Highways and Hukou

The impact of China's spatial development policies on urbanization and regional inequality

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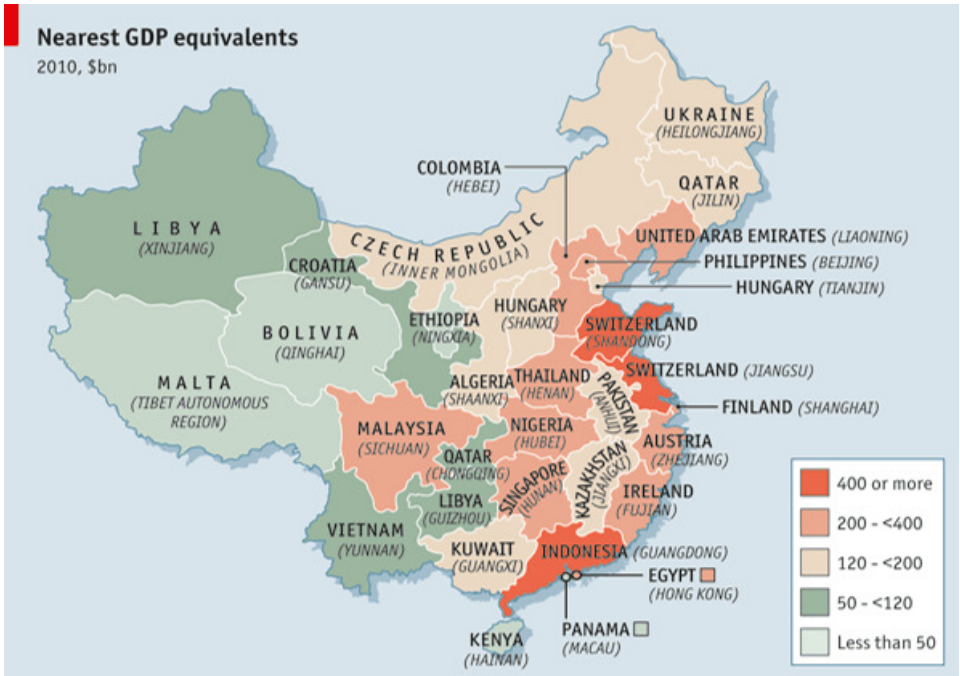
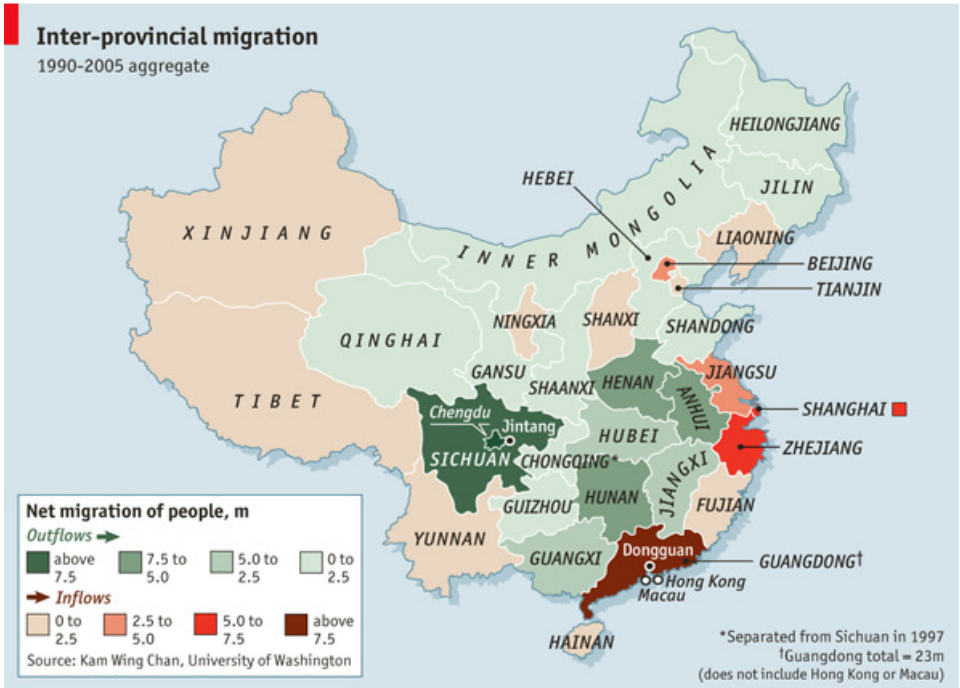
China's economic geography

