For Better or For Worse? The Effects of an Employment Guarantee in a Seasonal Agricultural Market

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1 Introduction

The National Rural Employment Guarantee Act (NREGA) - or the Mahatma Gandhi National Rural Employment Guarantee Act, as it is now known - was introduced in 200 of India's poorest districts in August 2005, and extended to cover all rural areas of the country in 2008. The NREGA provided for a hundred days of unskilled manual work per rural household, at the state-wise minimum wage (subject to a national minimum) and within 5 km of the worker's place of residence. Poverty reduction schemes have historically been a significant part of India's public works programs.[1] However the NREGA stands out as being the first of its kind to provide the *right* to employment to the rural poor. As an Act rather than a Scheme, it is more durable, provides more security to the workers and cannot be cancelled or changed without an amendment in Parliament, all features that are desirable from the point of view of poverty reduction and improvement of the livelihoods of rural agricultural laborers (see Dey and Drèze [2007] for more details on the provisions of the Act).

The benefits of such an Act have been widely discussed. At the time of implementation its main goals were stated as the "creation of durable assets and strengthening of the livelihood resource base of the rural poor" (Chakraborty [2007]). The social benefits, as envisioned by those who fought for its enactment, are many and far-reaching. The Act would help protect rural households from poverty and hunger by providing work in the slack season when money is hard to come by, it would help reduce rural-urban migration by providing employment to families within the village, it would aid in the empowerment of women and the increase in their agency within the household by providing them with income security,

[1] Most notably the Maharashtra Employment Guarantee Scheme, the Employment Assurance Scheme, National Rural Employment Programme, Jawahar Rozgar Yojana and the Sampoorna Grameen Rozgar Yojana.

and so on (for more details, see Khera [2011]).

This paper develops a theoretical framework to study the effects of the introduction of such an employment guarantee on labor market outcomes, and delivers the interesting and somewhat counter-intuitive result that the introduction of such an Act could potentially have *negative* consequences on the welfare of workers. It builds a model of a two-period seasonal agricultural market, a slack season followed by a peak season (see Johnson [2009] and Basu [2013] for a similar segregation) and models intertemporal spillovers between the two periods. The spillovers are of the productivity kind, as the amount of labor hired in the slack period to till the land or sow the seeds affects the size and the quality of the peak season crop, and hence the marginal productivity of the peak season labor employed.

In India there are generally two seasons of planting throughout the year, the *rabi* and the *kharif* crops.[2] There is considerable variation in these two crop cycles depending on the region in question, if nothing else then because the monsoon arrives in different parts of the country at different points of time. What is common across most agricultural markets though is the fluctuation of periods of intense activity with periods of inactivity. The harvest season is the busiest period of time in the whole year, with farmers who own land finding it necessary to hire in as much labor as they can find in order to bring the harvest in in a timely fashion. The slack season consists of some work on the land in the form of weeding, irrigating, and preparing the land for the next season, but by and large the period between the planting of the crop and its maturity is when workers struggle to find employment.

An employment guarantee scheme like the NREGA is seen to provide two types of benefits - transfer benefits, which come from increasing the worker's income, and the stabilization benefits, that come from smoothing the income flow over time, especially when the markets exhibit considerable seasonality (Ravallion [1990]). The stabilization benefit makes it more desirable to have the employment guarantee in the off-peak or lean season, which seems to be when most of the demand for public works occurs. Empirical calculations of the magnitude of the direct transfer benefits from the program by Jha et al. [2012] and Imbert and Papp [2011] find that though these benefits are not that large, they are higher for the poor and for those with small land-holdings and help redistribute income from the larger households

[2] The *rabi* (winter) crops are sown just after the monsoon season and harvested in winter, and the main crops grown in this season include wheat, barley, peas, gram and mustard. The *kharif* (autumn) crops are generally sown at the start of the monsoon and harvested sometime in October, and include crops like millet, sorghum, maize, sugarcane, peanuts, sunflowers and soybeans. Rice is the main *kharif* crop.

(the land-owners and net buyers of labor) to the smaller households (net suppliers of labor). Based on NSS employment and wage data Imbert and Papp [2011] show that the welfare effects may be negative for richer households.

There is nothing in the operational guidelines that dictates that the NREGA works only be undertaken in the slack season. However many districts implement these works only in the off-peak seasons (see Imbert and Papp [2011]). In some cases this is driven by demand, in some by lobbying by farmers, who need laborers during the peak season. In some cases, as in Andhra Pradesh, it is even imposed by the state through 'work calendars', which are in violation of the NREGA guidelines (Johnson [2009]).[3] Whatever the reason, it seems to be a fairly widespread phenomenon. I follow Basu [2013] in incorporating this feature by assumption.

The model developed in this paper is that of a competitive labor market, in order to keep the analysis simple. Many studies of Indian labor markets remark on the high levels of involuntary unemployment in the slack season (see Drèze and Mukherjee [1989], Bardhan [1979]), suggesting that markets in fact do not clear and that on the whole wages are rigid downward in the slack season. Several explanations have been discussed for this, for example theories of peasant resistance to wage cuts or implicit collusion on the part of the workers, nutrition-based efficiency wages, and the pegging of casual labor wages to those of permanent (tied) laborers. Swamy [1997] and Ghose [1980] provide empirical tests of the latter two explanations, while Mukherjee and Ray [1992] build a theoretical framework to model the first phenomenon and then test it using data from Palanpur. In this model the stylistic fact of involuntary unemployment is incorporated through the slightly unsatisfactory but simple tool of a worker reservation wage.

Table 1 shows the distribution of primary occupations for a sample of villagers from 10 districts in the large north and central Indian states of Jharkhand, Chattisgarh, Rajasthan, Bihar, Madhya Pradesh and Uttar Pradesh.[4] These are some of the poorest regions in the country and the people interviewed were selected only from among those working for the NREGA (drawn at random from the worksite attendance sheets), so this sample is not representative. With this caveat, however, it is interesting to look at the figures. The primary occupation of more than half the sample is casual labor, followed by self-employment in agriculture. More than 90% of the population is covered by these two occupations. Table 2 shows the

[3]The guidelines say that work should be provided whenever it is demanded, so restricting work to certain seasons of the year is not permitted under the provisions of the Act.

[4]Districts covered: Palamu, Surguja, Dungarpur, Badwani, Sitapur, Araria, Koderma, Kaimur, Sirohi and Sidhi.

Table 1: Occupational Statistics - Primary Occupation

Occupation	Freq.	Percent	Cum.
Casual Labor	560	53.03	53.03
Self-employment (agriculture)	411	38.92	91.95
Self-employment (non-agriculture)	30	2.84	94.79
Regular Employment	8	0.76	95.55
Other	43	4.07	99.62
Unclear	4	0.38	100
Total	**1056**	**100**	**100**

[a] Source: Survey data obtained from Jean Drèze and Reetika Khera, surveys supported by the Centre for Development Economics, Delhi School of Economics.

Table 2: Secondary Occupation of Self-employed Agricultural Workers

Occupation	Freq.	Percent	Cum.
Casual Labor	203	92.27	92.27
Self-employment (non-agriculture)	13	5.91	98.18
Regular Employment	1	0.45	98.63
Other (specify)	3	1.37	100
Total	**220**	**100**	**100**

[a] Source: Survey data obtained from Jean Drèze and Reetika Khera, surveys supported by the Centre for Development Economics, Delhi School of Economics.

secondary occupation for those who stated self-employment in agriculture as their primary occupation (not everyone has a secondary occupation) and as can be seen from the table, more than 92% reported casual labor. Regular contractual agreements between farmers and laborers seem to be uncommon, at least in this sample.

