A Multisector Labour Market Model for India

Presentation for 7th Advanced Graduate Workshop on Development and Globalization

Kalyani Raghunathan, Gary Fields

January 20, 2014

- Though there are a large number of micro-models of the Indian economy (particularly of the rural sector) there is a lack of more market level or macro models.

- This paper attempts to fill the gap by developing a model that delivers a more market level analysis.

- We incorporate certain features of the Indian economy which are well-understood and accepted, such as seasonality in agriculture and the presence of an 'informal' sector in the urban areas.

- We then attempt to study the introduction of the NREGA in such an economy and conduct some welfare comparisons.

Literature Review

- Micro models of the rural economy in India (Mukherjee and Ray [1992], Mukherjee and Ray [1995], Basu [2002], Basu [2013]).

- Basu et al. [2013] is a recent attempt at building a multi-sector model for developing countries.

- Many empirical papers on the rural economy: Drèze and Mukherjee [1989] surveys these.

- Effects of the NREGA on employment and wages give contradictory results (Zimmermann [2013], Imbert and Papp [2011], Azam [2012]).

- Ravi et al. [2012] finds that the NREGA reduced rural-urban migration and urban unemployment in India.

- Shamsuddin [2013] finds it led to a reduction in urban informal sector employment.

Worker Characteristics

- There are two 'areas' in the model - the urban area and the rural area. Workers are born into one of the two areas.

- We denote rural workers by l, urban workers by L and the total labour force in the economy by $\mathcal{L}$.

- Workers are distinguished not only by their place of birth, but also by their education levels, which can be low or high (e=0, e=1).

- We assume that all those born in rural areas have low education, while those born into urban areas can be either high or low education workers.

Education and Skills

- We distinguish workers with and without education using superscripts e and u respectively.

- So a rural uneducated workers is l^u and an urban educated worker is L^e. Then we have $l \equiv l^u$ and $L \equiv L^e + L^u$.

- Workers born into urban areas cannot work in the rural areas (think of agricultural skills, land ownership etc) but the reverse is not true.

Rural Areas

- There is only one type of work in the rural areas, which is agriculture.

- However there are two seasons, the *slack* (s) and the *peak* (p) seasons, where the types of tasks conducted and the marginal productivity of workers differs.

- Let the production function for season k be $F(\epsilon_k, a_k)$ where ϵ_k is the number of people employed and a_k is a demand shifter (e.g. rainfall). We assume that $a_p > a_s$.

- Then the wage in season k is competitively determined as

$$w_k = \frac{\partial F(\epsilon_k, a_k)}{\partial \epsilon_k}.$$

Urban Areas

- Three sectors - the 'managers' sector (M), the 'office-workers' sector (O) and the free-entry sector (F).

- M sector jobs are only available to those workers with high education.

- O sector jobs can be filled by workers of any education level, but high education workers are hired preferentially.

- F sector work is available to any worker who chooses it.

- Rural workers can migrate to the urban areas free of cost in search of work.

Urban Areas (contd)

- The wage in the managers sector is fixed at w_m and the number of jobs available at that wage is E_m.

- The wage in the office-workers sector is fixed at $w_o < w_m$ and the number of jobs available at this wage is E_o.

- We assume that the number of people employed in both of these sectors is a downward sloping function of the wage.

- The wage in the free-entry sector is an average product and is divided among all workers of a certain type who work there.

- The total fixed product for urban workers is F and for rural workers is f, and $F > f$.

Timing

- The model is a one-year model, with two agricultural seasons.

- Urban educated workers choose to allocate themselves among search strategies first.

- Urban uneducated and rural uneducated workers see their choices and then choose their own search strategies accordingly.

Search Strategies

- Workers are risk-neutral utility maximisers and allocate themselves among search strategies in order to maximise their expected utility.

- Expected utility is a function of the workers expected income net of status value of the job.

- The status value of the job is the amount of importance a worker of a particular type assigns to being employed in a particular sector and is assumed to be dependent on education.

- In particular, we assume that the status cost of having a job in the free entry sector for someone with high education is $s > F$, while it is zero for all other jobs and for those with low education.

- We distinguish workers who are searching for different types of jobs by subscripts.

