

Of Cities and Slums

Alexander Monge-Naranjo

Federal Reserve Bank of St. Louis

Pedro Cavalcanti Ferreira

EPGE-Fundação Getulio Vargas

Luciene Torres de Mello Pereira

EPGE-Fundação Getulio Vargas

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Introduction

- ▶ **Questions:** Structural Transformation & Emergence of Slums
 - ▶ **Causes:** Conditions on labor, housing and education markets.
 - ▶ **Consequences:** Slums: Traps or Stepping Stones?
- ▶ **This Paper:**
 - ▶ **Facts:** Emergence & Workings of Slums in Brazil.
 - ▶ **Model:** Structural Transformation & Urbanization.
 - ▶ When do slums emerge?
 - ▶ Dynamic implications.
 - ▶ Calibration and replication of Brazilian observations.
 - ▶ **Counterfactuals:** Macro and Micro Impacts of Policies.

Key Take Aways

- ▶ **The Workings of Slums:** *A roundabout way to live in cities*
 - ▶ Integrated Urban Labor Markets.
 - ▶ Segregated Human Capital Formation.
- ▶ **Emergence:** *Structural Transformation+ Low Human Capital*
 - ▶ Lower prices of Agriculture.
 - ▶ Low skill households and housing costs.
 - ▶ **Housing Costs:**
 - ▶ *Direct:* Barriers to enter cities.
 - ▶ *General Equilibrium:* Total Urban absorption.
- ▶ **Consequences:** *(wrt full crack-down)*
 - ▶ Less disperse skill accumulation for the country overall.
 - ▶ Faster structural transformation/depletion of rural areas.
 - ▶ **Less** slums in the future.

Data and Definitions

- ▶ **Defining Slums: IBGE:** *Subnormal Agglomerates*: sets of 51 or more housing units characterized by one of the following:
 - ▶ Irregular traffic routes or irregular size (shape) of land plot.
 - ▶ Lack of essential public services (e.g. garbage collection, sewage, electricity and public lighting.) ▶ (Alternative: UN Habitat:)
- ▶ **Data:**
 - ▶ Brazilian Census (IBGE):
 - ▶ "subnormal agglomerate" question for 1991 and 2000.
 - ▶ Favela Census (Gov of Rio) 2010.
 - ▶ Social Mobility Supplement for PNAD (household survey)
 - ▶ Groningen Growth & Development Centre (GGDC) database.

The Emergence of Slums in Brazil

I. Urban Slums are Substantial ▶ EmergenceSlums

2010: 1-in-5 in Rio; 1-in-4 in Sao Paulo.

II. Low Human Capital in Urban Slums ▶ Who Lives? ▶ Slums and LSS

*Education: Rural: Very Low; Slums: Low; Cities: High(er)
Rise of Slums associated with rise of low-skill urban jobs.*

III. Intergenerational Persistence of Slums ▶ Persistence

Prob. >60% if staying if born there.

IV. Housing Costs are Barriers to Entry in Cities ▶ Housing Costs

Housing Costs in Cities: 6x rural, 3x slums.

V. Slums: Access to Urban Schools and Labor Markets?

Adults Integrated; Children Segregated.

VI. Location Differences in Human Capital Formation

Slums: Access to Urban Schools and Labor Markets?

- ▶ **Adults in Slums Access Jobs in the City** (Relative Incomes: Rural, Slum, City)

Jobs of Adults Living In Three Slums in Rio (%)

	<i>Alemão</i>	<i>Manquinhos</i>	<i>Rocinha</i>
Inside slums	22.7	22.4	22.0
In the close vicinity	15.7	19.3	6.9
Outside slums	61.6	58.4	71.1