The following sections of this paper are organized as follows. Section 1.1 discusses previous studies of employment guarantees. Section 2 lays out the basic features of the model that Section 3 and 4 develop. Section 5 provides a numerical example of the welfare effects. Section 6 discusses the caveats, and then Section 7 concludes.

1.1 Studies of Employment Guarantees

There have been a large number of studies of how public works programmes should be designed in order to achieve maximum efficiency, however there has not been a lot of focus on the effects the introduction of such schemes can have on agricultural wages and prices. One paper which does discuss the market responses to public works programmes and which tries to characterize the situations under which such a relief program actually increases the worker's welfare is Ravallion [1990]. He shows that the introduction of an employment guarantee programme can put an upward pressure on agricultural wages, and hence reduce the demand for agricultural labor, and emphasizes that even a rural works programme that hires only *unemployed* workers can have an effect on wages and employment elsewhere in the economy. In the setup of the model in this paper, I find that such a program can actually have ambiguous effects on worker welfare due to intertemporal spillovers.

Using NSS data, Imbert and Papp [2011] find an increase in public employment and in the average daily earnings of casual laborers as a result of the program, but the increase is highly seasonal and is mostly confined to the lean season with low rainfall. They find also that the introduction of the program leads to a fall in the fraction of days spent on private work. In their study of households in Andhra Pradesh, Ravi and Engler [2009] find that while the program initially attracted non-agricultural labor, over time there was a shift towards households that would have participated in agricultural labor had the guarantee not existed. In their words "this suggests broader labor market distortions where NREGS is not just viewed as an employment assurance during the slack agricultural season but as an alternative to agricultural labor work". In some sense these 'broader labor marker distortions' are being discussed in this paper.

Basu et al. [2009] model the Employment Guarantee Scheme (EGS) as a 'wage-access pairing" - i.e. a combination of the wage offered and the ease with which a worker can avail of the guarantee (for example, the distance to the workplace). Depending on the levels of wage and access they show that the EGS can either raise or lower private employment, leading to a non-monotonicity in the relationship between the EGS wage and private employment for a given level of access, or between EGS access and private employment keeping wage constant. Finally Basu [2013] builds on the same basic theoretical framework as in Mukherjee and Ray [1995]. He models the impact of an EGS in a market with inter-seasonal tied labor contracts, and shows that technological change and productivity increases are more effective in improving worker welfare than increases in the wages paid at the employment guarantee program.

2 The Basic Features of the Theoretical Model

This paper is attempting to go from empirical observations to a simple theory, rather than to come up with predictions that can be tested in the Indian rural labor market. To this end, it attempts to incorporate *by construction* a number of the core features of Indian labor markets which have been found in many different studies.

The first big assumption regards seasonality. In this model, the agricultural market is characterized by two seasons - a slack (or lean) season, and a peak season. The peak season is the busiest time of the year. Activities undertaken in the peak season involve ploughing the land, sowing the seed for the crop to be grown, harvesting the grown crop, transporting the grain to the nearby market, and finally selling it at the end of this process. Studies have shown that the peak season labor market is at or close to full employment, and that is how it will be modeled in the next section.

The slack season, on the other hand, is the part of the year when there is not much work to be done on the farms. It consists largely of the time between the sowing of the crop and its maturation. During this period some amount of labor is required for irrigation, weeding and the application of fertilizer to the crops - in general, tending to the well-being of the plants in their growing phase - however there are not a large number of tasks to be conducted. Thus the slack season will be characterized by involuntary unemployment in the model to follow.

In reality these two seasons do not follow one another in a neat chronological order, however for ease of exposition we will assume here that there is a clear timeline. The way it is modeled here the slack season comes first and is followed by the peak season. We also assume that at the end of the peak season the cycle starts afresh, so it will suffice to study only one single year of two seasons.

The remaining 'stylized facts' of the Indian labor market that this paper will incorporate include the following:

1. The main source of labor for the farmers is casual labor, where workers are generally hired on a day-to-day basis.
2. The village labor markets are largely closed, with laborers searching for employment within their own villages and rarely (if ever) migrating to nearby villages in search of work.
3. The daily wage is uniform across workers within a particular season, regardless of their skill level.
4. There are a large number of employers, and a large number of laborers.

Table 3: Wages of Sample Workers

Average Wage (Rs/day)	**Women**	**Men**
Statutory Minimum wage	88*	88*
Agricultural Work	47	53
Other casual labor	58	71
NREGA work	85	85

[a] Source: Reproduced from table 4.1 of Khera [2011].

* Unweighted average of the state minimum wages in the six survey states

The last stylized fact that has not been discussed already is that at the time of the introduction of the NREGA, the slack season agricultural wage was typically lower than the stipulated minimum wage workers were entitled to under the Act. This is borne out both by our own field observations, as well as survey data. For example, Table 3, reproduced from Khera [2011], shows that at the time of the introduction of the act, the NREGA wage was considerably higher than the average wages for any other agricultural or casual work for both men and women. While this is data drawn from a small sample of workers in only six states, it is suggestive of the wedge between the going wage in the absence of the employment guarantee, and the NREGA wage.[5]

3 The Model

There are two main sets of players in this agricultural market.

3.1 Farmers

The first set of players are the farmers, who own a certain amount of land that they grow their crops on. Farmers may or may not work on their own land, but regardless of this, they need to supplement family labor with hired labor, particularly in the peak season when tasks are many and timely completion of them is of the utmost importance. There are a large number of farmers, denoted by N.

The farmers hire labor on a season by season basis, not for the whole year at a time. The amount of labor the farmers choose to demand at each wage rate in each season is determined by maximizing their profit taking the wage rates as given, as detailed below. We assume here that all farmers are identical in terms

[5] It is unclear from the context whether the agricultural wages are those reported by the NREGA participants (in which case one might worry about the 'Ashenfelter's dip' phenomenon), or whether these are market-wide averages. It is also unclear whether these are seasonal or annual averages. In light of this the figures reported here are treated as being simply illustrative.

of their land-holdings, availability of family labor, and their production functions. We also assume that farmers form rational expectations of next period's wages.

Since the amount of land held is assumed to be a fixed input it will not be explicitly mentioned henceforth, but one should keep in mind that all production functions mentioned below have both labor and land as inputs.[6]

3.2 Casual Laborers

The second set of players are the casual laborers, who do not own any land of their own. Throughout this paper I will use the words *casual laborers* and *workers* interchangeably. There are a large number of workers relative to the number of farmers, let us denote the number of workers by $L >> N$. We assume a certain degree of myopia on the part of the workers, in that their expectations of the next period's wage is equal to the wage that prevailed in the last period of the same type - i.e. they expect the peak season wage in the next period to be equal to the peak season wage last year.

Each worker has a single unit of labor to provide in each season of the year. Workers can be hired by the farmers to perform agricultural tasks, but if they do not find work within the village they remain unemployed and enjoy their leisure. Workers are utility-maximizers, so faced with several economic opportunities they will supply their labor to that opportunity that provides them with the maximum amount of utility. We assume here that all the workers have identical reservation utilities of $\underline{u}$, representing their valuation of leisure.

Let $u(y)$ be the worker's per period utility as a function of his full income y in that period. y then includes not only wage income but also the valuation of the worker's leisure at his reservation wage.

Assumption 1. *The workers' utility functions satisfy the following:*

1. $u'(y) > 0 \ \forall y > 0$, *i.e. utility is increasing in income.*

2. $u''() \leq 0 \ \forall y \geq 0$. *i.e. utility is concave.*

Let $\underline{w}$ be the wage rate at which if the worker supplies his entire one unit of labor to the farmer, he will receive utility of $\underline{u}$. In other words $u(\underline{w}) = \underline{u}$. $\underline{w}$ is thus the reservation wage, i.e. the lowest wage the farmer can pay the worker and still induce the worker to supply his labor.