- For example, L_m^e $[L_o^e]$ = the number of urban educated workers searching for an M $[O]$ job.

- l_k^u = the number of rural workers searching for an agricultural job in season k, and l_o^u $[l_f^u]$ = the number searching for an office-worker (free-entry) job.

Urban Educated Workers

Expected income to the educated worker from

1. Adopting the O-search strategy: $V_o^e = \eta_e w_o + (1 - \eta_e)0$.
2. Adopting the M-search strategy: $V_m^e = \pi w_m + (1 - \pi)0$.
3. Safe search: $V_f^e = \frac{F}{L_f^e + L_f^u} - s$.

where

η_e = probability of an educated worker getting a job in the O sector:

$$\eta_e = min\left\{\frac{E_o}{L_o^e}, 1\right\}.$$

and π = probability of getting a job in the M sector:

$$\pi = \frac{E_m}{L_m^e}.$$

Urban Uneducated Workers

Expected income to the educated worker from

1. Adopting the O-search strategy: $V_o^u = \eta_u w_o + (1 - \eta_u)0$.
2. Safe search: $V_f^u = \frac{F}{L_f^e + L_f^u}$.

where

η_u = probability of an uneducated worker getting a job in the O sector:

$$\eta_u = \frac{E_o - L_o^e}{I_o^u + L_o^u}.$$

Rural Workers

Expected income to the rural uneducated worker from

1. Taking a job in agriculture: $v_k^u = w_k = \left.\frac{\partial F(\epsilon_k, a_k)}{\partial \epsilon_k}\right|_{(\epsilon_k = l_k^u)}$ for $k = s, p$.

2. Taking a job in the free-entry sector: $v_f^u = \frac{f}{l_f^u}$.

3. Searching for a job in the O sector: $v_o^u = \eta_u w_o + (1 - \eta_u)0$.

Expected income equalisation

- In choosing the search strategies workers equalise the expected utility from each strategy.
- For urban educated workers this means

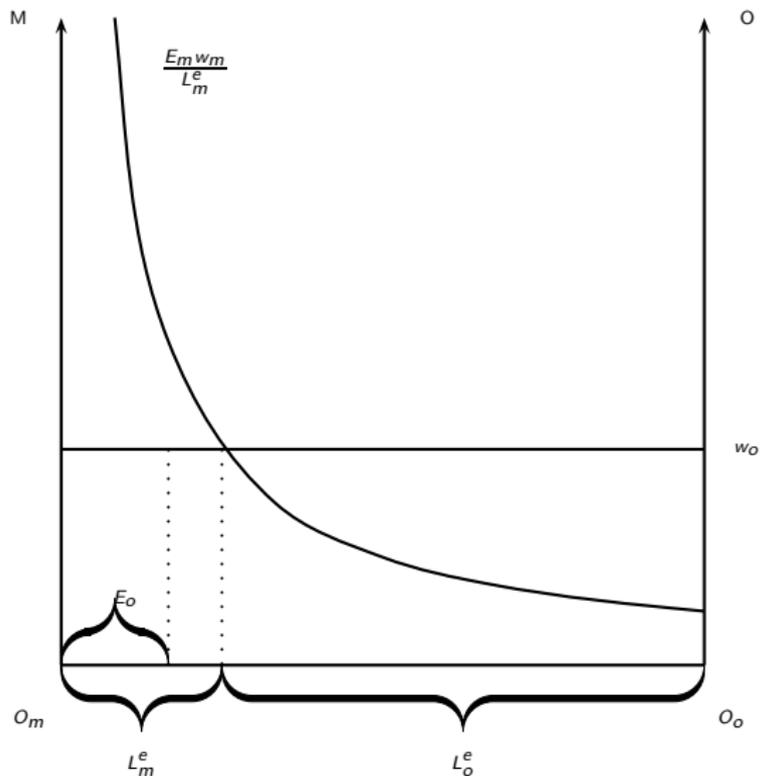$$L_m^e = \frac{E_m w_m}{w_o} \text{ and } L_o^e = L^e - \frac{E_m w_m}{w_o} < E_o. \tag{1}$$