- ▶ **Children in Slums go to Schools in Slums:**

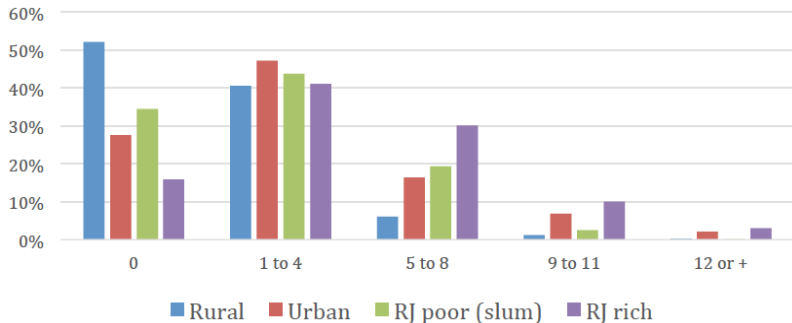
Schools of Children Living In Three Slums in Rio (%)

	<i>Alemão</i>	<i>Manguinhos</i>	<i>Rocinha</i>
Inside slums/<1km away	95.2	77.2	43.5
Outside, >1km away	0.0	12.3	26.0
Outside, >3km	1.5	7.8	30.2

Segmentation of Human Capital Formation

► Children of Parents 0 yrs of Schooling

(All Other Households)



Probabilities, Education Attainment, by Location

Model

Discrete time: $t = 1, 2, 3, \dots$ OLG.

Preferences: Intergenerational, Non-Homothetic:

$$V_t = u(c_t) + \beta E_t [z_{t+1}],$$
$$u(c_t) = \frac{\left[(c_t^A - \bar{c}^A)^{\alpha_A} (c_t^N)^{1-\alpha_A} \right]^{1-\gamma}}{1-\gamma},$$

Heterogeneous Skills: μ_t measure over skills $z \in \mathbb{R}_+$

Constant population size $\int_0^\infty \mu_t(dz) = 1$.

Time Evolution: $\{\mu_t\}_{t=1}^\infty$

Model

Three Locations: *Rural, Slums, City* $l = R, F, C$.

Occupations Choices:

unskilled: $h^u(z) = 1$ for all $z \in \mathbb{R}_+$;

qualified: $h^q(z) = \begin{cases} 0 & \text{if } z < z_{\min}, \\ 1 & \text{otherwise;} \end{cases}$

adaptable: $h^a(z) = z$ for all $z \in \mathbb{R}_+$.

Two Sectors:

- ▶ Agricultural (Rural):

$$Y_t^A = X_t^A L_t^u,$$

- ▶ Non-agricultural (Urban):

$$Y_t^N = X_t^N (L_t^q)^\eta (L_t^a)^{1-\eta}.$$

Model

Locations: Country's population $\mu_t(\cdot)$ allocated across locations:

$$\mu_t(\cdot) = \sum_{l \in \{R, F, C\}} \mu_t^l(\cdot),$$

where $\mu_t^l(\cdot)$ measure in location $l = R, F, C$.

Dwelling Costs:

Rural: None.

Slum: Utility Costs $\tau_t \geq 0$.

City: Housing Cost: $\zeta_t > \mathbf{0}$ non-agricultural goods.

Model

Skill Formation: Children in location l : $z' \sim Q(\cdot | Z_t^l)$.

Location l average: $Z_t^l \equiv \left[\frac{\int_0^\infty z^\rho \mu_t^l(dz)}{\int_0^\infty \mu_t^l(dz)} \right]^{1/\rho}$.

Population Dynamics: For any Borel set $B \subset \mathbb{R}_+$

$$\mu_{t+1}(B) = \sum_{l \in \{R, F, C\}} \int_0^\infty Q(B | Z_t^l) \mu_t^l(dz).$$

Assumptions:

$\mu_0(\cdot)$, $Q(\cdot | Z)$: *continuous, unbounded support* $[0, \infty)$.

If location l is empty, then $z' \sim Q(\cdot | z)$.

Slack Productivity: For all t , $X_t^A > \bar{c}^A$.

Equilibrium

State variables: **Exogenous:** X_t^A, X_t^N . **Endogenous:** $\mu_t(\cdot)$.

Competitive Equilibrium: Indiv.Rationality & Market Clearing

Price System: $\{p_t^N, w_t^u, w_t^q, w_t^a\}; p_t^A = 1$.