[6] The buying and selling of land is neither easy nor common in rural parts of India, so most landholdings are inherited.

3.3 The Players' Problems

In this section we will describe the maximization problems faced by the farmer and the workers in this market. Throughout we will use s to denote individual worker labor supply choices in each season, S to denote market labor supply, and D to denote the farmer's labor demand in each season. Subscripts s and p will denote the slack and the peak seasons respectively. For example, S_s and S_p stand for the market labor supply in the slack and the peak period. Actual equilibrium employment will be determined by the intersection of labor demand and supply, or by the short side of the market in case there is no intersection. We denote actual employment by E, with the same subscripts for the slack and peak seasons.

3.3.1 Farmers

At the start of the slack season, a farmer chooses the amount of slack and peak season labor to hire, denoted D_s and D_p respectively, taking as given the slack season wage w_s and his expectation of the wage that will prevail in the peak season, w_p^e. Since there is no uncertainty in this model, under the assumption of rational expectations the farmer's expectation of the peak season wage will be equal to the prevailing peak season wage, so we can replace w_p^e with w_p henceforth. The price of agricultural output produced in the peak season is given by p. Without loss of generality, we can normalize p to be 1, so that all the wages are expressed in real terms. The farmer's annual profit maximization problem can then be written as:

$$\max_{D_s, D_p \geq 0} f(D_s, D_p) - w_s D_s - w_p D_p,$$

where f is the farmer's production function.

Assumption 2. *The production function $f(D_s, D_p)$ satisfies the following assumptions:*

1. $f(D_s, 0) = 0 \ \forall D_s$, *and* $f(0, D_p) > 0$ *for* $D_p > 0$, *i.e. without any peak season labor input the agricultural output is zero, but even without slack season labor input, output can be produced so long as there are a strictly positive number of peak season workers.*

2. $f_1(D_s, D_p) > 0, f_2(D_s, D_p) > 0 \ \forall D_p > 0$, *i.e. output is strictly increasing in both arguments so long as peak season employment is not zero.*

3. $f_{12}(D_s, D_p) > 0 \ \forall D_p > 0$, *i.e slack and peak season labor inputs are complements to each other, which means that an increase in the amount of one input used increases the marginal productivity of the other input.*

4. *Lastly,* $f_{11}(D_s, D_p), f_{22}(D_s, D_p) < 0 \ \forall D_p > 0$, *and* $f_{11}(D_s, D_p)f_{22}(D_s, D_p) - f_{12}(D_s, D_p)^2 > 0$, *i.e. the production function is strictly concave.*

The above problem can be thought of in the following intuitive manner. Labor hired in the slack season is used in tasks like weeding, irrigating, applying pesticides and so on. The greater the amount of labor that is spent in these tasks, the healthier the crop is and hence the larger the harvest. A plentiful harvest in turn requires more peak season laborers, as there are more fruit to be picked or bushels of corn to be gathered, more people needed to stack and store the harvest, and to transport it to the nearby markets and so on. Without workers engaged in conducting the peak season activities, the fruits or grains grown rot in the fields, yielding no revenue to the farmer.

On the other hand, there will still be some output even if no workers are employed in the slack season. For example, rain could substitute for regular irrigation, enabling crops to grow despite being neglected during the slack season. However the *size* of the harvest will be smaller - perhaps because some part of it was consumed by pests, or perhaps because a poor monsoon meant that some of the more water-dependent crops did not survive to maturity. A smaller harvest in turn requires fewer peak season laborers.

Since the production function is concave, the farmer's problem has a unique solution for every combination of wages in the slack and the peak seasons. Since we will be looking at a competitive equilibrium in this market, it will suffice to look only at the problem of one single 'representative' producer.[7]

The first order condition for this problem gives us

$$\nabla f(D_s, D_p) = w, \tag{1}$$

where $\nabla f(D_s, D_p)$ is the gradient vector of the function f and w is the vector of input prices. These two first order conditions define the labor demanded in the slack and the peak season as functions of the two input prices, w_s and w_p. Under the assumptions stated above, we can derive that

$$\frac{\partial D_k}{\partial w_k} < 0 \text{ for } k = s, p,$$

and

$$\frac{\partial D_k}{\partial w_j} < 0 \text{ for } k, j = s, p; j \neq k.$$

[7] See Mas-Colell et al. [1995], Chapter 5 for theory of aggregation of the firm.

In other words, an increase in the price of an input reduces the demand for that input. Since a reduction in the amount of that input also reduces the marginal product of the second input through our assumptions on the production function, the complementarity works to also reduce the demand for the second input at the same time.

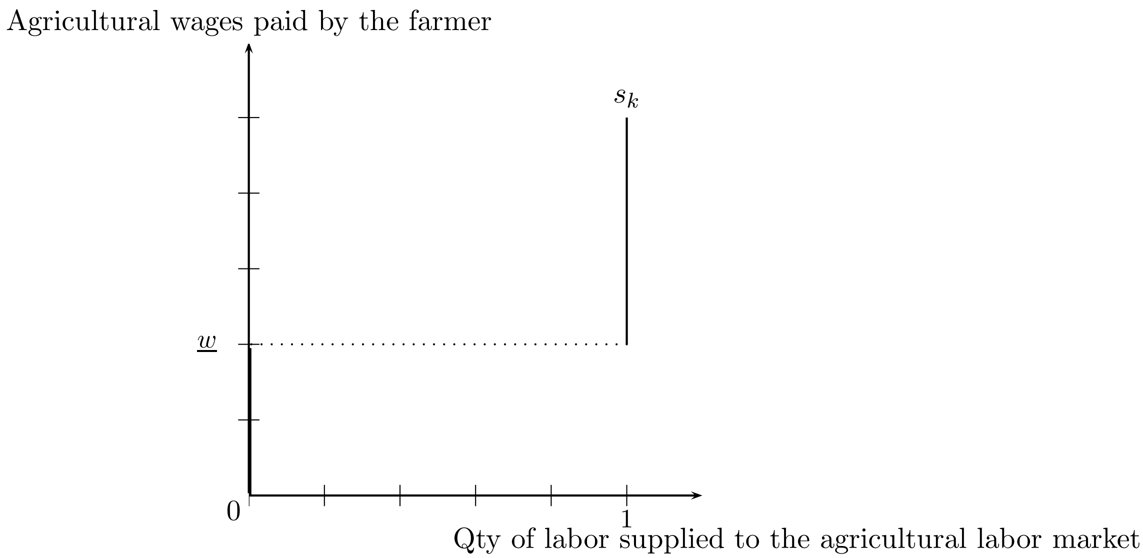

Figure 1: An individual worker's labor supply in period k

3.3.2 Laborers

The laborers maximize their utility by choosing how much labor to supply to the farmer. This clearly depends on the wage being offered in that particular season. A given laborer chooses the amount of labor to devote to agricultural work and the amount to devote to other pursuits (in this case, enjoying leisure) in each season to solve the following problem:

$$\max_{s_k \geq 0} \sum_{k=s,p} [u(w_k s_k + \underline{w}(1 - s_k))],$$

where s_k is the amount of labor the worker supplies to the farmer in period $k = s, p$. We are assuming additive separability in the worker's utility function. Let us assume that if the wage in the agricultural market is equal to the worker's reservation wage, he supplies his one unit of labor to the farmer. The way we have written it the worker's problem can be analyzed on an annual basis. Under this assumption, the individual worker's labor supply to the representative farmer can be depicted as in Figure 1.

