

The Effect of Land Market Restrictions on Employment Pattern and Wages: Evidence from Sri Lanka¹

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Abstract

A substantial proportion of agricultural land in Sri Lanka is publicly owned and privately farmed under lease arrangements that impose strict restrictions on land sales, rental, mortgage, subdivision and succession through inheritance. This paper investigates the effect of these leases on employment diversification and wages. The structural estimation utilizes spatial variations in the incidence of these leases and identifies the causal effect through a combination of instrumental variable and control function approaches. The empirical results suggest a significant adverse effect of these leases on wages and employment diversification out of agriculture. The adverse effect is more pronounced in areas closer to large urban markets. The mobility barriers created by land restrictions thus lead to poor integration of labor market across areas and a slower sectoral transition from farm to non-farm activities.

Key Words: Land Sales Restrictions, Migration Costs, Spatial Wage distribution, Employment Diversification

JEL Classification: O14, O15, O18, J21, J61

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1 Introduction

Economic development is frequently modeled as a transformation from a predominantly agrarian and rural economy to an industrialized and urban one. Understanding the process of structural change has been one of the central focuses of development economics from Lewis (1954), Kuznets (1973), Chenery et. al. (1986) to Lucas (1988, 2004), among others. A number of recent studies has shown that misallocation of labor across sectors (e.g. sustained differences in urban and rural wages and returns to capital) can explain a large fraction of the international differences in the overall total factor productivity (Vollrath, 2008; Temple and Wobmann, 2006). This "dual economy" effect can result from restricted entry into urban jobs as in Harris and Todaro model as well as from labor and land markets policies and institutions. However, empirical evidence on the impact of land market policies on the structural transformation process is still sparse. In this paper, we provide micro level evidence on the effects of land market restrictions on employment diversification and spatial labor market integration from a developing country, Sri Lanka.

A large body of literature on land markets examines the impacts of various restrictions on land market transactions on agricultural productivity, incentive to invest on productivity enhancement, and credit market access. Literature on the effect of land restrictions on employment pattern and wages is still limited. In a recent paper, Hayashi and Prescott (2008) argued that informal restrictions on land inheritance can have a substantial negative effect on the process of structural transformation from agriculture to non-agriculture. Hayashi and Prescott (2008) showed that during the 1855-1940, agricultural employment remained nearly unchanged in Japan, despite a very large urban-rural income disparity. They argued that the pre-war patriarchy forced the son designated as heir (primarily first-born) to stay in agriculture. This informal barrier to labor mobility caused misallocation of labor across activities, depressing per capita output (GNP) in Japan by about a third. Post-war reforms in inheritance of agricultural land (equal share for all children) led to mass exodus of younger cohorts of

labor force from rural areas, and a sharp change in employment pattern as well as increase in growth of per capita income. Yang (1997) developed a model where lack of land sales right pushes up migration costs for rural residents who would have to forego the earnings of land in the case of migration. Yang (1997) argued that inalienability of land rights under the Household Responsibility System in China increased migration costs, slowing sectoral transformation. Removal of the control over residential change in 1988 was followed by a surge in migration but much of the migrants population in the cities were "floating population" who left family in rural areas to retain rights of the households' to land earnings. Field (2007) finds that land titling in Peruvian urban slums resulted in substantial increase in labor hours, a shift from work at home to work outside, and from child to adult labor.¹

In this paper, we examine how barrier to labor mobility created by land market restrictions affects employment and wages over geographical space using data from Sri Lanka. Sri Lanka is a lower middle income country in South Asia where agriculture accounts for less than half of employment and 16 percent of GDP. The pace of sectoral transformation has been slow (Figure 1). In 1960, agriculture's share in total employment was about 56 percent in Sri Lanka, 60 percent in South Korea, and 78 percent in Indonesia. Today, those shares stand at 44, 9 and 44 percent respectively. Even India experienced a faster decline in agriculture's share in employment and income during this period. The regional pattern in Sri Lanka indicates higher level of sectoral transformation in the richest Western province but a much higher dependence on agriculture in the rest of the provinces. This slow pace of transformation is especially surprising in light of Sri Lanka's achievement in human capital development and economic reforms. Sri Lanka is renowned for equitable provision of education, health and other social services to its citizens. The country also implemented a broad-based economic liberalization and industrial de-regulation program in 1977, almost a decade and a half earlier than India.

¹Deininger et al (2003) finds that in Ethiopia, households who have part-time jobs in the off-farm sector are significantly more likely to expect land to be taken away from them through administrative means. In the context of Vietnam's land titling program, Iyer and Do (2008) find that households in provinces with more land titles devote more time to non-farm activities.