- Rapid economic growth and rapid urbanization
- But, big spatial differences in development across China:



China's economic geography

$\Rightarrow$ to which (some) people respond with their feet



Policies shaping China's economic geography

- Restrictions on labor mobility (Hukou system)
  - loss of public service entitlement when moving
  - recently (partly) relaxed
- Large scale infrastructure investments
  - within cities
  - between cities: $\approx$ 96000km of highways connecting cities $\geq$ 500k inhabitants, the National Expressway Network (NEN)

This paper

Assess the (spatial) impact of these two different policies on:

Using an NEG-based combination of

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- Real income per capita
- Population
- Urbanization
- Urban-rural income gap

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Using an NEG-based combination of

- Estimation
- Simulation of counterfactual scenarios

Our contribution

Earlier papers have already looked at the these two policies separately using a similar combination of estimation and simulation:

- NEN: Roberts et al. (RSUE 2012), Faber (REStud, 2014)
- Hukou: Bosker et al. (JUE, 2012), Whalley & Zhang (JDE, 2007)

We consider them together, using the same underlying NEG model.

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Why interesting?

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$\Rightarrow$ We extend the model in Roberts et al. (2012) to incorporate labor mobility in response to

- changes in real wages induced by the lower trade costs as a result of the construction of the NEN
- differences in (dis-)amenities across cities

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$\Rightarrow$ Our model:

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- Only consider the effects on the distribution of people across Chinese cities

$\Rightarrow$ Our model:

- Takes the large-scale investments in the NEN into account
- Models and estimates the migration dynamics
- Also considers the effects on real income and urbanization

The model

Roberts et al. (2012) extended to allow for labor mobility following e.g. Tabuchi and Thisse (JDE, 2002):

Each individual j chooses to live in that location i that maximizes his/her expected utility:

$$P(U_{ij} > max_{k \neq i} U_{kj}) = P(W_i + A_i + \epsilon_{ij} > max_{k \neq i} W_k + A_k + \epsilon_{kj})$$

Where:

- W_i is real income in location i
- A_i captures location i's (dis)amenities
- ϵ_{ij} captures any individual-specific idiosyncratic preferences for living in location i

The "NEG - part"

Real income (wages) W_i in each location's urban and rural area is determined as in the NEG model developed by Roberts et al. (RSUE, 2012):

- urban sector producing manufacturing varieties
- rural sector producing agricultural goods
- consumer preferences show "love of variety" in both manufacturing and in agricultural goods
- both goods face transport costs when shipping from one city to another

$\Rightarrow$ it depends on a location's Market Access, that increases when facing lower trade costs (e.g. because of the NEN)

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- upward pressure because of better access to demand
- downward pressure because of increased competition

Spatial equilibrium

A spatial equilibrium is reached when the likelihood of an individual choosing to live in location i equals the actual observed share of people living in that location.

$$P(W_i + A_i + \epsilon_{ij} > max_{k \neq i} W_k + A_k + \epsilon_{kj}) = L_i / \sum_k L_k$$

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Under a standard assumption on the distribution of ϵ_{ij} (see McFadden, 1974), and normalizing by a reference location's likelihood, we can write this condition as:

$$\ln L_i / L_1 = \beta_0 + \beta_1 W_i + \beta_2 A_i^{obs} + \nu_i \quad (1)$$

where ν_i captures any unobserved (dis)amenities of location i.

