adjustment

Figure 8: Regional log Cumulative Formal Establishment Entry and Exit - 1987-2010



Dix-Carneiro and Kovak 2017

Scenarios for wage adjustment

$$\hat{w}_r = \sum_i \beta_{ri} \hat{P}_i + \sum_i \beta_{ri} \hat{A}_{ri} - \delta_r \left(\hat{L}_r - \sum_i \lambda_{ri} \left(1 - \zeta_i\right) \hat{K}_{ri} \right)$$

1. **Only regional labor supply responds to liberalization**: $\hat{A}_{ri} = \hat{K}_{ri} = 0$. $\hat{w}_r$ falls following liberalization. Decline in L_r in formal sector buffers wage losses because $\delta_r > 0$. *Shock dies out over time (at lower wage levels).*
2. **Both $\hat{L}_r$ and $\hat{K}_{ri}$ adjust**. $\hat{w}_r$ depends on relative speed of L, K adjustment. If L_r fixed and K_{ri} falls, *MRPL* falls, $\rightarrow \hat{w}_r$ falls further. *Adverse earnings impacts can rise over time.*
3. **Add agglomeration of formal employment**: $\hat{A}_{ri} = \kappa \hat{L}_r$. Trade shock decreases wages on impact. Formal employment falls due to η. *Regional productivity drops due to de-agglomeration. $\hat{w}_r, \hat{L}_r$ fall further.*

Implied agglomeration elasticity κ, conditional on labor supply Elasticity η^{-1} and specific factor share of non-labor inputs ς

Table 8: Agglomeration Elasticity Estimates

Panel A: Inverse labor supply elasticity (η)	0.363***		
	(0.060)		
Panel B: Agglomeration elasticity (κ)			
	(1)	(2)	(3)
Specific factors' share of non-labor inputs (ζ):	low (0.152)	mid (0.349)	high (0.545)
Wage-based agglomeration elasticity (κ)	0.042*	0.188***	0.333***
	(0.023)	(0.023)	(0.025)
Employment-based agglomeration elasticity (κ)	0.215***	0.330***	0.461***
	(0.032)	(0.038)	(0.043)

Labor supply elasticity, η, estimated from (12) using RTR_r as an instrument for the change in regional log earnings premium. The first-stage partial F-statistic (Kleibergen-Paap) for this regression is 59.14. Given the estimate of η, the agglomeration elasticity, κ, is estimated using two alternative methods. The earnings-based approach estimates (13), and the employment-based approach estimates (14), both using nonlinear least squares, and both including 1986-1990 pre-liberalization outcome trends and state fixed effects. The employment-based estimates control for industry price changes as in column (3) of Table 7, and results using other approaches are very similar. We present estimates for three different values of ζ, specific factors' share of non-labor inputs, based on Valentinyi and Herrendorf (2008). See text for details. Standard errors (in parentheses) bootstrapped by regional resampling. *** Significant at the 1 percent, ** 5 percent, * 10 percent level.