An important feature of Sri Lanka’s agricultural land market is that a substantial proportion of agricultural land is owned by the Government and farmed by the private farmers under Land Development Ordinance and other leases (Appendix A provides a brief history of the present land tenure system and its colonial past, see also Peebles, 2006; World Bank, 2008). The Crown Lands Encroachment Ordinance of 1840 transferred all lands without private title—forests, waste, unoccupied or uncultivated land – to State. The Land Development Ordinance (LDO) of 1935 initiated a program of making Government-owned agricultural land available for private household use. The State introduced a system of protected tenure under which recipients of LDO land had the right to occupy and cultivate the land in perpetuity subject to restrictions imposed on sale, leasing and mortgaging, and conditions related to abandoning or failing to cultivate the land. While subsequent amendments have weakened some conditions on mortgage (allowed only for loan from public banks) and limited transferability (with permission from Government), the basic provision of unitary succession and ban on subdivision of plots and land rental remain largely intact. What is more important for our analysis is that LDO leases coexist with complete private holding in same location. Moreover, the share of land under LDO leases varies across villages. We utilize these variations to identify the effect of LDO restrictions on the distribution of employment and wages.

The conceptual framework underpinning the empirical work draws from two strands of literature. Following Hayashi and Prescott (2008) and Yang(1997), we argue that inalienability of land rights along with restriction on rental transaction increases migration costs for household members. This is because in the case of migration, households will loss the right to the net present value of future earnings from land. With increased migration costs, there are persist differences in marginal product of labor and hence wages across areas with different degrees of restrictions. As agricultural operation also requires a minimum amount of labor, households need to keep some of its members on farm even though it can not provide full-time employment in farming. Villages with larger share of restricted land will thus observe larger reliance on wage labor, particularly agricultural wage labor.

Higher wages in urban areas due to weaker migration flow, according to economic geography literature, will make it more profitable for firms engaged in traded goods to move into low wage areas if transport costs are not prohibitively high (Puga, 1999; Krugman and Venables, 1995).² In contrast, self employment in non-farm enterprises and employment in non-traded activities are likely to be less important in villages with larger fraction of land under LDO because of weaker local demand and credit constraint emanating from mortgage restrictions. We also expect the effect of LDO restrictions to depend on how far the villages are from the large urban centers. This interaction effect results from the fact that migration costs vary positively with distance to travel. When migration costs due to traveling distance are prohibitive, the land restriction may not matter for migration.

In the empirical analysis, we estimate two relationships: one describing the employment choice of the workers, and other the wages earned. We make distinction among six different types of employment: farming, self employment in non-farm enterprises, wage employment in agriculture, manufacturing, skilled and unskilled services activities. We estimate wage equations for four different activities (agriculture, manufacturing, skilled and unskilled services) separately. Econometric estimation however presents challenges. In the case of wage regressions, unobserved location-specific heterogeneity may be correlated with both land under LDO restrictions and travel time biasing estimates of their respective coefficients. In addition to adding location attributes to regression, we follow an instrumental variable estimation strategy familiar in location sorting literature (Bayer and Timmins, 2007).³ Identification in this case relies on the fact that attributes of own location affects productivity and thus wages directly, but attributes of other locations affect sorting of workers over space but not their productivity directly. Following this identification strategy, we control for own area attributes in the structural regressions and use average attributes of other locations as instruments. The regression

²When wages differences across regions persist, they act as a dispersion force by increasing production costs of firms producing in locations with relatively many other firms. This dispersion force can moderate agglomeration process, and sustain equilibrium in which most locations will have manufacturing, even if in different proportions.

³Similar identification and estimation strategies are utilized in the estimation of differentiated products demand system. See Berry, Levinsohn, Pakes (1995) and Berry, Levinsohn, Pakes (2004).

diagnostics performed in the empirical analysis also confirm the validity of these instruments.

The potential omitted variable bias due to unobserved locational heterogeneity is also a concern in the estimation of employment choice. The traditional two-stage IV estimation can not be applied directly due to categorical nature of the dependent variable. Instead, we utilize a control function approach suggested by Petrin and Train (2010). Following Petrin and Train (2010), we define the control function term from the structural estimates of the wage equations and introduced it as a separate regressor in the multinomial logit regression for employment choice. The estimation results suggest a statistically significant effect of control function term, highlighting the need for correcting for the potential omitted variable biases.

The econometric estimation yields three main results. Wages from all types of activities including agriculture are significantly lower in locations with higher percentage of land under LDO restrictions.⁴ The LDO restrictions also have a significant negative impact on the probability of participation in nonfarm wages (manufacturing and skilled services) and self-employment activities. In contrast, participation in agricultural wage work increases with an increase in share of land under LDO restrictions. The effect of LDO restrictions depends on the remoteness of the area itself. The adverse effect of LDO restrictions on wages is much larger in areas which are located closer to large urban markets. Similar interaction effects are found in the case of participation in (traded) manufacturing and (non-traded) skilled services employment. The robustness checks also confirm these results.

Taken together, the results suggest that areas with larger share of land under LDO leases not only have more people dependent on agricultural wage labor but they tend to earn much less per unit of labor. Employment in those areas are less diversified, and labor market rewards are also lower. As suggested by the theoretical literature, LDO leases are thus associated with slower sectoral transformation and larger disparity in wages across locations.