3.4 Equilibrium

We assume a competitive agricultural labor market. The firms choose the amount of labor to hire in each period to maximize their profits, taking wages as given. The workers choose how much labor to supply to the farmer in each season, also taking wage rates as given. The wage rates themselves adjust to equate labor demand and supply. The stylized fact of full employment in the peak season combined with less than full employment in the slack season would mean that the equilibrium vector of wages and employment $((w_s^*, w_p^*), (E_s^*, E_p^*))$ would be such that

1. $D_s(\underline{w}, w_p^*) < L$, i.e even at the lowest possible wage the farmers can pay the workers and still induce them to work, they do not wish to hire all the laborers who are willing to supply their labor. Employment in the slack season is then determined by the short side of the market, the demand side, $E_s^* = D_s^* < L$.

2. $D_p(\underline{w}, w_p^*) = L$, i.e. in the peak season the farmer wants to hire all the labor that is available to him. Employment in the peak season is then given by $E_p^* = L$. The wage in the peak season adjusts to equate demand and supply, $w_p^* = f_2(D_s^*, L)$.

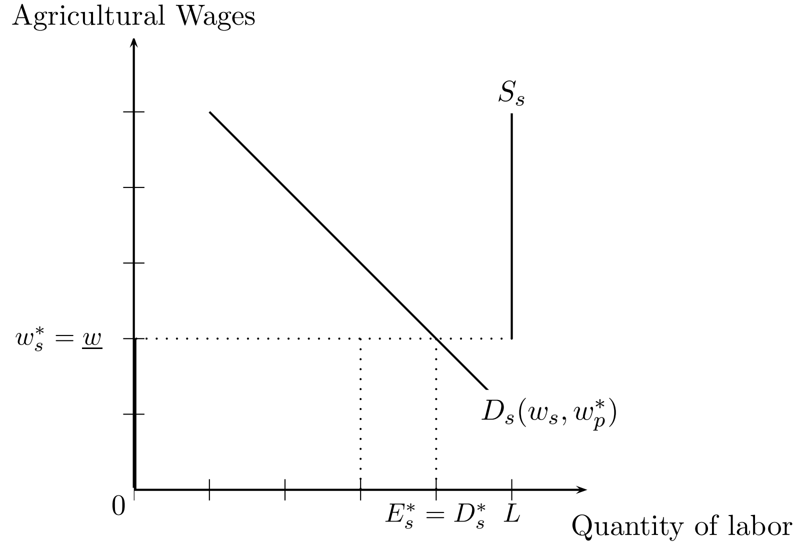

Figure 2: Agricultural Market Supply and Demand - Slack Period

These two assumptions are depicted in Figures 2 and 3. The way we have depicted it, the peak season wage rate is greater than the workers' reservation wage of $\underline{w}$.

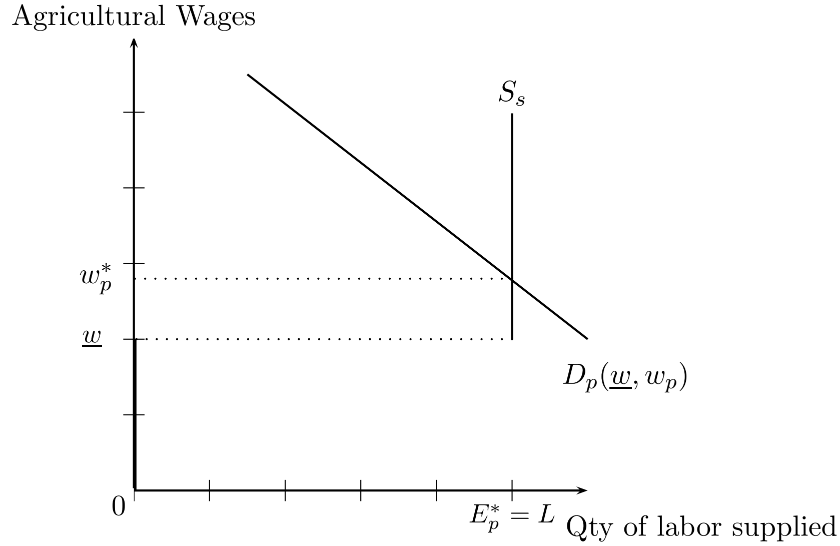

Figure 3: Agricultural Market Supply and Demand - Peak Period

This model now encompasses all the stylized features of a typical Indian rural labor market without an employment guarantee in place. The wage rate in the slack season is low, and there is involuntary unemployment as there simply is not enough demand for workers from the farmers. However in the peak period the demand is higher, there is full employment, and peak season wages are higher as well. We are now ready to see what happens when an employment guarantee scheme is introduced into such a market. The interesting conclusion will be that under certain conditions such a guarantee might even have adverse effects on the worker's welfare through the mechanism of the intertemporal spillovers.

4 Introducing the Employment Guarantee Act

Suppose now that an employment guarantee act is put into place in such an economy. For simplicity, assume that the workers can only avail of this guarantee during the slack agricultural season, as the government wishes to interfere as little as possible with the agricultural market. Each worker can avail of $n < 1$ units of time on the employment guarantee works, at an exogenously given government wage of w_n (here n stands for NREGA). In line with the stylized facts described earlier, we assume the following:

Assumption 3. *The NREGA wage is higher than the market clearing wage in the slack season in the absence of the scheme, i.e.* $w_n > w_s^* = \underline{w}$.

If instead we had that $w_n \leq \underline{w}$, then it should be clear that the employment guarantee scheme would have no effect on the labor market whatsoever. Workers would continue to supply as much labor as the farmers demanded at their reservation wage, farmers would still be able to hire all the labor they needed to complete the slack season tasks, and peak period labor demand would remain unaffected. In light of empirical observations that the introduction of the scheme attracted workers *away* from agricultural work, the scenario just described seems unlikely to have occurred. Note that we are not making any assumption about the relationship of the employment guarantee wage to the peak season wage. It will not matter in this model since we have assumed that the guarantee is available only in the slack period.

Now we need to say something about the timing of events in the slack period. At the start of the slack period, the government-stipulated employment scheme wage is announced, and workers first decide how much of their labor hours to supply to the scheme. Depending on how much they decide to supply, the farmer knows how much labor (or more correctly, how many units of labor time) are available for cultivation on the farm. The number of hours the guarantee provides then determines whether the agricultural labor markets are affected by the introduction of this scheme or not.

4.1 The Farmer's Problem

The farmer's problem does not change with the introduction of the NREGA. He still chooses the amount of labor to demand in each season in order to maximize his profit, taking the wage rate prevailing in that season as given. However the worker's problem *does* change, and so the equilibrium wage rate and the amount of labor employed in agriculture could also be altered, as described below.

4.2 The Worker's Problem

Without the employment guarantee, the typical worker had only one choice to make - how much labor to supply to agriculture in each season. The rest of his unit of time he spent in leisure, earning his reservation wage. Now he is faced with two choices in the slack season. He has to decide how much labor to supply to the employment guarantee, and how much to work on the farmer's land. He allocates his labor to that economic opportunity that provides him with the maximum income, and therefore utility. Let us assume here that faced with an option of working for the NREGA or working for the farmer at the same wage, he always chooses to work for the farmer. Similarly working for either the farmer or the NREGA is chosen over leisure if the wage he is paid for either type of work is equal to his reservation wage.[8]

[8] These are tie-breaking assumptions made only to simplify the analysis.

The main assumption I am making in this setup is that the worker's labor supply choice in the slack period does not depend on his expectation of the wages that will prevail in the peak period to follow, because he assumes that the wage will be the same as in the peak period of the previous year. In other words, though I am modeling the farmers as completely rational, I am assuming a degree of myopia on the part of the workers. In justification it seems to me reasonable to think of these casual laborers as worrying simply about getting enough food this period and not thinking of how much the wages will change in the next season as a result of their choices in this period. However the implication of this assumption is that we are looking only at a one-period effect on worker welfare, as after one period they will update their beliefs about the wages.