Allocations:

Occupations: *Skill thresholds.*

Consumptions: *Gorman Aggregable.*

Locations: *Labor Markets and Schools:*

$$V_t(z) = \max \{V_t^R(z), V_t^F(z), V_t^C(z)\}$$

$$\text{Rural: } V_t^R(z) = v_t(\mathbf{w}_t^u, p_t^N) + \beta E_t [z_{t+1} | \mathbf{Z}_t^R],$$

$$\text{Slum: } V_t^F(z) = v_t(y_t^U(z), p_t^N)(1-\tau) + \beta E_t [z_{t+1} | \mathbf{Z}_t^F],$$

$$\text{City: } V_t^C(z) = v_t[y_t^U(z) - \mathbf{p}_t^h, p_t^N] + \beta E_t [z_{t+1} | \mathbf{Z}_t^C]$$

Equilibrium

Urban Occupations Given urban population μ_t^{F+C}

$$z_t^H = \frac{\eta}{1 - \eta} \left[\frac{\int_0^{z_{\min}} z \mu_t^{F+C} (dz) + \int_{z_t^H}^{\infty} z \mu_t^{F+C} (dz)}{\int_{z_{\min}}^{z_t^H} \mu_t^{F+C} (dz)} \right].$$

for any admissible selection μ_t^{F+C} .

Relative Price p_t^N : Given city and slum populations μ_t^F , μ_t^C :

$$p_t^N = \frac{1 - \alpha_A}{\alpha_A} \left[\frac{Y_t^A (\mu_t^{F+C}) - \bar{c}^A}{Y_t^N (\mu_t^{F+C}) - \zeta_t \times \text{size city}} \right].$$

Equilibrium

Proposition: Existence of Monotone, Fully Separating Equilibria:

rural population, $\mu_t [0, z_t^R]$,

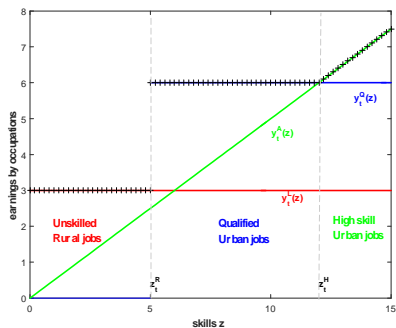
slum population, $\mu_t (z_t^R, z_t^F]$,

city population $\mu_t (z_t^F, \infty)$.

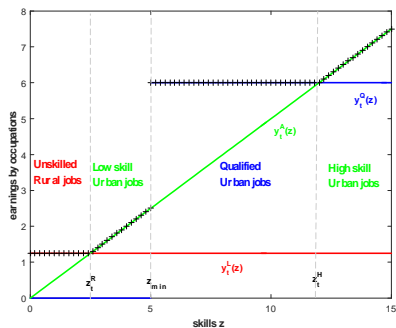
Urban Configurations

	Urban Locations	
Urban Jobs	Cities Only	Cities and Slums
High Skill Only	$z_F = z_R \geq z_{\min}$	$z_F > z_R > z_{\min}$
High & Low Skill	$z_F = z_R < z_{\min}$	$z_R < z_{\min}; z_F > z_R;$

Equilibrium Urban and Employment Configurations



Urban High Skill Jobs Only



Low & High Skill Urban Jobs

Discussion: Growth Urban Areas: $z^R < z_{min}$ **vs** $z^R > z_{min}$.