⁴This is despite the fact that agricultural yields per unit of land in the areas with higher share of LDO leases are much higher.

Restrictions on land market transactions are common in developing countries. The restrictions in LDO leases are somewhat stricter than those observed in other South Asian countries, but they are similar to those found in China, Vietnam and many African countries. The empirical results in this paper show that such restrictions have important implications for structural transformation of an economy – going far beyond their direct influence on agricultural productivity.

The rest of the paper is organized as follows. Section 2 provides the main conceptual framework for the empirical estimation. Section 3 discusses various estimation and data issues. Empirical results are presented in section 4. Section 5 concludes the paper.

2 Conceptual framework

A general equilibrium model of wage determination in the presence of land market restrictions on sales and rental is needed to generate the testable predictions. Although no such model exists in literature, a number of standard wage determination models can still be used to describe the basic insights and testable hypothesis. For instance, Foster and Rosenzweig (2004) considers the wage and employment determination in a village economy distinguishing among different types of activities (traded vs non-traded). Hayashi and Prescott (2008) develops a two-sector dynamic general equilibrium model where a minimum amount of labor has to be employed in one of the sectors (e.g. agriculture) due to informal restriction on land inheritance. Yang (1997) considers time allocation of farm households among farming and non-farm activities in the case where land can not be sold. The production technology in all of the above models is constant returns to scale. A more general class of models of new economic geography allows increasing returns in some activities (e.g. manufacturing), leading to unequal concentration of these activities across space. Extending on the paper by Krugman and Venables (1995), Puga(1999) develops a general equilibrium model where labor immobility interacts with transportation, and produces different regional patterns of industry location and employment.

However, none of the above model provides a complete set of predictions regarding the land market restrictions that are the focus of this paper. In the following, we utilize the basic insights generated in the above models to derive a set of testable hypotheses regarding the impact of land market restrictions on wages and employment pattern across locations.

2.1 Wage Determination

We start from the simplest formulation of wage determination model. Consider a closed local economy (location k) with an endowment of T units of agricultural land, L units of labor and K units of capital, all of which are exogenously given. For simplicity, there are only two types of activities: agriculture which uses land and labor, and manufacturing which uses human capital and capital.⁵ Under the standard assumption of concave production and utility functions, equilibrium wages in this closed economy can be defined as:

$$w_{ak} = \mu_m w_{mk} = w_j(E_k) \text{ for all } j = a, m \quad (1)$$

where subscript a stands for agriculture and m for manufacturing, and μ_m is the skill premium for manufacturing workers and E_k is a vector of endowments, technology and preference parameters. Suppose a fraction of land endowment (θT) is subject to sales and rental restrictions. If there is no supervision cost for hired labor, then these restrictions will have no impact on production and wages as labor will be allocated across farms of different sizes so as to equate its marginal product. If hired labor requires supervision, then land rental restriction in particular will be associated with lower wages even in this autarkic village economy. Restriction on land sales alone will have no efficiency implications and thus impact on wages.

⁵For simplicity, we ignore non-traded activity such as services because services employment is tied to local demand and tends to move in the same direction as the predominant traded activity (e.g. agriculture in rural areas) in the locality. See Foster and Rosenzweig (2004) for a model where non-traded activities are also considered.

Suppose we allow labor markets in various locations to be linked in the sense that labor and capital can move across locations. If migration is cost-less, then our earlier result that wages are affected negatively by tenancy restrictions but not by sales restriction per se still holds. Note also that tenancy restrictions will not necessarily cause wage dispersion across locations. A more realistic scenario is where migration is costly. In the case of costly migration, land sales restrictions can affect migration costs. Following Hayashi and Prescott (2008) and Yang (1997), we argue that inability to sale the land and threat of losing the rights to future earning from it will increase migration costs for the households. This implies that at least some member (s) of the household would have to stay in farming. We assume that migration cost increases with an increase in land under sales restriction:

$$\varphi_k = \varphi(\theta_k, M_{kh}), \text{ and } \partial\varphi_k/\partial\theta_k > 0$$

where M_k is a vector of determinant of migration decision including distance from origin (k) to destination(h). With positive migration costs, the equilibrium wage for same activity can differ across locations. At the equilibrium, however, the following condition should hold:

$$w_{jk} \cong w_{jh} - \varphi(\theta_k, M_{kh}), \text{ and } w_{jh} > w_{jk} \tag{2}$$

Where h is an alternative location. The condition in equation (2) implies that in a cross-section of locations, wages will vary inversely with an increase in percentage of land area under sales restrictions because of later's role in raising migration costs.