Assessing the (spatial) effects of the NEN and the Hukou system

- Collect information for the urban and rural part of 331 prefectures on
- incomes, population, travel times with(out) the NEN in place, etc (same as in Roberts et al., 2012)
- stock of migrants and amenities (geographical, and man-made (access to toilet, tap water, natural gas))

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- Complement them with estimates of the relative importance of real wages and (dis-)amenities in people's migration decision using (1) ▸ click here

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- Simulate counterfactuals of China's economic geography
  - using the pre- and post-NEN travel times between cities
  - using restricted or unrestricted labor mobility

Simulating our counterfactual scenarios

We always start from the observed 2007 distribution of people/economic activity of the 662 locations we have data on (the urban and rural part of 331 Chinese prefectures)

In terms of our model this is the spatial equilibrium with:

- Restricted labor mobility (Hukou restrictions in place)
- The NEN in place

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- The NEN in place

Starting from this situation, we simulate our main counterfactuals by:

1. Changing travel times back to the pre-NEN situation keeping the Hukou restrictions in place: only observed migrants respond to the resulting changes in real wages
2. Allowing everybody instead of only observed migrants to respond to differences in real wages and/or amenities between locations (i.e. no Hukou restrictions)

Simulating our counterfactuals

Obtaining our no-NEN scenario

1. change travel times back to the pre-NEN situation
2. calculate the changed W_i^* in each location
3. calculate the resulting change in each location's population using our estimates of (1):

$$ln(M_i^*/M_1^*) = \hat{\beta}_0 + \hat{\beta}_1 W_i^* + \hat{\beta}_2 A_i + \hat{\nu}_i \tag{2}$$

$$L_i^* = L_i^{non-migrant} + M_{China} \frac{M_i^*/M_1^*}{\sum_k M_k^*/M_1^*} \tag{3}$$

4. this population movement may again result in changes in W_i
5. reiterate steps [2]-[4] until convergence

Simulating our counterfactuals

Obtaining our no-Hukou scenario

In the actual 2007 "Hukou" equilibrium the probability of a "observed-migrant" choosing location i equals the share of migrants in that location.

In a no-Hukou equilibrium, with everyone a potential migrant, this probability instead needs to equal the total population share in each location!

Simulating our counterfactuals

Obtaining our no-Hukou scenario

If this is not the case: people start to move when Hukou is abandoned:

1. calculate the resulting change in each location's population using our estimates of (1):

$$ln(M_i^*/M_1^*) = \hat{\beta}_0 + \hat{\beta}_1 W_i + \hat{\beta}_2 A_i + \hat{\nu}_i \tag{4}$$

$$L_i^* = L_{China} \frac{M_i^*/M_1^*}{\sum_k M_k^*/M_1^*} \tag{5}$$

2. calculate the resulting changes in W_i
3. reiterate steps [1]-[2] until convergence

Aggregate Results

Counterfactual scenario:	Roberts et al. (2012) NEN vs. no NEN (extreme Hukou)	Scenario 1 NEN vs. no NEN Hukou	Scenario 3 Hukou vs. no Hukou NEN
change in aggregate Chinese			
real income (pw) (%)	6.0	6.6	169.7
sd real income pw (%)	8.6	9.0	50.2
urbanization (ppt)	-	0.4	35.4
sd urbanization (%)	-	3.2	9.0
sd population (%)	-	1.3	160.9
mean (std dev) change in			
real income pw (%)	4.0 (3.4)	3.9 (3.7)	23.0 (26.2)
urban/rural wage gap (%)	0.4 (7.1)	1.3 (6.3)	11.4 (35.3)
total population (%)	-	-0.3 (1.75)	3.7 (143.6)
urbanization (ppt)	-	0.1 (0.7)	21.8 (15.9)
% prefectures with increasing			
real income pw	96.1	97.3	98.5
urban/rural wage gap	44.7	52.9	52.3
population	-	15.4	32.9
urbanization rate	-	40.2	89.1

Aggregate Results

Compared to earlier papers assuming complete labor immobility:

- impact of the NEN under (more realistic) restricted labor mobility not that different
- only modest effect of the NEN effect on spatial reallocation / urbanization