Calibration

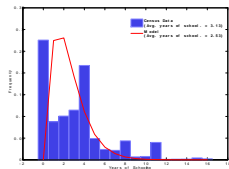
Parameters			Exogenous Variables		
Parameter	Value	Source/Criterion	Variable	Value	Target/Criterion
I. Preferences			III. City & Slum Dwelling Costs		
β	0.294	Model period = 30 years	τ_1	0.19	Slum & City Pop.
α	0.01	Herrendorf et al.(2014)	τ_2	0.245	Slum Rents, 91.
z^A	0.245	% Agric. Employment.	ξ_1	0.1	Slum & City Pop.
			ξ_2	0.6	Slum & City Pop.
II. Technology			IV. Sectoral Productivities		
η	0.6	% Output, HS+, 91.	X_1^A	1	Normalization
z_{\min}	11	HS Diploma.	X_2^A	2.5	Agric. Prod.,81-10
			X_1^N	10	% Non-Ag.Y, 50-80.
			X_2^N	11	% Non-Ag.Y, 81-10.
V. Human Capital Formation: $z' \sim \Gamma(Z_t^I, k)$					
k	2.4	Avg.Schooling:50-10	Z_0^R	0.8	Educ. old, 1950
ρ	1	Eliminate Extern.	Z_0^F	1	Educ. old, 1950
			Z_0^C	2	Educ. old, 1950

Calibration

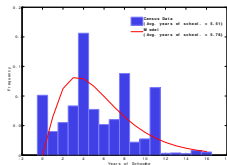
Calibrated Model and Observed Data for Brazil

Variable	1980		2010	
	Data	Model	Data	Model
Population:(%)				
Slum Population:	10.34	10.96	18.70	18.84
City Population:	57.26	56.58	66.30	63.63
Agriculture(%)				
Labor Share:	38.15	32.46	16.70	17.53
Output Share:	6.85	4.67	5.72	2.29
Average Schooling:(years)				
Rural Areas:	1.46	2.20	3.13	2.53
Urban Slums:	–	4.07	5.51	5.78
Cities, Proper:	–	4.27	9.48	9.92

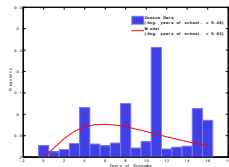
Calibration: Human Capital Distributions, 1980-2010



Rural



Slum



City

Counterfactuals I: Cracking Down Slums

Variable	Benchmark		Alternative Utility Costs of Slums			
			$\tau_1 \nearrow 1$		$\tau_2 \nearrow 0.5$	$\tau_2 \nearrow 1$
	1980	2010	1980	2010	2010	2010
Population: (%)						
Slum Population:	11.0	18.4	0.0	26.4	1.4	0.0
City Population:	56.6	63.6	17.4	58.0	79.6	30.0
Agriculture(%)						
Labor Share:	32.5	17.5	82.7	15.7	19.0	70.0
Output Share:	4.7	2.3	1.4	2.8	2.0	2.3
Average Schooling: (years)						
Rural Areas:	2.2	2.5	4.8	3.3	2.7	3.5
Urban Slums:	4.1	5.8	–	7.4	4.4	–
Cities, Proper:	4.3	9.9	7.3	10.2	8.4	14.9

May **reduce cities at t & increase slums at t + 1.**

Counterfactuals II: Schooling Integration Policies

$$Z^F = \iota \hat{Z}^F + (1 - \iota) \hat{Z}^C; \quad Z^C = \iota \hat{Z}^C + (1 - \iota) \hat{Z}^F.$$

Variable	Integration of Cities and Slums					
	Benchmark		$\iota_2 = 0.75$		$\iota_1 = \iota_2 = 0.75$	
	1980	2010	1980	2010	1980	2010
Population: (%)						
Slum Population:	11.0	18.4	10.96	23.23	46.32	14.60
City Population:	56.6	63.6	56.58	60.50	21.22	68.01
Agriculture(%)						
Labor Share:	32.5	17.5	32.46	16.27	32.46	17.39
Output Share:	4.7	2.3	4.67	2.26	4.71	2.33
Average Schooling: (years)						
Rural Areas:	2.2	2.5	2.20	2.54	2.21	2.65
Urban Slums:	4.1	5.8	4.07	6.04	4.15	5.96
Cities, Proper:	4.3	9.9	4.26	7.67	4.21	8.08

More slums at t , less slums at $t + 1$; increase City proper.