The wage model so far ignored the possibility that increasing returns in some activities, more notably in manufacturing, can lead to regional concentration and thus locational sorting of workers. An important implication of the new economic geography (NEG, for short) literature is that in addition to the factors mentioned so far, economic density as well as trading costs of a location will also influence wages, where both economic density and trading costs are determined by the proximity of the location

to main concentration of activities such as large urban centers. The wage function can be modified as:

$$w_{jk} = w(\delta_{jk}, \theta_k, E_k) - \varphi(\theta_k, M_{kh}) \quad (3)$$

where δ_{jk} is the density in location k , and location h is the nearest urban center. The locational sorting of activities in new economic geography models is determined by the trading costs and strength agglomeration economies. Assuming location h as the center of agglomeration in a region, density of economic activity will decrease once one moves farther and farther away from h . Thus δ can be taken as a negative function of distance from h to k . It is straight forward to see from equation (3) that wage will vary inversely with distance from urban center and with share of land under sales restriction. Note that if migration cost is prohibitively high, labor market in location k will act as if it is in autarky. In that case, wages will be determined by equation (1). The land sales restriction will have no impact on productivity in agriculture. Wages may still respond negatively to rental market restrictions, but the magnitude of the effect will be smaller. This points to the presence of possible interaction effect of distance to urban centers and share of land under sales restrictions. Taking a linear approximation of equation (3), a wage equation incorporating the above mentioned intuitions can be specified as:

$$w_{ijk} = \beta_0 + \beta_1\theta_k + \beta_2d_{kh} + \beta_3\theta_k d_{kh} + \beta_4E_k + \beta_5Z_{ijk} + \nu_{ijk} \quad (4)$$

Where subscript i refers to individual i , Z_{ijk} is a vector of observed individual characteristics, d_{kh} is the distance between location k and h , and ν_{ijk} is the error term. The error term ν_{ijk} in equation (4) in part reflects unobserved location specific factors that are not measured by the econometricians but valued by the workers and firms/farms. This could reflect some locational amenity that is not included in E_k . This could also arise if workers are sorted across locations on the basis of their unobserved productivity and/or taste. The error term in the wage equation can be decomposed as:

$$\nu_{ijk} = \eta_{jk} + \epsilon_{ijk}$$

where ϵ_{ijk} represents the idiosyncratic error term and η_{jk} is the location-specific error. The estimating equation thus becomes:

$$w_{ijk} = \beta_0 + \beta_1\theta_k + \beta_2d_{kh} + \beta_3\theta_k d_{kh} + \beta_4E_k + \beta_5Z_{ijk} + \eta_{jk} + \epsilon_{ijk} \quad (5)$$

2.2 Employment Choice

The land market restrictions will have impact on employment pattern across locations as well. The ban on land rental will restrict the movement of land from larger farms with shortage of family labor to smaller farms with abundant family labor. The increased migration cost due to land sales restriction will force some people to stay in the village. Thus villages with higher share of land under rental and sales restrictions are likely to have more workers dependent on agricultural wage labor. As already noted, the migration costs resulting from inalienability of land rights would result in higher dispersion of wages across regions. Higher wages in urban areas due to weaker migration flow, according to economic geography literature, will make it more profitable for firms engaged in traded goods to move into low wage areas if transport costs are not prohibitively high (Puga, 1999; Krugman and Venables, 1995). When wage differences across regions persist, they act as a dispersion force by increasing production costs of firms producing in locations with relatively higher density of other firms. This dispersion force can moderate agglomeration process, and sustain equilibrium in which most locations will have manufacturing, even if in different proportions. This means that traded activities subject to agglomeration economies (e.g. manufacturing) will be more evenly spread across locations than what one would expect in the absence of land restrictions. The lower wages in areas with higher concentration of restricted land will lower the demand for non-trade activities (such as services) which

depend more on local demand. The mortgage restrictions may also affect adversely the development of financial intermediation in villages with higher share of restricted land. This may reduce the non-farm self employment opportunities in these villages.

To incorporate the above predictions of impact of land sales, mortgage and rental restrictions on employment pattern across locations, we consider an employment choice model at the individual level. Suppose an individual i can choose from a set of J different employment options ($j = 1, 2, \dots, J$) at location k . Individual i will choose activity j if:

$$u_{ijk} \geq u_{imk} \text{ for all } j \neq m$$

where u_{ijk} is the utility derived from being engaged in activity j at location k . We further specify the utility function as:

$$u_{ijk} = u(w_{jk}, Z_{ijk}, \varepsilon_{ijk})$$

where w_{jk} is the wage/income in activity j and location k , Z_{ijk} is a vector of observed individual characteristics, and ε_{ijk} is the individual specific error term. Following McFadden(1981), we assume that utility u_{ijk} can be approximated by a linear specification:

$$u_{ijk} = \alpha_0 + \alpha_1 w_{jk} + \alpha_2 Z_{ijk} + \varepsilon_{ijk} \tag{6}$$

In the above formulation, location specific factors including land market restrictions affects utility through its effect on wages. Substituting wage from equation (5), we have:

$$u_{ijk} = \gamma_0 + \gamma_1 \theta_k + \gamma_2 d_{kh} + \gamma_3 \theta_k d_{kh} + \gamma_4 E_k + \gamma_5 Z_{ijk} + \gamma_6 \eta_{jk} + \varepsilon_{ijk} \tag{7}$$

Under the assumption that ε_{ijk} follows an iid logit distribution, equation (7) can be estimated

using the standard multinomial logit formulation.