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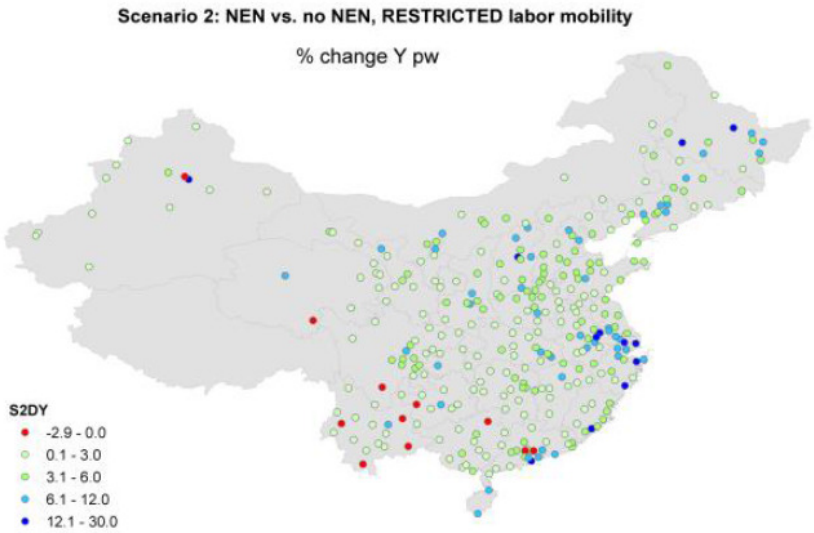
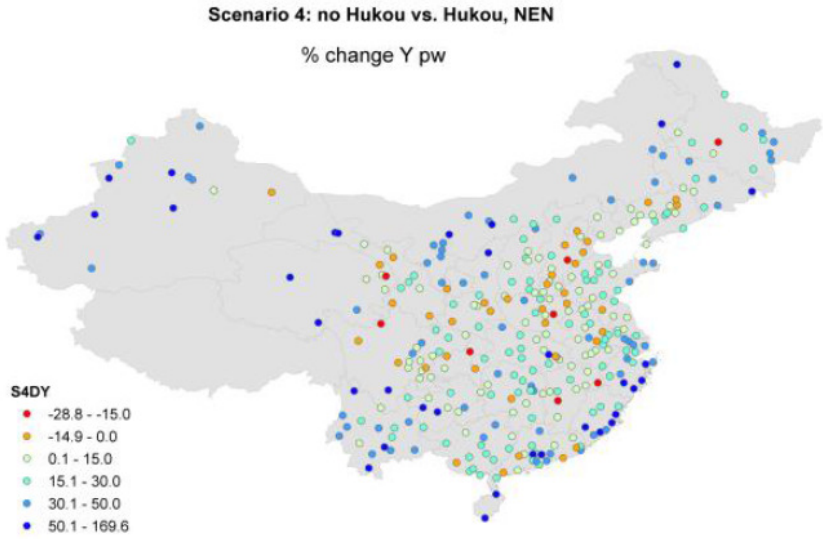
- only modest effect of the NEN effect on spatial reallocation / urbanization

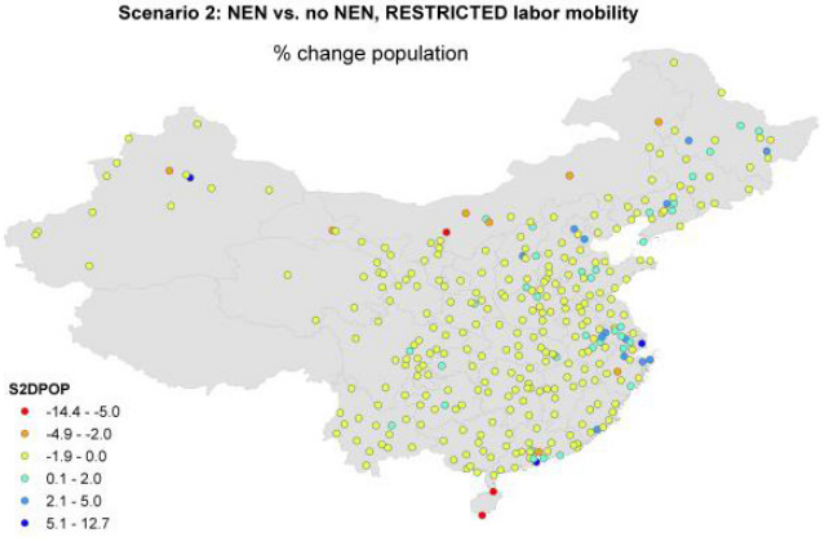
Much bigger effects when completely abandoning the Hukou restrictions (note.. also "extreme counterfactual")