To begin with we study the slack season. It should be clear that the farmer will never raise the agricultural wage so high that it exceeds the wage on the employment guarantee, as once the two wages are equal he can employ as many laborers as he chooses. The worker chooses labor hours to allocate to the scheme (denoted by s_n) and the amount to devote to agriculture (still denoted as s_s) in order to maximize his utility. This slack season problem can be written as:

$$\max_{1 \geq s_n, s_s \geq 0} [u(w_n s_n + w_s s_s + \underline{w}(1 - s_n - s_s))].$$

By assumption the wage the workers are being offered on the employment guarantee is higher than their reservation wage (the prevailing equilibrium slack season wage) and so the workers choose to allocate n units of their time to the guarantee. This leaves a maximum of $L(1-n)$ units of labor for the farmer to use, unless he bids the wages up to w_n.

4.3 Equilibrium

There are now two cases to consider, depending on the size of the guarantee n.

4.3.1 n is 'small'

The first case we consider is that where n is 'small', where 'small' means that even after the workers allocate n units of their time to the scheme, the number of labor hours available to the farmer is greater than the equilibrium number of labor units he employed in the market *without* the employment guarantee. In other words, $L(1-n) > D_s^*$. In this case, the employment guarantee clearly has a positive effect on worker welfare, and there is no change in the equilibrium levels of employment and wages. Since he can employ as many workers as he needs at wage $\underline{w}$, equilibrium labor employment does not change ($E_s = D_s^*$), and neither does the slack season agricultural wage. This means that there is also no change in the peak season problem.

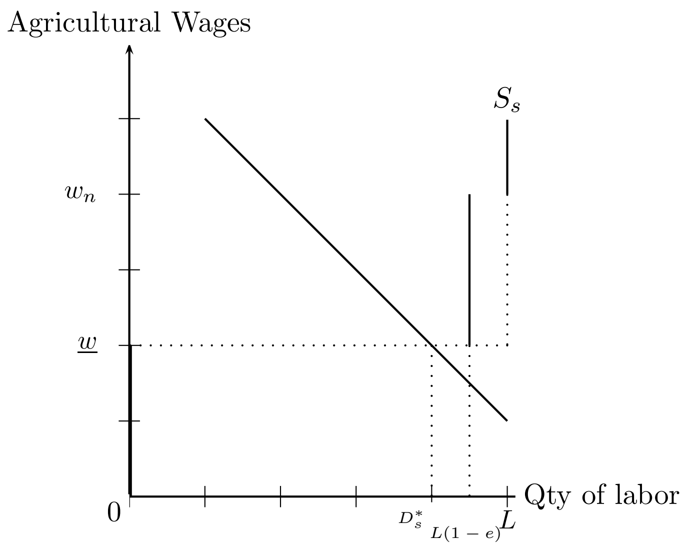

Figure 4: Slack Season in the Agricultural Market with Employment Guarantee - n small

The slack season scenario is depicted in Figure 4. All workers (whether employed in agriculture in the slack season or not) receive wages w_n for n units of their time and $\underline{w}$ for the remaining $(1-n)$ units of time, and the same peak season wage as before, and are thus unambiguously better off. The change in worker welfare in the slack period can be written as:

$$[u(w_n n + \underline{w}(1-n)) - u(\underline{w})].$$

Since we have assumed that $w_n > \underline{w}$, this change in welfare is always positive. However, empirical evidence suggests that in actuality this scenario is unlikely to have occurred. There is considerable evidence that the introduction of the employment guarantee led to an increase in the agricultural wage and a decline in private agricultural employment in the slack season. This is therefore the case we consider next.

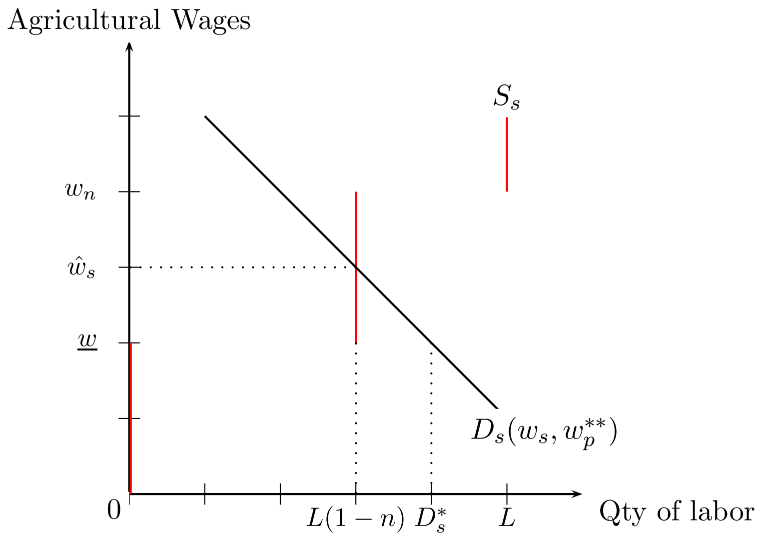

Figure 5: Slack Season in the Agricultural Market with Employment Guarantee - n large

4.3.2 n is 'large'

In the second case, the guaranteed amount of work on the employment scheme is so generous that after all the workers allocate n units of their time to the scheme the amount of labor hours available to the farmer is less than the equilibrium number of units he would have employed in the absence of the guarantee. This is depicted in Figure 5. Here based on the original slack season labor demand curve of the farmer, the amount of labor he would have demanded at wage $\underline{w}$ is no longer available after the workers supply labor to the employment guarantee. If there were no intertemporal linkages, then the wage would simply have risen to $\hat{w}$ to equate the amounts of labor demanded and supplied at $L(1-n)$. However with intertemporal linkages the story is slightly more complicated.

Let us work through the logic in order to see what happens. Recall that the farmers are assumed to have rational expectations about the wage prevailing in the next period. Suppose the wage rose to $\hat{w}$ and the slack season labor employment fell to $L(1-n)$. This would have an effect on the amount of labor hired in the peak period as well, as is obvious from Equation (1). Due to the complementarity between slack and peak season labor in the farmer's production function, the peak season labor demand will shift to the left as a result of the employment guarantee, leading to a fall in the peak season wage and possibly a fall in the peak season labor employed (depending on how much the labor demand curve shifts).

Subcase (i):

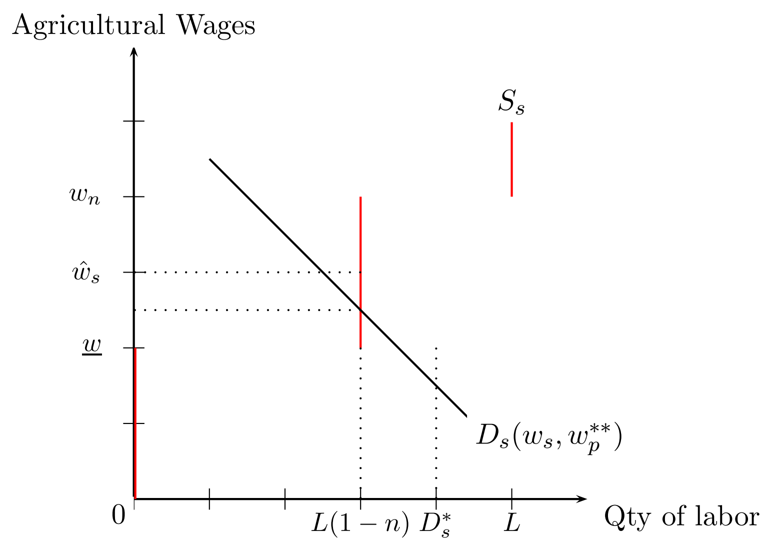

Figure 6: n large, subcase (i) - Slack Season Final Equilibrium

Let us first consider the case where the amount of peak season labor employed does indeed decrease from full-employment as a result of the change in the slack season employment. The farmer anticipates this in the slack period, and knows that the fall in the amount of peak period employment will decrease the marginal value of an extra unit of slack period labor. In other words, the slack period labor demand shifts to the left, causing the slack season wage to fall. Equilibrium is re-attained at the wage and employment combination where the slack season labor demand is optimal given the peak season wage and employment, which in turn is optimal given the slack season wage and employment. The final equilibrium of this case is depicted in Figures 6 and 7.