3 Estimation Strategy

The presence of location specific error η_{jk} in equations (5) and (7) complicates estimation considerably. If the location specific error term η_{jk} is correlated with θ_k , then that will cause endogeneity problem in the estimation. First, we address the potential endogeneity issues in the context of estimation of wage equation. Although econometric estimation is done using individual level data, and in a competitive equilibrium where individuals can take wage as given, there are several reasons for suspecting an omitted variable bias.

An important worry is that if unobserved land quality in an area is correlated with share of agricultural land under LDO leases, it may bias the estimate of coefficient of LDO in the OLS regression. As more productive lands are expected to have clear private titles, the lands under state control can be argued to be of lower agricultural potential. The history of land reforms and LDO leases in Sri Lanka indicates that if anything, the correlation between land quality and LDO leases is likely to be positive. First, as a result of the Crown Lands Encroachment Ordinance of 1840, the British Crown became the owner of nearly all lands, as landownership in Sri Lanka was governed by local customs and few in the peasantry possessed clear titles (De Silva,1981; Peebles, 2006). Between 1840 and 1870, Crown lands suitable for coffee plantation were purchased rapidly by British officials and investors as well as some wealthy Sri Lankans.⁶ After the complete demise of coffee crop due to leaf disease by 1875, plantations diversified into other crops such as tea, rubber etc. The expansion of plantations on the basis of Crown lands subsided by the 1920s.⁷ The importance of plantation crops in Sri Lankan economy today has also declined substantially with an increasing share of land going

⁶Peebles (2006) states that land in Kandyan hills were particularly suitable for coffee plantation. This land was reclaimed from the Kandyan peasantry regardless of their titles to sell them to plantation owners.

⁷The larger plantations were nationalized during the early 1970s, and are now run by private companies under long-term lease arrangements with the government.

to paddy and other field crops.⁸ The point to emphasize here is that purchase of Crown lands by private individuals/plantation owners during the late 19th and early 20th century was driven by suitability of land for coffee production, a crop which had virtually disappeared from Sri Lanka. The lands suitable for coffee (hilly land) are not necessarily considered as particularly suitable for paddy and other field crops which are now the mainstay of Sri Lanka's smallholder agriculture. Second, the LDO lands were distributed under various settlement schemes. The settlement schemes brought landless Sinhalese people from the wet zone in the South to the minority dominated dry zones in the North and Eastern part of the country.⁹ Government of Sri Lanka has made substantial investment in irrigation and other infrastructure in the settlement areas. For instance, the dry zone settlement scheme was integrated with the implementation of the Accelerated Mahaweli Development program which invested heavily on irrigation and infrastructure development. Consistent with cropping patterns in rest of the country, paddy and other field crops dominate in the settlement areas. As a result of generous public investments, today land productivity in many settlement areas are much higher than that in the rest of the country.¹⁰ The productivity advantage of settlement areas implies that areas with higher incidence of LDO leases are likely to be more productive areas, causing attenuation bias in the estimation of the impact of LDO leases.

The second source of omitted variable bias is location specific determinants of migration cost that are not observed by econometricians. If unobserved location specific determinant of migration cost is correlated with θ_k , then simple OLS estimation will produce biased estimate. Along with migration costs, regional concentration of activities on the basis of agglomeration economies can also lead to locational sorting of workers with different level of unobserved productivity. Again, the endogeneity problem arises if some determinants of this sorting is unobserved but correlated with θ_k . To deal with

⁸Indeed, the estate/plantation sector now accounts only for 5.5 percent of Sri Lanka's population in 2006. Only 8.6 percent of our sample comes from estate/plantation areas. The incidence of poverty is highest in the estate sector.

⁹As a result, many districts in settlement areas experienced significant change in the ethnic composition of population between pre- and post- settlement census years.

¹⁰Paddy is a major agricultural crop in Sri Lanka. Paddy yield during the monsoon season in Mahaweli system H is about 30 to 40 percent higher than average yield in Sri Lanka.

the potential endogeneity problem, we utilize a number of strategies that are being offered in recent literature. We include an extensive set of location specific controls. The district level fixed effects included in all regressions account for not only locational sorting but also other location specific amenities, agricultural potential, and climatic conditions. Note also that distance from villages to nearest urban agglomeration will pick up the effects of trading and migration costs as emphasized in the new economic geography literature. We include controls for agricultural potential such as availability of cropland, suitability of cropland for paddy production, and availability of inland water.¹¹ We also include an estate dummy to control for any possible productivity differences/advantages associated with development of plantation land. The inclusion of these explanatory should lessen the concern for omitted variable bias.