- Larger welfare gains
- More spatial inequality
- 35ppt increase in urbanization - 89% of prefectures see a rise in urbanization rate

Spatial impacts:







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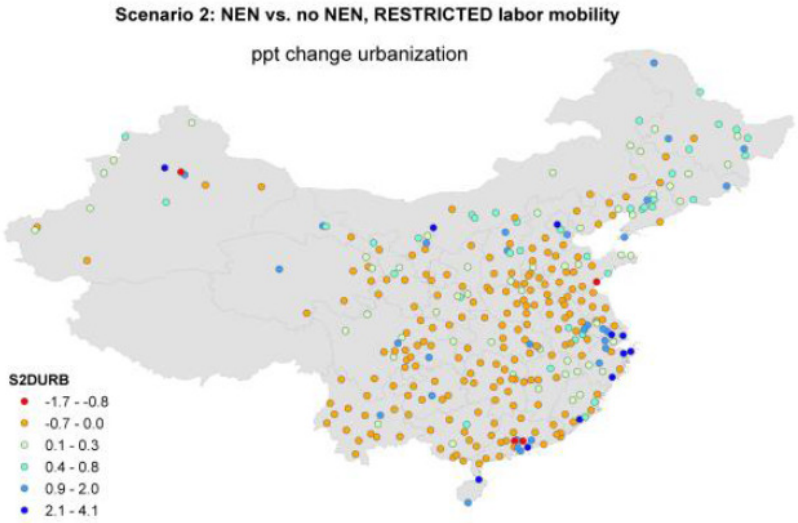
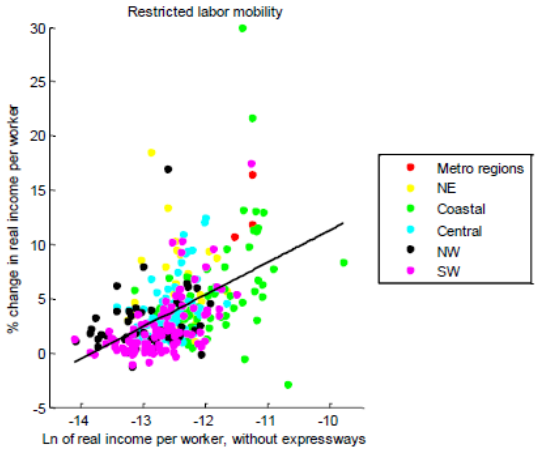
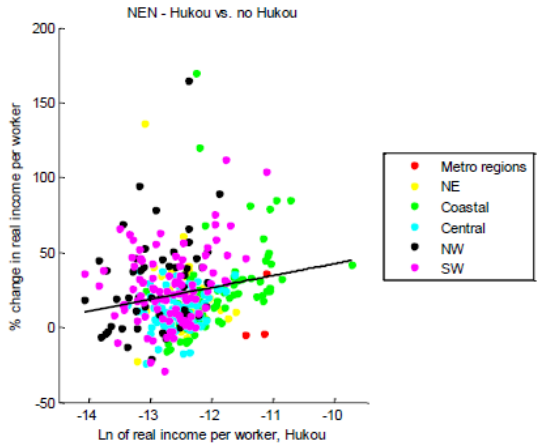


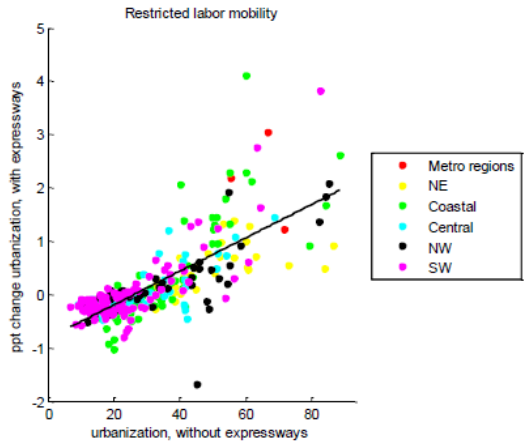
Spatial impacts: increasing inequality?