At this equilibrium the amount of labor employed in agriculture in both the slack and the peak seasons has fallen, and the peak season wage has also decreased to the workers' reservation wage. While the workers get the higher employment guarantee wage for a fraction of the slack season units of time, the fall in the peak season wage raises questions about the overall welfare effect of this policy. It is conceivable that in some scenarios the workers are actually made worse off by the introduction of this scheme, when the fall in peak season utility due to a lower peak season wage outweighs the rise in slack season utility due to increased earnings in that period.

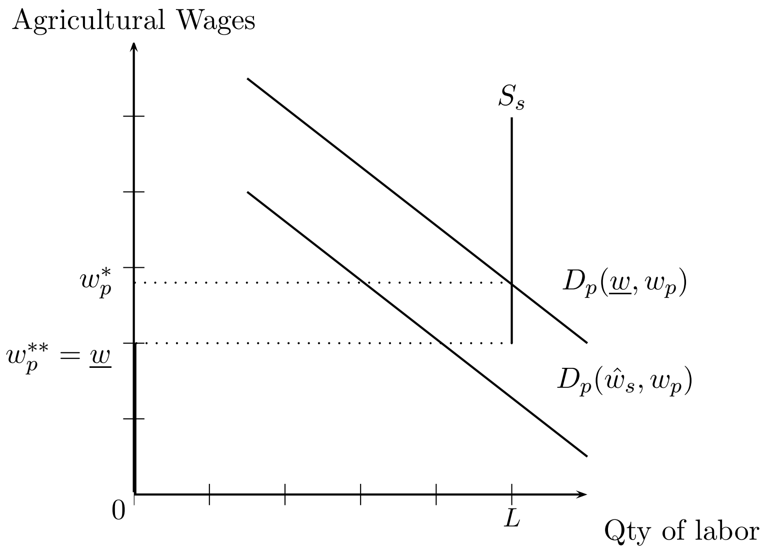

Figure 7: n large, subcase (i) - Peak Season Final Equilibrium

Subcase (ii):

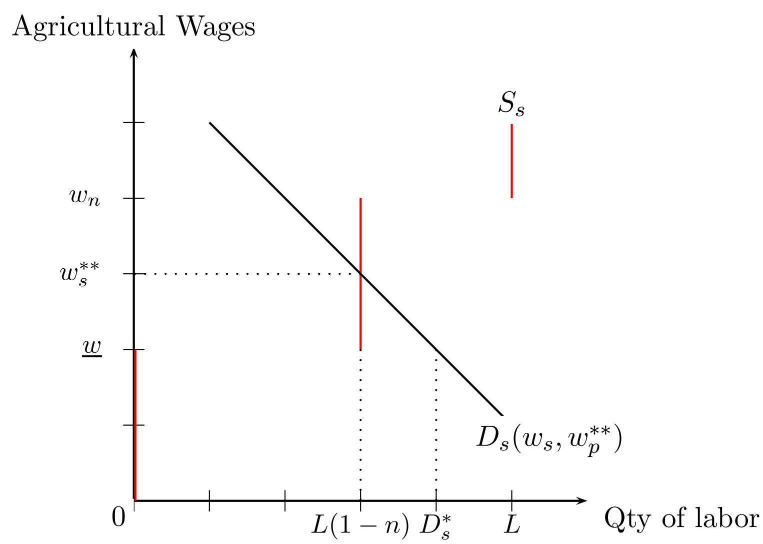

Figure 8: n large, subcase (ii): Slack Season Final Equilibrium

Now we consider the case where the equilibrium amount of peak season labor employed by the farmer does *not* change from full employment, L, in other words even after the fall in the amount of slack season labor employment, the farmer demands more labor than is available at the workers' reservation wage.

The peak season wage falls to $w_p^{**} = f_2(L(1-n), L) < f_2(D_s^*, L) = w_p^*$. The slack season labor demand curve is defined by $f_1(D_s, D_p) = w_s$. Since the quantity of labor demanded in the peak season remains the same, the only movement is *along* this slack season demand curve to the point where employment is equal to $L(1-n)$ and the equilibrium slack season wage is given by $\hat{w}$. In the new equilibrium, therefore, the slack season agricultural wage is higher, slack season agricultural employment is lower, peak season employment is unchanged, but the peak season wage has fallen. This subcase is depicted in figures 8 and 9.

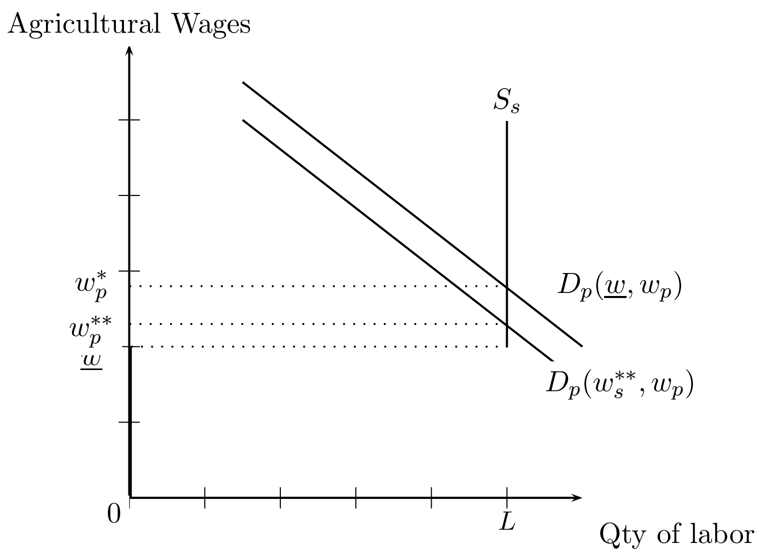

Figure 9: n large, subcase (ii): Peak Season Final Equilibrium

Are the workers better or worse off in the case where n is large? The answer to this question depends on the relative magnitudes of the fall in peak season wage and the rise in the slack season wage. In the slack season, workers receive the NREGA wage for n units of time and the higher slack season wage for the remaining $(1-n)$ units of time. This is clearly higher than what they were receiving without the employment guarantee. However the wage they receive in the peak season has fallen, in extreme scenarios it is now equal to their reservation wage (Subcase (i)). Thus there are two effects going in opposite directions.

The change in annual worker welfare can be written as follows:

$$[u_s(w_n n + w_s^{**}(1-n)) - u_s(\underline{w})] + [u_p(w_p^{**}) - u_p(w_p^*)].$$

The first of these terms is always positive, while the second is always negative. Which one outweighs the other? There is no clear answer for this question - it depends on the particular slack and peak season labor demand curves. Interestingly, it is possible to construct scenarios where worker welfare actually *declines*, i.e. the fall in the worker's utility from the decrease in the peak season wage is greater than the increase in his utility from the increased slack season wage -

$$|u_p(w_p^{**}) - u_p(w_p^*)| > [u_s(w_n n + w_s^{**}(1-n)) - u_s(\underline{w})].$$

This is a scenario that has not been considered at all in the recent policy debates about the effect of this scheme on worker welfare. We now turn to a simple numerical illustration of this welfare effect in the case of large n.