The inclusion of district level fixed effect means that we are only relying on within district variations to estimate the effects of θ_k and d_{kh} . To correct for any remaining endogeneity bias, we utilize the instrumental variable approach. For identification, we need instrument which will be correlated with θ_k , but uncorrelated with η_{jk} . This rules out any geographic variable for location k as potential instrument since it will likely to affect agricultural productivity and thus wage directly. Recent literature on locational sorting suggests a set of possible instruments (Bayer and Timmins, 2007; Fu and Ross, 2007). Following this literature, we use characteristics of neighboring locations as instruments. The identification assumption in this case is that productivity in a location depends directly on characteristics of that location (e.g. quality of its own paddy land) but not other locations.

The endogeneity problem in equation (7) can not be addressed simply by an IV strategy because of the discrete nature of the dependent variable. For the estimation of equation (7), we follow an estimation strategy proposed in Petrin and Train (2010). If equilibrium wage rate for activity j in location k is a monotonic function of attributes of k , then wage equation can be inverted to form

¹¹Note also that if labor can move freely and cost-lessly across areas, marginal product of labor should roughly equalize across areas, making wages at a location less sensitive to agricultural potential of that location. We are also considering villages within which labor can move freely between farms under LDO leases and under complete private control.

an estimate of η_{jk} . The linear specification in equation (5), derived from the existing theoretical models on wage formation including those of the new economic geography literature (Krugman, 1991, Puga, 1999), satisfies this condition. The underlying condition for the invertibility is that both production and migration cost functions are continuous and monotonic in location attributes. Once this invertibility condition is met, one can use the residual from the estimation of wage regression as a control function in the estimation of multinomial logit model. The estimation can be done even if utility function in equation (7) is not separable in η_{jk} . The possible non-linearity can be tackled by introducing interaction terms in the estimation (Petrin and Train, 2010).

3.1 Data

The main data source for the estimation of employment choice and wage regressions is the Household Income and Expenditure Survey, 2002 (HIES, 2002). The survey collected information from a nationally representative sample of 16,924 households drawn from 1913 primary sampling units. The survey covered 17 of Sri Lanka's 25 districts, and 249 of its 322 District Secretariat Divisions (DSD).¹² The DSD identifier in the HIES (2002) allows us to examine the employment and wages pattern at much disaggregated geographical levels. From the 16924 households in the survey, about 25,886 individuals participated in the labor force. Our sample consists of the adults [age 21 to 65 years] who participated in the labor force. The HIES 2002 has complete employment, wage and other information for 22,323 individuals in this age range.. Our main estimation is based on this sample of 22,323 individuals. In addition to employment and wages, the survey collected information on household size and composition, education, age, gender, ethnicity, religion and expenditure. The HIES 2002 on the other hand has only limited information on farming (farm size and income only).

A key piece of information for our analysis is the amount of land under LDO leases at each

¹²The land territory in Sri Lanka is divided into administrative units of different levels of aggregation: from province (largest geographical unit) to district to district secretariate divisions to gram niladhari (smallest unit).

location. We draw this information from the Agricultural Census of 1998. We estimated percentage of agricultural land under LDO leases (including permits and grants). The geographic information including travel time from surveyed DSDs to major urban centers with population of 100 thousand or more are drawn from the Geographical Information System (GIS) database. The travel time is estimated using the existing road network and allowing different travel speed on different types of roads. We also estimated the straight-line distances from the surveyed DSD's to urban centers which are then used as instruments. We also drew land quality data from the IFPRI SPAM model for Sri Lanka. Before turning to the estimation results, we provide a brief account of the regional employment and wage pattern in the following subsection.

3.2 Regional Pattern of Employment and Wages

The analysis of HIES shows that among 22,323 adults in the labor force, 16 percent are farmers, 16.4 percent are agricultural wage laborers, 16.2 percent employed in manufacturing and 36.4 percent in services (Table 1). The rest (15 percent) are employed in household based non-farm enterprises. There are, however, considerable variations among the provinces. In Western region, 46 percent are employed in services and 24 percent in manufacturing. Only 12 percent are employed in agriculture including agricultural wage laborers. At the other end of the spectrum, in Uva province, 31 percent are farmers, and another 32.2 percent are agricultural wage workers. Manufacturing employment is only 5.6 percent of the provincial labor force.¹³

Table 2 reports the real annual wages from different types of wage employment.¹⁴ Consistent with employment pattern, the annual wages in the Western region are much higher than that in any of the other provinces for all types of non-farm employment. The regional differences in annual income from agricultural wage labor are much smaller across provinces. The agricultural wages are lowest in

¹³The district level employment shows the pattern similar to provincial patterns.

¹⁴The real wages are nominal wages deflated by regional price index.

Sabaragamuwa, Uva and Southern provinces. These are also the provinces where agriculture is the largest source of employment. On average, annual wages from manufacturing employment is more than twice that from agricultural wage labor. However, skilled services employment on average pays the highest amount, more than 3.2 times that of agriculture, about 2 times that of unskilled services wage and 1.5 times that of manufacturing employment. The real per capita income is highest in Western province and lowest in Sabaragamuwa, followed by Uva.