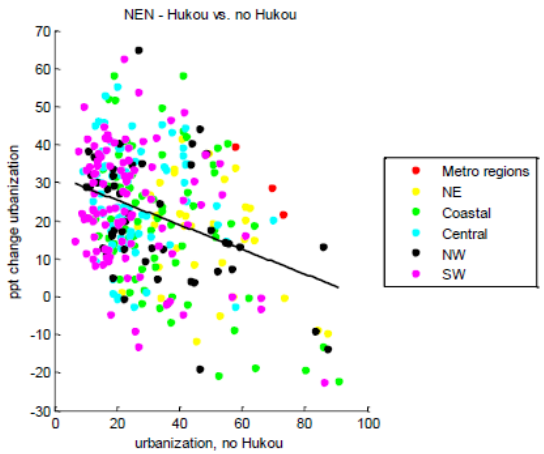
a. Real income per worker



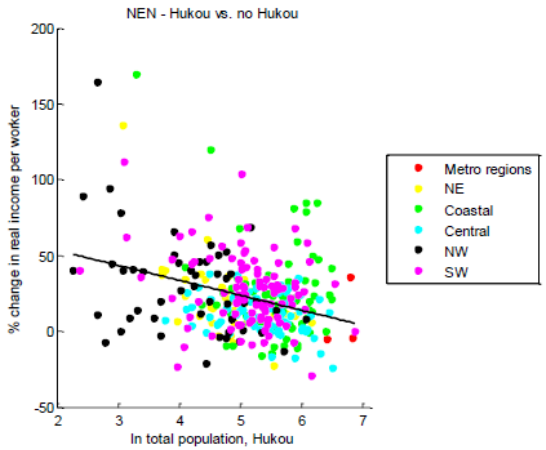


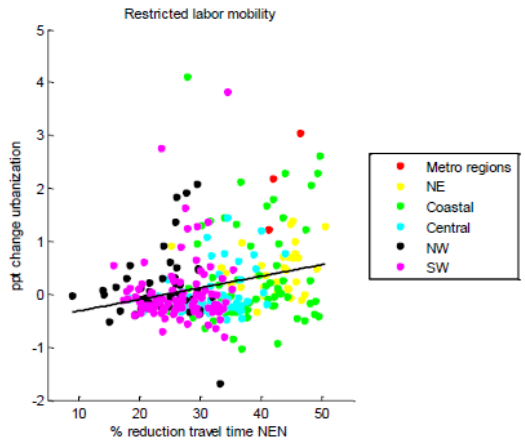
b. Urbanization

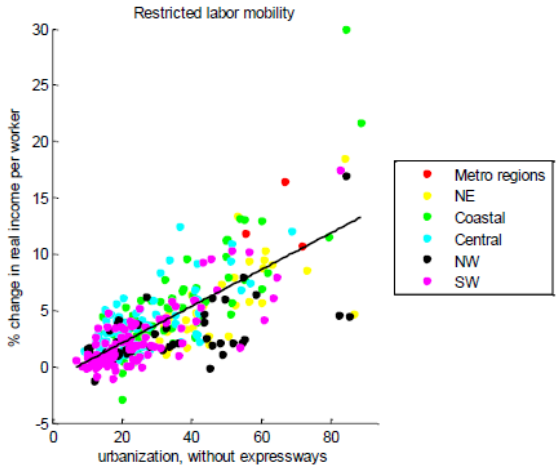


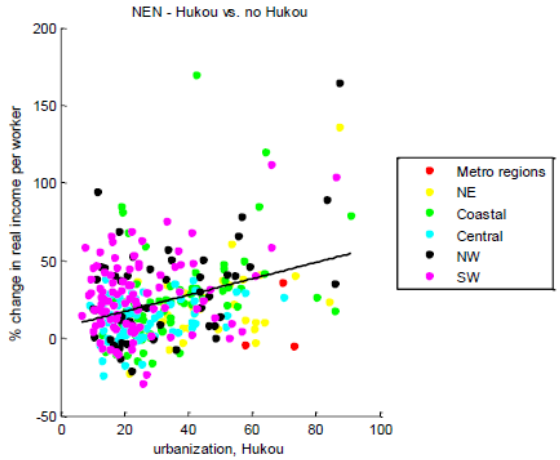


Spatial impacts: who gains?