5 Numerical Example

I have claimed above that the result on worker welfare in the case where n is large is 'ambiguous' in the sense that it is possible to conceive of situations where worker welfare increases, and other situations where it actually declines with the introduction of the employment guarantee. In order to illustrate this, let us consider a numerical example that will show that in the case of n large the effects on worker welfare can go both ways.

Let the number of workers be $L = 75$ and the production function be given by

$$f(D_s, D_p) = C(A + D_s)^{\alpha} D_p^{\beta},\ \ \alpha + \beta < 1,\ \ \alpha > 0, \beta > 0,\ \ A, C > 0.$$

This production function satisfies Assumption 2. To see this, observe the following:

1. It is possible to produce output without using any slack season labor, however if no peak season labor is employed output is zero:
   $f(D_s, 0) = 0\ \forall D_s$, and $f(0, D_p) = CA^{\alpha} D_p^{\beta} > 0\ \forall D_p > 0$.

2. Output is increasing in both slack and peak season labor employed:

$f_1(D_s, D_p) = C\alpha(A + D_s)^{\alpha-1}D_p^{\beta} > 0$ and $f_2(D_s, D_p) = C\beta(A + D_s)^{\alpha}D_p^{\beta-1} > 0$ for $D_p > 0$.

3. Slack and peak season labor are complements to one another:
   $f_{12}(D_s, D_p) = C\alpha\beta(A + D_s)^{\alpha-1}D_p^{\beta-1} > 0$ for $D_p > 0$.

4. The production function is strictly concave:
   $f_{11}(D_s, D_p) = C\alpha(\alpha - 1)(A + D_s)^{\alpha-2}D_p^{\beta} < 0$, and $f_{22}(D_s, D_p) = C\beta(\beta - 1)(A + D_s)^{\alpha}D_p^{\beta-2} < 0$ for $D_p > 0$, and
   $f_{11}(D_s, D_p)f_{22}(D_s, D_p) - f_{12}(D_s, D_p)^2 = (1 - \alpha - \beta)C^2\alpha\beta(A + D_s)^{2(\alpha-1)}D_p^{2(\beta-1)} > 0$.

In the context of the model, we can think of A as representing factors that allow for some output even when slack period labor employed is zero, for example, a good rainfall which substitutes for irrigation by slack period workers. Parameter C can be thought of as land productivity.

The farmer takes the slack and peak season wages as given and demands labor by equating the marginal product of labor to its price. The first order conditions for the farmer's maximization problem without the employment guarantee are given by

$$w_s = C\alpha(A + D_s)^{\alpha-1}D_p^{\beta} \equiv f_1(D_s, D_p), \tag{2}$$

and

$$w_p = C\beta(A + D_s)^{\alpha}D_p^{\beta-1} \equiv f_2(D_s, D_p). \tag{3}$$

With this production function we can write the labor demands as functions of the input prices in the following way:

$$D_p = \frac{1}{C}\left(\frac{\alpha}{w_s}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{w_p}\right)^{\frac{1-\alpha}{1-\alpha-\beta}},$$

and

$$D_s = \frac{1}{C}\left(\frac{\alpha}{w_s}\right)^{\frac{1-\beta}{1-\alpha-\beta}}\left(\frac{\beta}{w_p}\right)^{\frac{\beta}{1-\alpha-\beta}} - A.$$

It follows from the above expressions that

$$\frac{\partial D_k}{\partial w_j} < 0 \text{ for } k, j = s, p; j \neq k,$$

i.e. that slack and peak period labor are indeed complements.

Let us define a worker's full income as the sum of income he receives from working (either in agriculture or in the employment guarantee) and the valuation of his leisure at his reservation wage. We will call this simply income, and denote it by y. Let the workers' utility in each period as a function of that period's income y be given by

$$u(y) = y^{\gamma}, y \geq 0, \gamma < 1.$$

This utility function is increasing and concave for positive income levels. Without an employment guarantee, the worker's income in any period $k = s, p$ is simply $y_k = w_k s_k + \underline{w}(1 - s_k)$, i.e. the total amount he receives either from his labor income and from leisure. With an employment guarantee in place, his slack period income is given by $y_s = w_n s_n + w_s s_s + \underline{w}(1 - s_n - s_s)$, i.e. the sum of incomes he receives from both the guarantee and agricultural work. The peak period income definition remains the same.

5.1 Workers worse off

To begin with, let us choose the following parameter values: $\alpha = \beta = 0.4$, $n = .8$, $A = 50$, $C = 300$ and $\gamma = .8$. Let the workers' reservation wage be $\underline{w} = 45$. Workers supply labor in order to maximize their annual utility $u(y_s) + u(y_p)$ where y_s is the slack period income, and y_p is the peak period income. The workers will supply all their labor for any wage greater than the reservation wage of 45. As before, let s_s and s_p denote the individual worker's labor supply to the farmer, and S_s and S_p denote the market labor supplies. Let Q_s and Q_p denote the quantities of labor demanded, and E_s and E_p denote the actual levels of employment at the equilibrium. Throughout, let 0 denote the period without the employment guarantee, and 1 denote when the guarantee is present.

We assume full employment in the peak season, so $E_p^0 = Q_p^0 = 75$. In the slack period, the quantity of labor demanded, Q_s^0, at the reservation wage of 45 and full employment in the peak period can be determined by solving Equation (2), the solution of which is

$$Q_s^0 = \left(\frac{C \alpha Q_p^{0\beta}}{\underline{w}} \right)^{\frac{1}{1-\alpha}} - A = \left(\frac{300 * .4 * 75^{.4}}{45} \right)^{\frac{1}{.6}} - 50 = 41.199 < 75.$$

However the market quantity of labor supplied is $S_s^0 = 75$, as all laborers supply their one unit of labor so long as the wage is greater than $\underline{w}$. The short side of the market dictates equilibrium employment, so we have $E_s^0 = 41.99$. The wage in the slack period is driven down to the reservation wage, $w_s^0 = \underline{w} = 45$.

Given these values of the parameters and the slack season levels of employment, we can use Equation 3 to solve for the peak season wage

$$w_p^0 = C\beta(A + D_s)^\alpha D_p^{\beta-1} = 300 * .4 * (50 + 41.199)^{.4} * 75^{-.6} = 54.72.$$

The worker's utility is then equal to

$$\underline{w}^\gamma + (w_p^0)^\gamma = 45^{.8} + 54.72^{.8} = 45.59. \quad (4)$$

Since we are defining income as also the valuation of leisure, this is the utility *all* workers earn, regardless of whether or not they are employed in agriculture.

Now the employment guarantee is introduced at the exogenous wage $w_n = 50 > w_s^0$. Since the size of the employment guarantee in hours is $n = .8$, the amount of labor available to the farmer after the introduction of the guarantee is $L(1-n) = 75(1-.8) = 15$, unless the agricultural wage rises till w_n. This constitutes a leftward shift in the market labor supply curve as in Figure 8. The farmer's labor demands at the new slack and peak season wages are still given by Equations (2) and (3).

Assuming that the peak season labor equilibrium employment remains at full employment, $E_p^1 = Q_p = 75$, the slack season wage equating the amount of labor demanded by the farmer and the amount of labor supplied by all workers is given by

$$w_s^1 = C\alpha(A + D_s)^{\alpha-1} D_p^\beta = 300 * .4 * (50 + 15)^{-.6} * 75^{.4} = 55.13.$$

This wage given by the intersection of the market labor demand and supply is less than the employment guarantee wage, w_n, which means that the amount of labor employed in equilibrium is given by $E_s^1 = L(1-n) = 75(1-.8) = 15$ units (see Figure 8). This constitutes a movement *along the same slack period demand curve* to a higher equilibrium wage and lower equilibrium employment.