- For urban uneducated workers this means

$$\frac{(E_o - L_o^e)w_o}{L_o^u + l_o^u} = \frac{F}{L^u - L_o^u}, \tag{2}$$
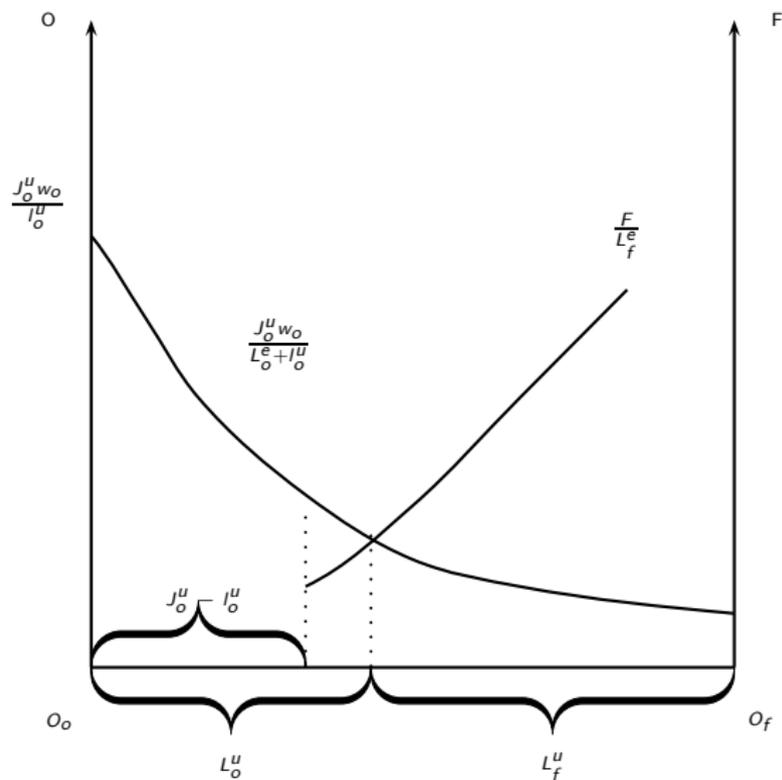
- For rural uneducated workers this means

$$\frac{\partial F(E_s, a_s)}{\partial \epsilon_k} = \frac{f}{l_f^u} = \frac{(E_o - L_o^e)w_o}{L_o^u + l_o^u}. \tag{3}$$

Graphically...

Figure: Search strategies for urban educated workers

Figure: Search strategies for urban uneducated workers

Ex-ante outcomes

- Using the expected income equalisation equations we can solve for ex-ante outcomes, i.e. the number of workers who choose each search strategy at the start of the slack season.

- Let us specify a functional form for the production function: $F(\epsilon_k, a_k) = a_k \log(\epsilon_k)$ for $k = s, p$.

- With this functional form and equations 1, 2 and 3 we can solve for all the unknowns L_m^e, L_o^e, L_o^u, L_f^u, l_o^u, l_f^u and l_s^u.

Summary of the Slack Season

- Ex-ante outcomes $\neq$ ex-post outcomes

Table: Slack Season Final Outcomes

Type of job	Wage	Educated urban workers	Uneducated urban workers	Uneducated rural workers
Managers	w_m	E_m	0	0
Office Workers	w_o	$L^e - \frac{E_m w_m}{w_o}$	$\frac{(J_o^u w_o + a_s + f)L^u - Fl^u}{w_o(L^u + l^u)}$	$\frac{(J_o^u w_o + F)L^u - (a_s + f)l^u}{w_o(L^u + l^u)}$
Agriculture	$\frac{J_o^u w_o + a_s + f + F}{L^u + l^u}$	0	0	$\frac{a_s(L^u + l^u)}{J_o^u w_o + a_s + f + F}$
Free-entry	$\frac{J_o^u w_o + a_s + f + F}{L^u + l^u}$	0	$\frac{F(L^u + l^u)}{J_o^u w_o + a_s + f + F}$	$\frac{f(L^u + l^u)}{J_o^u w_o + a_s + f + F}$
Unemployed	0	$\frac{E_m(w_m - w_o)}{w_o}$	U^u	u^u

where

- $J_o^u = E_o - L_o^e$, the number of O sector jobs left over.
- $u^u = \max\left(0, [l^u(J_o^u w_o + F) - (a_s + f)L^u]\left[\frac{1}{J_o^u w_o + f + F} - \frac{1}{w_o(L^u + l^u)}\right]\right)$.
- $U^u = \max\left(0, [l^u(J_o^u w_o + a_s + f) - (F)L^u]\left[\frac{1}{J_o^u w_o + a_s + f + F} - \frac{1}{w_o(L^u + l^u)}\right]\right)$.