Spatial impacts

The construction of the NEN

The abandonment of the Hukou

Spatial impacts

The construction of the NEN

- Urbanized places become more urbanized
- Better connected places urbanize faster (and see fastest per capita income growth)

The abandonment of the Hukou

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The abandonment of the Hukou

- Creates more spatial inequality, especially in population
- Coastal cities in SE grow fastest
- Smaller places see faster per capita income growth
- "Urban catch-up" of currently least urbanized places [but largely due to "rural out-migration"]

Main findings

The impact of the NEN when allowing for (restricted) labor mobility

- not that different from earlier papers assuming immobile labor
- only modest effect on spatial reallocation of people / urbanization
- places that get better connected gain most and become more urbanized

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The impact of abandoning the Hukou restrictions

- stronger overall welfare effects, but also (much) more spatial inequality
- reinforces existing spatial inequality in real incomes
- but.. leads to urban catch-up of the periphery

Possible extensions?

- add congestion force(s), e.g. house prices, public service provision, etc.
- partial Hukou relaxation - cities up to 500k
- ...

THANK YOU

Evidence on the determinants of migration

To estimate the relative importance of real wages and amenities in people's migration decision, we use our information on the migrant stock in the urban and rural part of each prefecture, i.e. we estimate:

$$\ln(M_i/M_1) = \beta_0 + \beta_1 W_i + \beta_2 A_i + \nu_i \tag{6}$$

We use migration stocks instead of total population because:

- Most people do not make an active location choice of the type implied by our model, exactly because of the Hukou restrictions
- Difficult to infer willingness to move in response to real wage and/or amenity differences using total population as dependent variable

$\Rightarrow$ hereby we do assume that these migrants' preferences are representative of those of the entire Chinese population (in the absence of the Hukou restrictions)!

Evidence on the determinants of migration

	(1)	(3)		(4)		(5)
Dep. Variable:	ln migrants	ln migrants		ln migrants		ln migrants
ln real wage	0.986	0.923		0.749		0.608
	[0.00]***	[0.00]***		[0.00]***		[0.008]***
		urban	rural	urban	rural	no split Geo
ln rugg	-	-0.137	-0.151	-0.109	-0.138	-0.139
	-	[0.023]**	[0.001]***	[0.044]**	[0.003]***	[0.003]***
ln cooling days	-	0.336	0.165	0.156	0.022	0.200
	-	[0.254]	[0.537]	[0.622]	[0.933]	[0.403]
ln heating days	-	0.365	0.392	0.194	0.291	0.172
	-	[0.056]*	[0.001]***	[0.486]	[0.045]**	[0.394]
ln rainfall	-	-0.117	0.679	-0.072	0.679	0.237
	-	[0.564]	[0.003]***	[0.735]	[0.004]***	[0.23]
D yangtze	-	0.235	-0.196	0.051	-0.323	-0.135
	-	[0.104]	[0.273]	[0.768]	[0.12]	[0.489]
nat.res.index	-	-0.014	0.005	-0.009	-0.006	-0.006
	-	[0.37]	[0.871]	[0.55]	[0.839]	[0.71]
% hh water	-	-		0.117		0.584
	-	-		[0.702]		[0.098]*
% hh toilet	-	-		1.197		1.401
	-	-		[0.009]***		[0.004]***
% pop gas	-	-		0.515		0.548
	-	-		[0.022]**		[0.031]**
nr.obs	662	662		662		662
R2	0.589	0.630		0.670		0.620

Evidence on the determinants of migration

This provides us with estimates of:

- how migration decisions depend on real wages and observable amenities (i.e. the $\hat{\beta}$'s in (6))
- each location's unobserved amenities (the residuals of (2), $\hat{\nu}_i$)

We use them to, under the assumption that a location's amenity stock remains unchanged, assess how a location's (migrant) population changes as a result of changes in its real wages

◂ go back