Table 3 reports provincial distribution of selected services and infrastructure along with percentage of land under LDO. Sri Lanka is renowned for the equitable provision of social services across geographical areas. Though data in Table 3 show a slight concentration of population with higher education in the Western province, the variations in the levels of education across provinces are rather small for education below higher secondary level. There is some dispersion in household's access to land and mobile phones across provinces.¹⁵ Compared with education or access to phones, provinces differ considerably in terms of access to large urban centers (with population equal to or more than 100 thousand).¹⁶ Access to large urban markets is best in the Western province, with an average travel time of 48 minutes (Table 3). The provinces that are worst in terms of market access are Eastern (5.5 hour), Uva (4.7 hour) and North Central (3.95 hour) provinces. Area under LDO leases is lowest in the mostly urbanized Western province (Table 3). Land under LDO lease is highest in the North Central province (31 percent) followed by Eastern (20 percent) and Uva (19 percent) provinces.¹⁷ Table 3 also provides evidence on the suitability of land for the cultivation of paddy, the main crop in Sri Lanka. The North Central province has highest amount of land which can be considered to be particularly suitable for paddy production, followed by Eastern and North Western provinces. Note also that North Central and Eastern provinces are areas with higher percentage of land under LDO

¹⁵There is also little regional dispersion in the availability of schools, health clinics and drinking water.

¹⁶Sri Lanka has 7 cities with population more than 100 thousand. These are Colombo, Kandy, Dehiwala, Jaffna, Kote, Moratuwa and Negombo. Except for two cities (Kandy and Jaffna), all other large urban centers are clustered around Colombo, and in the Western coast.

¹⁷A large part of dry zone colonisation scheme as well as Mahaweli Development areas are located in the North Central province.

lease. Thus areas with higher incidence of LDO land are not necessarily land with lower agricultural productivity. As mentioned before, this is due to heavy public investment in irrigation and land improvement in these areas. In the next section, we present the empirical results regarding the effect of LDO leases on employment and wages.

4 Empirical Estimation

Equation 5 and 7 are estimated using individual level data. An individual in a location is assumed to have choices among different employment options. In recognition of heterogeneity of non-farm activities, we make a distinction among six different types of employment. The main categories of employment considered are self employment in agriculture, wage employment in agriculture, self employment in non-agriculture, wage employment in manufacturing sector and wage employment in skilled and unskilled services. The unskilled services consists mainly of wholesale and retail trade, hotel and restaurants, and personal services. In contrast, a large fraction of skilled services is public administration, and those employed in health and education services. The dependent variable in the employment regression is an unordered categorical variable. We use a multinomial logit model to estimate equation (7).

Similar to employment, we make a distinction between wage income from agricultural labor and non-agriculture work. In the case of non-agricultural wages, equation (5) is estimated separately for the traded (manufacturing) and non-traded (skilled and unskilled services) activities. All wages are deflated using the regional consumer price index and expressed in logarithm.

For the estimation of equations 5 and 7, we need to specify the vector of explanatory variable Z_{ijk} . The Z_{ijk} vector includes controls for individual characteristics such as education level, age, gender, marital status and ethnicity in the wage equation.¹⁸ In the case of employment choice, it also includes

¹⁸The omitted category for the ethnicity dummies is Sinhalese. About 84 percent of Sri Lanka's population are Sinhalese.

household level variables such as household size and composition. The endowment vector E_k includes location specific factors such as total agricultural land, median of elevation, availability of inland water, and dummies for urban and estate areas. In addition, the regressions for agricultural and unskilled services wages include controls for land quality measured by suitability of land for paddy production. As noted before, the inclusion of district level fixed effect in all regressions accounts for much of the variations in service provision, agro-climatic condition and sorting due to agglomeration economies.

For the IV estimation, we use locational characteristics of neighboring DSDs. The following formula is used to define the instruments:

$$I_k = \sum \frac{E_h}{H - 1} \text{ for all } h \neq k$$

where H is the total number of DSDs in a district. E_h is the location characteristics of $h \neq k$ and I_k is the set of instruments for location k . The set of instruments include crow fly distance to large urban centers, percentage of area under LDO leases in other DSDs in the district, and its interaction with crow fly distance. For agricultural and unskilled services wages, average agricultural land area of surrounding DSDs and share of land marginally suitable for paddy production are included as additional instruments. For manufacturing and skilled services wages, median of elevations in surrounding DSDs is included as an instrument. Note that all these attributes of location k are already included in the regressions.¹⁹ The summary statistics for the explanatory variables as well as instruments are provided in appendix Table A.1.

¹⁹Note that both regression specifications and instruments sets for agricultural and unskilled services wages are similar, but they differ slightly from those for skilled services and manufacturing wages. The difference is due to the fact that land availability and quality may influence agricultural productivity, and demand for unskilled services which are dependent on agriculture. In contrast, quality of land is unlikely to affect both manufacturing and skilled services productivity. These predictions are confirmed by regressions results where land quality was found to have no statistically significant effect on manufacturing and skilled services wages.