As a result of the fall in the slack period amount of labor employed, the new peak season wage will fall to

$$w_p^1 = C\beta(A + D_s)^\alpha D_p^{\beta-1} = 300 * .4 * (50 + 15)^{.4} * 75^{-.6} = 47.78.$$

The worker's slack season income is given by the sum of his earnings from the employment guarantee and the agricultural work, $y_s^1 = w_s^1(1-n) + w_n n$.

The worker's utility is then equal to

$$(w_s^1(1-n) + w_n n)^\gamma + (w_p^1)^\gamma = (55.13 * 0.2 + 50 * 0.8)^{.8} + 47.48^{.8} = 45.29. \tag{5}$$

Comparing Equation (5) to the original utility without the employment guarantee in Equation (4), we can see that in this example the worker's utility actually *declines* as a result of the introduction of the employment guarantee. As can be seen from the example, this is because the fall in the peak season wage is so large that it outweighs the rise in the slack season wage.

5.2 Workers better off

In the second case let us choose the following parameter values: $\alpha = \beta = .4$, $A = 60$, $C = 300$. Again, we assume full employment in the peak season, $E_p^0 = 75$ and the same reservation wage of $\underline{w} = 45$. In the slack period, farmers demand only

$$Q_s^0 = \left(\frac{C\alpha Q_p^{0\beta}}{\underline{w}}\right)^{\frac{1}{1-\alpha}} - A = \left(\frac{300 * .4 * 75^{.4}}{45}\right)^{\frac{1}{.6}} - 60 = 31.199 < 75$$

number of workers at the reservation wage. The market labor supply is, however, 75. Thus in equilibrium the agricultural employment is determined by the short side of the market, in this case, the demand: $E_s^0 = 43.75$. The slack season wage is driven down to the reservation wage $w_s^0 = \underline{w} = 45$, but the peak season wage is higher at

$$w_p^0 = C\beta(A + D_s)^\alpha D_p^{\beta-1} = 300 * .4 * (60 + 31.199)^{.4} * 75^{-.6} = 54.72.$$

The worker's utility is given by

$$\underline{w}^\gamma + (w_p^0)^\gamma = 45^{.8} + 54.72^{0.8} = 45.59. \tag{6}$$

The employment guarantee is introduced into this economy, and a worker can avail of $n = .8$ units of time at the same exogenous wage of $w_n = 50$. Now the maximum amount of labor available for the farmer is again 15, unless he pays workers the same wage as the guarantee. The new slack wage is given by the intersection of the slack season labor demand curve and the new labor supply curve, which has shifted to the left for wages between the reservation wage and the employment guarantee wage (see Figure 8 for a diagrammatic representation). Inserting the assumed parameter values and performing the same calculations as in the above example gives us $w_s^1 = 50.60$. The slack season wage has risen, though not as high as the employment guarantee wage. The new peak season wage has fallen to $w_p^1 = 50.60$, from Equation (3). The worker's utility after the introduction of the guarantee is given by

$$(w_s^1(1-n) + w_n n)^{\gamma} + (w_p^1)^{\gamma} = (50.60 * 0.2 + 50 * 0.8)^{.8} + 50.60^{.8} = 45.99. \tag{7}$$

Comparing Equations (6) and (7) we can see that in this example the worker is made *better off* with the introduction of the employment guarantee. The reason for the workers being better off in this case versus the case discussed above is that the employment guarantee wage is higher here. So a higher employment guarantee wage can result in better worker welfare even if the production function remains unchanged.

Thus with the help of a numerical example we have shown that depending on the nature of the production function and other parameters like the size of the employment guarantee, n, and the wage it provides workers, it is possible for workers to be made worse off with the introduction of such a scheme.

6 Caveats

The purpose of this paper was to study the welfare effects of the employment guarantee scheme on the casual laborers in the agricultural sector, and to demonstrate that such a scheme could *potentially* also have adverse consequences in the short-term for those it is intended to benefit, if there are intertemporal spillovers between seasons and the market is competitive.

In the case of the Indian scenario, the latter assumption might prove to be too restrictive, as there is evidence (discussed in Section 1) that the agricultural labor market is *not* in fact competitive, and there is evidence of implicit collusion on the part of the workers to keep wages raised above market clearing levels. Also if it is the case that there is a large amount of surplus labor in the slack season, then the introduction of the NREGA should have little or no effect on slack season agricultural employment and on slack season wages, which would mean that workers were made unambiguously better off. The number of empirical studies showing that in fact the introduction of the NREGA has had a significant upward impact on wages in the lean season would tend to suggest that labor cannot be in that much surplus, and so the effects outlined here are indeed plausible.

The degree to which intertemporal productivity spillovers do exist in the Indian context has not to my knowledge been studied until now. Part of the reason for that is perhaps that most surveys of employment and unemployment are conducted on an annual basis, rather than on a seasonal basis, and there is no way to conclude whether the amount of labor employed by a farmer in the peak season fluctuates with the amount of slack season labor he hired. This would, however, be an interesting question to assess.

With these caveats it is clear that this result is far from being conclusive, however in light of the many debates on popular media on the welfare effects of the NREGA it is interesting to think of one possible way in which it could potentially prove to be detrimental to those for whom it was instituted.

7 Conclusion

This paper contributes to the debate about the desirability of an employment guarantee such as the NREGA introduced recently in India by developing a simple theoretical framework within which is it possible to generate negative welfare effects for casual laborers. While policy makers might well have limited patience with the complaints of big farmers on rising wages and the reduction in the availability of labor at the previous going agricultural wage, there is also the possibility of potentially harmful effects even on the casual laborers the Act was instituted to help. Under the caveats mentioned above I should say that I do not believe the possibility of such an adverse effect is very realistic. However it is an interesting theoretical result that has not been mentioned in the literature as far as I am aware.

References

P. K. Bardhan. Wages and unemployment in a poor agrarian economy: A theoretical and empirical analysis. *Journal of Political Economy*, 87:479–500, 1979.

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, and R. Kanbur. A theory of Employment Guarantees: Contestability, Credibility and Distributional Concerns. *Journal of Public Economics*, 93:482–497, 2009.

P. Chakraborty. Implementation of the National Rural Employment Guarantee Act in India: Spatial dimensions and Fiscal implications. Technical report, National Institute of Public Finance and Policy and The Levy Economics Institute of Bard College, 2007.

N. Dey and J. Drèze. Employment Guarantee Act: A Primer, 2007. URL `http://www.righttofoodindia.org/data/ega_english.pdf`.

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.

A. K. Ghose. Wages and Employment in Indian agriculture. *World Development*, 8:413–428, 1980.

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`.

R. Jha, R. Gaiha, and M. K. Pandey. Net Transfer Benefits under India's Rural Employment Guarantee Scheme. *Journal of Policy Modelling, Elsevier*, 34(2):296–311, 2012.

D. Johnson. Can Workfare serve as a Substitute for Weather Insurance? The Case of NREGA in Andhra Pradesh. Technical report, Institute for Financial Management and Research, Centre for microfinance, 2009. URL `http://ifmr.ac.in/cmf/publications/wp/2009/32_Johnson_NREGA_Bad%20Weather.pdf`.

R. Khera, editor. *The Battle for Employment Guarantee*. Oxford University Press, 2011.

A. Mas-Colell, M. D. Whinston, and J. R. Green. *Microeconomic Theory*. Oxford University Press, 1995.

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.

M. Ravallion. *The Political Economy of Hunger*, volume 2, chapter 5, Market Responses to Anti-Hunger Policies: Effects on Wages, Prices and Employment. Clarendon, Oxford, 1990.

S. Ravi and M. Engler. Workfare in Low Income Countries: An Effective Way to Fight Poverty? The Case of the NREGS in India. Technical report, February 2009. URL `http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1336837`.

A. V. Swamy. A Simple Test of the Nutrition-based Efficiency Wage Model. *Journal of Development Economics*, 53:85–98, 1997.