The Peak Season: Who moves where?

- The starting point in the peak season is the slack season final outcome.
- Workers who were employed in the slack season can keep their jobs.
- All workers can also search for new employment if they choose to.
- Since we have assumed $a_p > a_s$ we have

$$\left.\frac{\partial F_p(E_p, a_p)}{\partial E_p}\right|_{E_p=l_s^u} > \left.\frac{\partial F_s(E_s, a_s)}{\partial E_s}\right|_{E_s=l_s^u} = \frac{f}{l_f^u}.$$

i.e. there is some reverse migration of workers from the urban to the rural areas in the peak season.

- Unemployed educated urban workers do not move into F because of the large status cost.

- Those with O or M sector jobs do not move, as the wages in these jobs are always higher than that of the free-entry sector and the agricultural jobs.

- However those uneducated rural and urban workers who were unemployed in the previous sector do move.

- There is thus reverse-migration of the rural workers who only get 'informal' labour, while those with more permanent positions remain in the urban areas.

- The urban uneducated unemployed workers from the slack season cannot work in agriculture and so they are absorbed into the free-entry sector instead.

- The rural uneducated unemployed workers can move either into agriculture or into the free-entry sector.

- The rural active population is $l_f^u + u^u + l_s^u$.

- They rearrange themselves among agriculture and the free-entry sector so as to eliminate unemployment.

Table: Peak Season Outcomes

Job	Wage	Ed. urban wkrs	Uned urban wkrs	Rural wkrs
Managers	w_m	E_m	0	0
Office-wkr	w_o	$L^e - \frac{E_m w_m}{w_o}$	$\frac{(J_o^u w_o + a + f)L^u - Fl^u}{w_o(L^u + l^u)}$	$\frac{(J_o^u w_o + F)L^u - (a+f)l^u}{w_o(L^u + l^u)}$
Agriculture	w_p	0	0	$\frac{a_p}{a_p + f}\left[l^u + \left(\frac{(a_s + f)L^u - (J_o^u w_o + F)l^u}{w_o(l^u + L^u)}\right)\right]$
Free-entry sector	$w_p/w_{F\prime}$	0	$L_f^u + U^u$	$\left[l^u + \left(\frac{(a_s + f)L^u - (J_o^u w_o + F)l^u}{w_o(l^u + L^u)}\right)\right]$
Unemployed	0	$\frac{E_m(w_m - w_o)}{w_o}$	0	0

■ where

$$w_p = \frac{w_o(a_p + f)(l^u + L^u)}{l^u\left[w_o(l^u + L^u) - (J_o^u w_o + F)\right] + (a_s + f)L^u}.$$

Final Annual Income distribution

- Now we are in a position to calculate the final income distribution from the various job combinations. These are given in the table below.

Table: Annual Income Distribution

Job combination	Annual Income	Number of workers
(M,M)	$2w_m$	E_m
(O,O)	$2w_o$	E_o
(F, F)	$w_s + w_{F'}$	$\frac{F(L^u+I^u)}{J_o^u w_o + a_s + f + F}$
(f,f), (f, p), (s, p)	$w_s + w_p$	$\frac{(a_s+f)(L^u+I^u)}{J_o^u w_o + a_s + f}$
(U, F)	$w_{F'}$	U^u
(u, f), (u, p)	w_p	u^u
(U, U)	0	$\frac{E_m(w_m-w_o)}{w_o}$

An Employment Guarantee Act: Basic Features

- We study the introduction of a rural employment guarantee act (EGA) along the lines of the NREGA introduced in India.
- The employment guarantee scheme is available only in the slack season, and only to rural workers.
- Following the manner in which the wage was pegged in this scheme in reality, we make the following assumption
    1. $\tilde{w}_n > w_s$, and
    2. $\tilde{w}_n < w_o$.
- In other words the wage paid under the scheme was more attractive than the slack season agricultural wage, but less so than that of the more formal urban employment.