Conclusions

- ▶ **The Workings of Slums:** *A roundabout way to live in cities*
 - ▶ Integrated Urban Labor Markets.
 - ▶ Segregated Human Capital Formation.
- ▶ **Emergence:** *Structural Transformation+ Low Human Capital*
 - ▶ Lower prices of Agriculture.
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Defining Slums

- ▶ **IBGE:** Subnormal agglomerates: sets of 51 or more housing units characterized by one of the following:
 - ▶ Irregular traffic routes or irregular size (shape) of land plot.
 - ▶ Lack of essential public services (e.g. garbage collection, sewage, electricity and public lighting.)

- ▶ **UN Habitat:** A slum household: a group of individuals living under the same roof and lacking one or more of the following:
 - ▶ Access to improved water;
 - ▶ Access to improved sanitation;
 - ▶ Sufficient-living area;
 - ▶ Durability of housing;
 - ▶ Security of tenure. [◀ Return](#)

The Emergence of Slums

Urban Population in Slums (%)

Year	Rio de Janerio	São Paulo
1950	7.0	–
1960	10.2	–
1970	13.3	–
1991	17.4	9.2
2000	18.5	11.1
2010	22.0	23.2

◀ Return

Who Lives in Rural Areas, Slums and Cities Proper?

Population Distribution by Years of Schooling, 2000 (%)

Education (years)	Brazil	São Paulo		Rio de Janeiro	
	Rural Brazil	Slums	City	Slums	City
0	31.3	14.4	5.4	12.4	3.8
1 to 4	50.2	42.7	27.5	39.1	21.5
5 to 8	12.5	30.2	23.6	31.0	21.0
9 to 11	4.9	10.4	23.2	15.4	29.1
12 or +	1.0	2.3	20.2	2.2	24.6
Average (years)	2.9	4.8	8.1	5.3	9.0

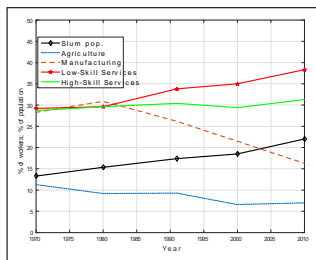
Source: Brazilian Census.

◀ Return

The Rise of Slums and of Low-Skill Urban Jobs

Employment Distribution by Sector and Location, 2000

	São Paulo		Rio de Janeiro	
	Slums	City	Slums	City
Agriculture & ND	2.2	2.3	3.1	3.4
Manufacturing	32.1	24.4	22.9	15.5
Low-Skill Services	47.7	39.6	53.6	39.5
High-Skill Services	18.0	33.8	20.6	41.5



Urban Jobs and Slum Population

Return

Slums are Intergenerationally Persistent

Migrants in Cities and Slums, 1991 (in %)

	São Paulo	Rio de Janeiro	Belo Horizonte	Belém	Salvador
<i>A. Cities</i>					
Migrants, total:	38.3	27.7	42.8	28.0	42.8
from Rural	11.0	4.8	9.1	9.2	9.1
from Urban	27.3	22.9	33.7	18.8	33.7
<i>B. Slums</i>					
Migrants, total:	48.2	29.8	43.5	29.5	32.8
from Rural	19.5	10.8	20.7	16.4	13.9
from Urban	28.7	19.0	22.8	13.1	18.9