Dix-Carneiro and Kovak 2017

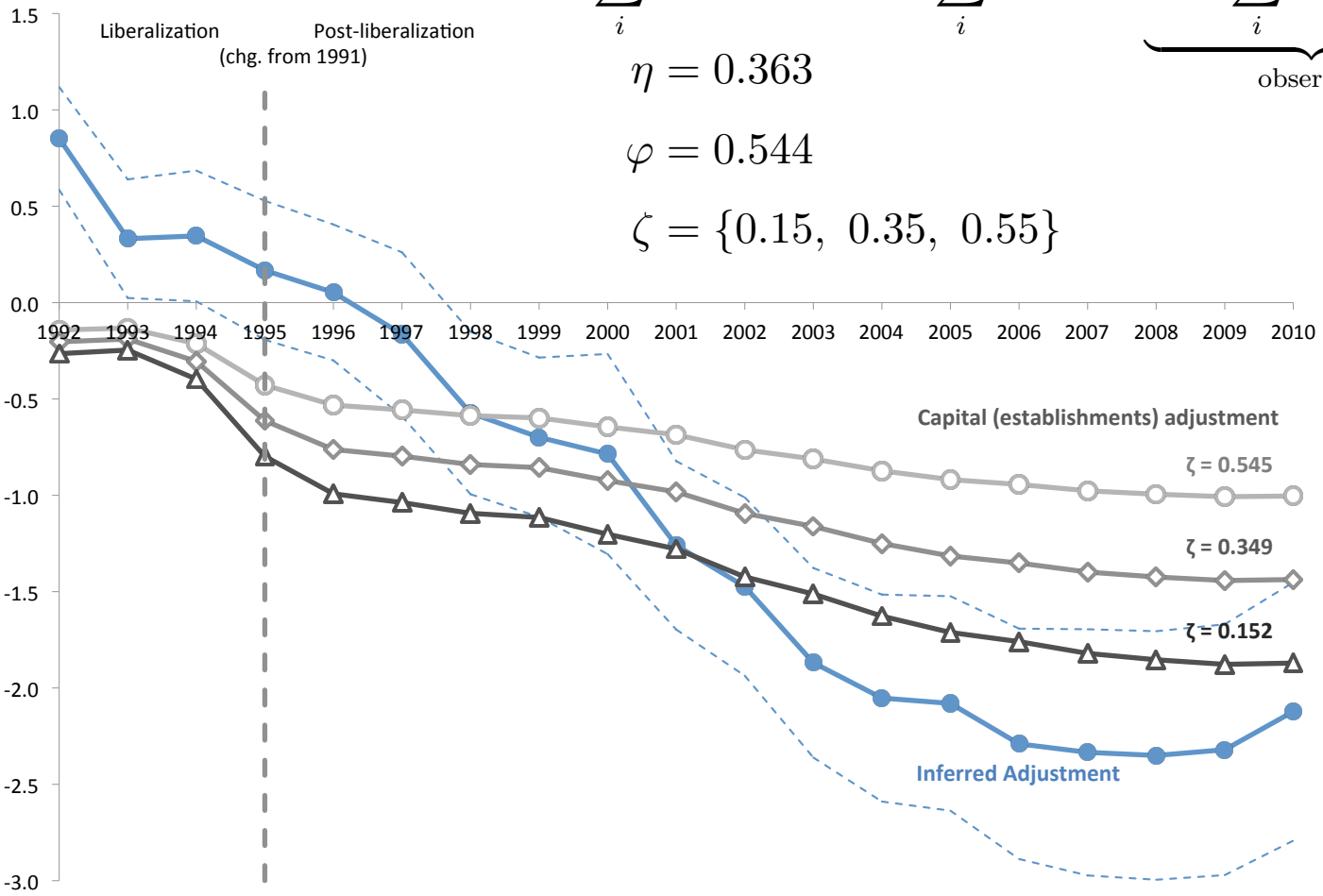
Inferred capital adjustment, 1987 – 2010

$$\sum_i \beta_{ri}\hat{A}_{ri} + \varphi(1-\zeta)\sum_i \lambda_{ri}\hat{K}_{ri} = \underbrace{\hat{w}_r - \sum_i \beta_{ri}\hat{P}_i + \varphi\hat{L}_r}_{\text{observed}}$$

$$\eta = 0.363$$

$$\varphi = 0.544$$

$$\zeta = \{0.15,\ 0.35,\ 0.55\}$$



Dix-Carneiro and Kovak 2017

Useful observations sentences from conclusion

"A growing literature has shown in a variety of contexts that trade and trade policy have heterogeneous effects across regions in the short-run. However, most researchers, ourselves included, generally assumed that these effects would be upper bounds on the long-run effects, as labor reallocation would arbitrage away regional differences. This paper finds precisely the opposite."

Some open questions

1. What *causes* agglomeration economies?
   - Input-output linkages
   - Marshallian knowledge spillovers
2. What is the role of the formal versus informal sector in generating 'agglomeration'
3. Why is there so little regional mobility?
4. What is the correct definition of a regional/ local labor market?