What changes?

- The only set of workers for whom the available search strategies alter are the rural workers.

- Rural workers now have an additional option in the slack season, which is to work for the EGA.

- However the ex-ante *outcomes* of the urban uneducated workers are also affected through the migration choices of the rural workers.

- Urban educated workers behave exactly as before.

- Expected wage equalisation means that the wages in agriculture and in the free-entry sector rise to equal $\tilde{w}_n$.

Slack Season with the EGA

- Agricultural wage higher $\implies$ number of people employed in agriculture is lower.
- The number of rural uneducated workers in the free-entry sector also declines, and the wage each receives is higher.
- We can solve for the slack season final outcomes as before:

Table: Slack Season Final Outcomes - With EGA

Type of job	Wage	Educated urban workers	Uneducated urban workers	Uneducated rural workers
Managers	w_m	E_m	0	0
Office Workers	w_o	$L^e - \frac{E_m w_m}{w_o}$	$\frac{\tilde{w}_n L^u - F}{w_o}$	$\frac{F + J_o^u w_o - \tilde{w}_n L^u}{w_n}$
Agriculture	$\tilde{w}_n$	0	0	$\frac{a_s}{\tilde{w}_n}$
EGA	$\tilde{w}_n$	0	0	$I^u + L^u - \frac{J_o^u w_o + a_s + f + F}{\tilde{w}_n}$
Free-entry	$\tilde{w}_n$	0	$\frac{F}{w_n}$	$\frac{f}{\tilde{w}_n}$
Unemployed	0	$\frac{E_m(w_m - w_o)}{w_o}$	$\frac{w_o - \tilde{w}_n}{\tilde{w}_n w_o}(L^u \tilde{w}_n - F)$	$\frac{w_o - \tilde{w}_n}{\tilde{w}_n w_o}(F + J_o^u w_o - \tilde{w}_n L^u)$

The main points of interest are the following:

- The introduction of the employment guarantee scheme does not change the outcomes for the educated urban workers at all and so their welfare remains the same.
- It reduces the number of rural and urban uneducated workers who search for free-entry sector jobs ($\tilde{l}_f^\mu$ and $\tilde{L}_f^U$).
- It also reduces the number of rural workers who search for O sector jobs, but increases the number of urban uneducated workers who search in this sector.
- The effects on unemployment are ambiguous, therefore, as that depends positively on the number of people searching for these jobs and negatively on the probability that each of them will get a job.

Peak Season with the EGA

- The analysis of the peak season follows the same lines as that of the case without the EGA.

- The urban uneducated unemployed workers simply shift into the free-entry sector in the following period, increasing the free-entry sector employment to

$$\tilde{L}_{f'}^{u} = \tilde{U}^u + \tilde{L}_f^u = \frac{\tilde{L}^u(\tilde{w}_n - w_o) + F}{w_o},$$

- The active rural population consists of those who were in the EGA or in agriculture in the previous period, those who were unemployed, and those in the free-entry sector:

$$\tilde{l}_f^u + \tilde{l}_n^u + \tilde{u}^u + \tilde{l}_s^u = \tilde{l}^u + \frac{\tilde{w}_n \tilde{L}^u}{w_o} - \frac{F}{w_o} - J_o^u.$$

- These active workers reorganise themselves among jobs in the free-entry sector and in agriculture.