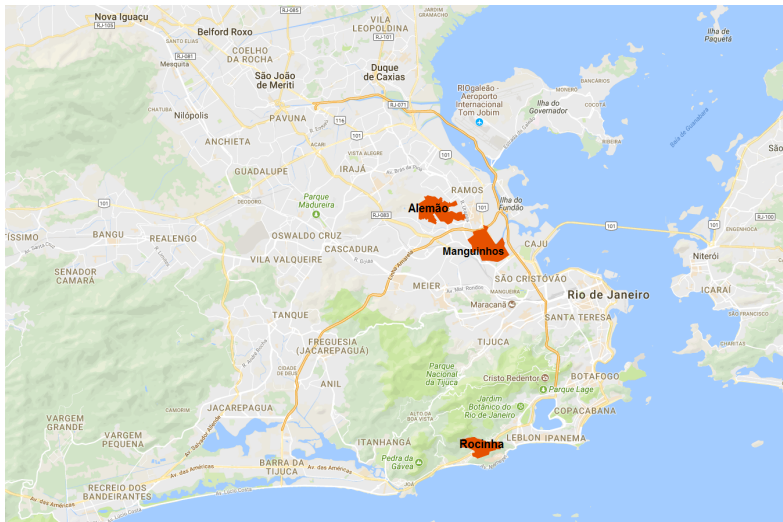
Source: Brazilian Census

- ▶ More than 50% of slum dwellers grew up there.

◀ Return

Slums: Access to Urban Schools and Labor Markets?

► Evidence from Three Favelas of Rio de Janeiro



Slums: Access to Urban Schools and Labor Markets?

► Adults in Slums Access Jobs in the City

Households Income Ratios: by Education and Location, 2000

Education	Brazil	Rio de Janeiro		São Paulo	
	Urban/Rural	City/Rural	Slum/Rural	City/Rural	Slum/Rural
0	1.3	2.1	1.6	2.5	2.0
1 to 3	1.4	1.9	1.4	2.1	1.6
4	1.3	1.6	1.1	1.8	1.2
5 to 8	1.3	1.6	1.0	1.7	1.0
9 to 11	1.4	1.6	0.8	1.8	0.9
12 or +	1.3	1.4	0.5	1.5	0.5

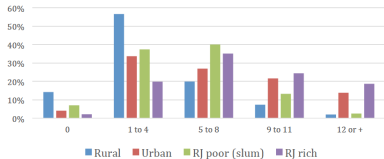
Source: Brazilian Census.

◀ Return

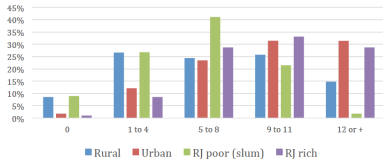
Segmentation of Human Capital Formation

Children of Parents by Schooling and Location

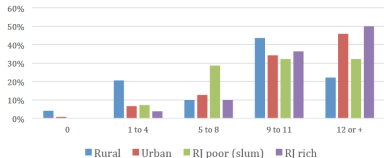
[Return](#)



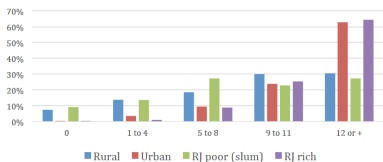
Fathers, Schooling 1-4 years



Fathers, Schooling 5-8 years



Fathers, schooling 9-11 years



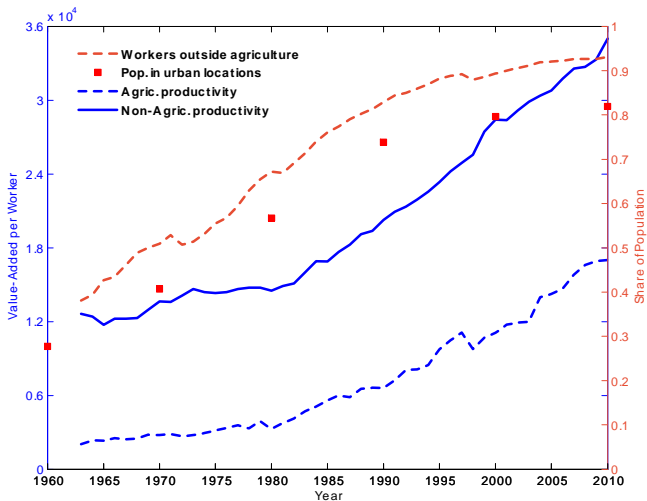
Fathers, schooling 12+ years

Counterfactual III: Housing Costs

Variable	Benchmark		Alternative Housing Costs in the Ci			
			$\zeta_1 \nearrow 0.2$		$\zeta_2 \searrow 0.3$	$\zeta_2 \nearrow 0$
	1980	2010	1980	2010	2010	2010
Population:(%)						
Slum Population:	11.0	18.4	55.3	24.9	1.44	31.63
City Population:	56.6	63.6	12.2	57.5	81.03	50.84
Agriculture(%)						
Labor Share:	32.5	17.5	32.5	17.6	17.53	17.53
Output Share:	4.7	2.3	4.7	2.3	2.34	2.26
Average Schooling:(years)						
Rural Areas:	2.2	2.5	2.2	2.5	2.53	2.53
Urban Slums:	4.1	5.8	7.0	6.3	4.2	7.23
Cities, Proper:	4.3	9.9	8.1	10.6	8.32	11.44