Peak Season Final Outcomes

The final outcomes can be summarised as:

Table: Peak Season Final Outcomes - With EGA

Job	Wage	Ed. urban wkrs	Uned. urban wkrs	Rural wkrs
Managers	w_m	E_m	0	0
Office Workers	w_o	$L^e - \frac{E_m w_m}{w_o}$	$\frac{\tilde{w}_n L^u - F}{w_o}$	$\frac{F + J_o^u w_o - \tilde{w}_n L^u}{\tilde{w}_n}$
Agriculture	$\tilde{w}_p^r$	0	0	$\frac{a_p}{a_p + f}\left(I^u + \frac{\tilde{w}_n L^u}{w_o} - \frac{F + J_o^u}{w_o}\right)$
Free-entry	$\tilde{w}_p^r / \tilde{w}_F^r$	0	$\frac{L^u(\tilde{w}_n - w_o) + F}{w_o}$	$\frac{a_p}{a_p + f}I^u + \left(\frac{a_p \tilde{w}_n - w_o(a_p + f)}{w_o \tilde{w}_n(a_p + f)}\right)(J_o^u + F + L^u)$
Unemployed	0	$\frac{E_m(w_m - w_o)}{w_o}$	0	0

- The main thing to note here is that the peak season wage with the introduction of the EGA is lower than it is without the EGA, and the mechanism operates through the reduced number of workers who migrate in the slack season.

Final Income distribution with the EGA

Table: Annual Income Distribution

Job combination	Annual Income	Number of workers
(M,M)	$2w_m$	E_m
(O,O)	$2w_o$	E_o
(f,f), (f, p), (s, p), (n,p)	$\tilde{w}_n + \tilde{w}_p'$	$(l^u + L^u) - \frac{J_o^u w_o + F}{\tilde{w}_n}$
(F, F)	$\tilde{w}_n + \frac{w_o F}{L^u(\tilde{w}_n - w_o) + F}$	$\frac{F}{\tilde{w}_n}$
(U, F)	$\frac{w_o F}{L^u(\tilde{w}_n - w_o) + F}$	$\frac{w_o - \tilde{w}_n}{\tilde{w}_n}(L^u \tilde{w}_n - F)$
(u, f), (u, p)	$\frac{w_o(a_p + f)}{w_o l^u + L^u \tilde{w}_n - F - J_o^u}$	$\frac{w_o - \tilde{w}_n}{\tilde{w}_n}(F + J_o^u w_o)$
(U, U)	0	$\frac{E_m(w_m - w_o)}{w_o}$

Putting it all together

- For both urban and rural uneducated populations the number in the free-entry sector declines.

- The number searching for office-worker jobs declines among rural workers, increases among urban workers and declines overall.

- As a result of the increase in the number of workers from the urban uneducated population looking for O jobs, the effect on unemployment in this population is ambiguous.

- In addition, while the slack season agricultural wage increases, the peak season wage falls, as more people are engaged in search in the peak season.

- Thus using income distribution comparisons yields an ambiguous welfare comparison.
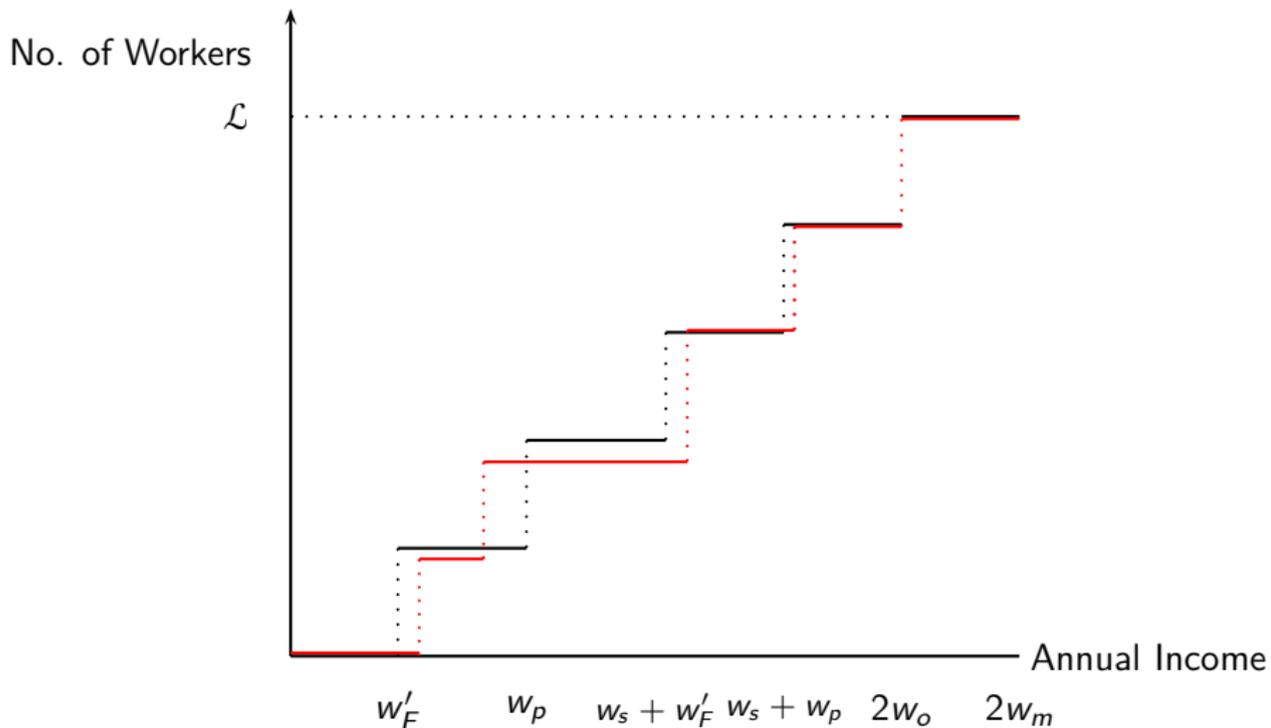
First Order Stochastic Dominance?