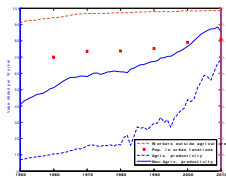
Impact depends on skill distribution.

A Common View Structural Transformation & Growth

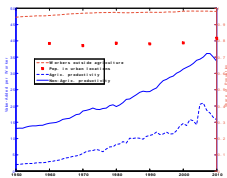


KOREA

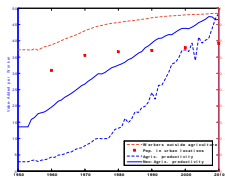
A Common View Structural Transformation & Growth



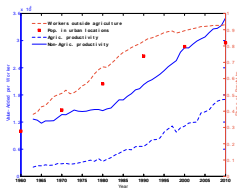
USA



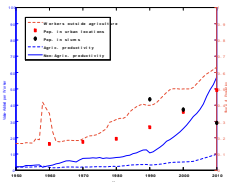
UK



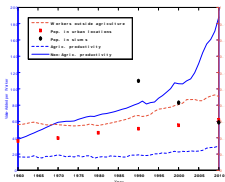
France



Korea

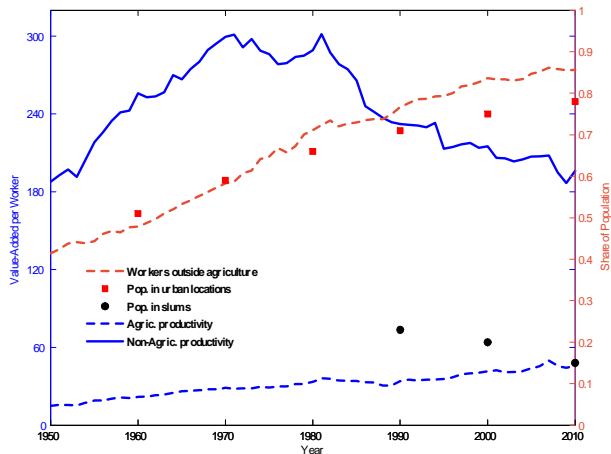


China



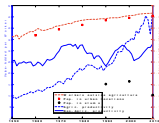
India

Problems with the Common View: Latin America

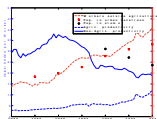


MEXICO

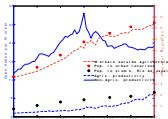
Problems with the Common View: Latin America



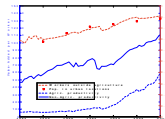
Argentina



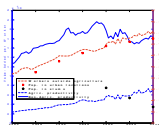
Bolivia



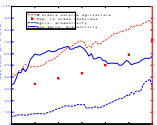
Brazil



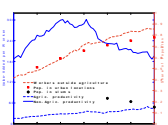
Chile



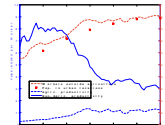
Colombia



Costa Rica

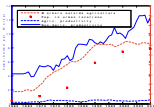


Mexico

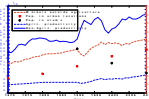


Venezuela

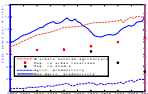
Problems with the Common View: Others



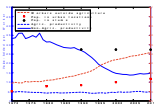
Botswana



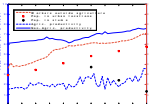
Indonesia



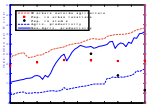
South Africa



Kenya



Morocco



Egypt

1. Slums and Low Skill Urban Jobs Happen

► The Rise of Low Skill Services:

Sectoral Allocation of Urban Labor (% in each Location)

	1991				2000			
	São Paulo		Rio		São Paulo		Rio	
	Slums	City	Slums	City	Slums	City	Slums	City
Agriculture	0.9	1.2	1.9	1.4	0.5	0.4	0.4	0.6
Manufact.	41.2	31.1	29.3	18.5	32.1	24.6	22.9	15.5
Lo-S Serv	42.8	33.8	48.7	34.0	47.7	39.6	53.6	39.5
Hi-S Serv	14.2	32.9	20.3	45.7	18.0	33.8	20.5	41.5
Not def.	1.0	1.0	0.7	0.4	1.6	1.9	2.7	2.8

Equilibrium

Firms: Competition in goods and labor markets

$$w_t^u = X_t^A.$$

$$w_t^q = p_t^M \eta X_t^M \left(\frac{L_t^a}{L_t^q} \right)^{1-\eta}.$$

$$w_t^a = p_t^M (1 - \eta) X_t^M \left(\frac{L_t^q}{L_t^a} \right)^\eta$$

Households: Consumption, Occupations and Locations.

► **Consumption:**

$$\text{Demand Functions: } c_t^i = \bar{c}^i + \frac{\alpha_i}{p_t^i} [y_t - \bar{c}^A];$$

$$\text{Flow (indirect) Utility: } v_t(e_t, p_t^N) = \frac{[\theta (p_t^N) (e_t - \bar{c}^A)]^{1-\gamma}}{1-\gamma},$$

$$\text{where } \theta(p^N) \equiv \frac{(\alpha_A)^{\alpha_A} (1-\alpha_A)^{1-\alpha_A}}{(p^N)^{1-\alpha_A}}.$$

Equilibrium

► Occupation Choices:

Rural: Trivial (by assumption.)

Urban:

$$y_t^U(z) = \max \{ w_t^q, w_t^a z \} .$$

► Location Choices: $V_t(z) = \max \{ V_t^R(z), V_t^F(z), V_t^C(z) \}$:

$$V_t^R(z) = v_t \left(w_t^u, p_t^N \right) + \beta E_t \left[z_{t+1} | Z_t^R \right] ,$$

$$V_t^F(z) = v_t \left(y_t^U(z), p_t^N \right) (1-\tau)^{1-\gamma} + \beta E_t \left[z_{t+1} | Z_t^F \right] ,$$

$$V_t^C(z) = v_t \left[y_t^U(z) - \mathbf{p}_t^h, p_t^N \right] + \beta E_t \left[z_{t+1} | Z_t^C \right] .$$

Competitive Equilibrium

Given an initial μ_0 and exogenous $\{X_t^A, X_t^N\}_{t=0}^\infty$, a competitive equilibrium is a price system $\{p_t^N, w_t^u, w_t^q, w_t^a\}_{t=0}^\infty$, and allocations described by (a) individual location, occupation and consumption decisions: and (b) aggregate quantities of outputs, consumptions, exposure to ideas and urban sizes

$\{\mu_t, Y_t^A, Y_t^N, C_t^A, C_t^N, Z_t^R, Z_t^F, Z_t^C, \sigma_t^F, \sigma_t^C\}_{t=0}^\infty$, s.t.:

1. Individual choices are optimal.
2. Aggregate variables are consistent with individual choices:
3. The goods, labor and housing markets clear:

$$Y_t^A = C_t^A = \bar{c}^A + \alpha_A \left[E_t - \bar{c}^A \right];$$
$$Y_t^N - \zeta_t \sigma_t^C = C_t^N = \frac{1 - \alpha_A}{p_t^N} \left[E_t - \bar{c}^A \right].$$

4. The law of motion of the population of skills

$$\mu_{t+1}(\cdot) = \sum_l \int_0^\infty Q(\cdot | Z_t^l) \mu_t^l(dz).$$