Figure: Welfare Comparisons Using the Income distributions

Conclusions

- This paper builds a model of the Indian labour market, and the linkages between the rural and the urban areas.
- It incorporates certain features like seasonality, reverse migration in the peak season and the presence of different sectors within the urban area that differ in terms of their skill requirements as well as their wages.
- It studies the introduction of an EGA into a market of this type, and analyses the changes in the distribution of workers across ex-ante and ex-post outcomes.
- It delivers the prediction that the introduction of the EGA is ambiguous about overall welfare changes.

References I

M. Azam. The Impact of Indian Job Guarantee Scheme on Labor Market Outcomes: Evidence from a Natural Experiment. Technical report, IZA Discussion Paper Series, May 2012. URL http://www.iza.org/en/webcontent/publications/papers/viewAbstract?dp_id=6548.

A. K. Basu. Oligopsonistic Landlords, Segmented Labor Markets, and the Persistence of Tied-Labor Contracts. *American Journal of Agricultural Economics*, 84:438–453, 2002.

A. K. Basu. Impact of Rural Employment Guarantee Schemes on Seasonal Labor Markets: Optimum Compensation and Workers' Welfare. *Journal of Economic Inequality*, (1):1–34, March 2013.

A. K. Basu, N. H. Chau, G. S. Fields, and R. Kanbur. A Multi-Sector Labor Market Model for Developing Economies. Technical report, Cornell University, 2013.

References II

- J. Drèze and A. Mukherjee. *The Balance between Industry and Agriculture in Economic Development vol.3: Manpower and Transfers*, chapter Labour Contracts in rural India: theories and evidence. Macmillan Press, London, 1989.

- C. Imbert and J. Papp. Government Hiring and Labor Market Equilibrium: Evidence from India's Employment Guarantee. Presented at the ISI conference, New Delhi, December 2011. URL http://www.isid.ac.in/~pu/conference/dec_11_conf/Papers/ClementImbert.pdf.

- A. Mukherjee and D. Ray. Wages and Involuntary Unemployment in the Slack Season of a Village Economy. *Journal of Development Economics*, 37:227–264, 1992.

- A. Mukherjee and D. Ray. Labor tying. *Journal of Development Economics*, 47:207–239, 1995.

References III

S. Ravi, M. Kapoor, and R. Ahluwalia. The impact of NREGS on urbanization in India. Technical report, Indian School of Business, 2012. URL http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2134778.

M. Shamsuddin. Labor market effects of employment guarantee program in India. Technical report, Georgetown University, 2013. URL http://www12.georgetown.edu/students/ms866/files/paper%201.pdf.

L. Zimmermann. Why guarantee employment? evidence from a large Indian public works program. Job Market Paper, University of Michigan, October 2013. URL http://www-personal.umich.edu/~lvzimmer/Zimmermann_NREGS_current_draft.pdf.