4.1 Wage Regressions

Table 4 reports the results from instrumental variable regressions of wages from different sources. For the ease of comparison, the fixed effect OLS regressions are reported in Table A.2. These regressions were estimated from the individual data and included household and individual level controls as well as district level fixed effect. The regression specifications for different types of wages differ slightly for two reasons. As migration is costly and sorting is imperfect, wage of an activity (e.g. agriculture) is likely to be function of location characteristics that affect production function of that activity (e.g. land quality for agriculture), and that affect migration costs. There is also strong collinearity among different location attributes. In the reported results, we keep a selected number of location attributes which are statistically significant.

Before presenting the main results, we note that instruments in each of the regressions satisfy the usual validity and relevance conditions (Table 4, lower panel). The Hansen’s J-statistics clearly show that instruments pass the overidentification tests easily at reasonable level of significance (smallest P-value=0.16). The instruments are also not weak. The diagnostics for first stage regressions indicate that instruments explain substantial amount of variation in percentage of land under LDO and interaction term. The instruments are less powerful in explaining variations in travel time to large urban centers. This is expected as district level fixed effect is likely to capture a large part of relative remoteness of DSDs. Even for travel time, the F-statistics for instruments are well above the critical threshold of 10 (lowest is 18.8). The Kleibergen-Paap test of weak identification can be rejected at 5 percent level for all wages except for skilled services where it can be rejected at 10 percent level.

The upper panel in Table 4 reports the regression results for wage equation (5). The coefficient of land under LDO is negative and statistically highly significant for agricultural and manufacturing wages. For unskilled services wages, it is negative but statistically significant at 10 percent level. Percentage of area under LDO restrictions on the other hand has no statistically significant effect

on skilled services (mainly public administration).²⁰ The magnitude of the estimated coefficients implies largest negative effect of LDO on agricultural wages, followed by manufacturing wages. The results in Table 4 suggest a statistically significant and negative effect of travel time to nearest city of 100 thousand or more population only for agricultural wages. The results suggest a positive and statistically significant effect of interaction of area under LDO and travel time for agricultural and manufacturing wages. In the case of agricultural and manufacturing wages, the overall effect of share of land under LDO thus depends on access to large urban centers and vice versa. The interaction effect implies a larger negative effect of LDO in locations with better access to urban centers. The effects of distance are smaller in locations with higher LDO land lease. In other words, wages are lower in a location with higher proportion of land under LDO compared with another location that is equidistant from urban center but has lower proportion of land under LDO. Similarly, wages are higher in location which is closer to large urban center, but has same amount of land under LDO lease as another location farther away.

Compared with the OLS results in Table A.2, the magnitude of effect of LDO is larger in the IV estimates. The OLS estimates would be biased downward if land under LDO has better agricultural potential. The evidence on land quality in Table 3 does suggest that to be the case: provinces with higher potential for paddy production are also provinces with larger share of land under LDO leases.

Several individual and household level variables are statistically significant in the regressions. The results indicate a premium for education in all activities. The premium is largest in skilled services, followed by manufacturing. The education premium is only slight in the case of agriculture. Male workers earn a considerable premium in all types of activities. Earning also increases with age though only in skilled services activities. Among ethnicity variables, Indian Tamils tend to earn a premium in agricultural wage work but earn less in skilled services activities. As expected, urban dummy has a significant and positive coefficient in manufacturing and services wages. Various land quality dummies

²⁰Note also that public service wages may not respond to local conditions as they are set by the central government.

have also statistically significant effect on agricultural wages.

4.2 Employment choice

The estimates from the conditional multinomial logit model is reported in Table 5. The base category is self employment in agriculture. For the multinomial logit estimation, first we constructed the indicator for η_{jk} using residuals from the three wage regressions reported above. For self employment, we do not have any income reported at the individual level but used household level data to generate the residuals. These regressions are reported in appendix Table A.3. The residuals are stacked in a vector η_k which is then used as control function in the multinomial logit estimation.

The estimation results in Table 5 show that compared with self-employment in farming, an increase in percentage of land under LDO leases reduces the likelihood of employment in all types of non-farm activities. An increase in travel time to urban centers also reduces log-odds of participation in all types of non-farm activities relative to farming. The interaction of percentage of area under LDO leases and distance to urban centers has a positive and statistically significant coefficient in the case of wage employment in manufacturing and skilled services. In contrast with non-farm employment, the log-odds of participation in agricultural work compared with self-employment in farming is not influenced significantly by percentage of land under LDO or travel time.

The logit coefficients in Table 5 do not reflect the way probability of participation in an activity responds to a change in an explanatory variable. To measure the magnitudes of these responses, we estimate the marginal effects which are reported in Table 6. The marginal effects are evaluated at the mean of the explanatory variables. The estimates of the marginal effects (Table 6) imply a significant negative impact of area under LDO on the probability of participation in nearly all types of non-agricultural employment (except for unskilled services activities). For wage employment in manufacturing and skilled services and self employment in non-farm activities, the probabilities of participating in these activities decline with an increase in land under LDO restrictions. The

interaction effect is however positive and statistically significant at 5 percent level for skilled services and 10 percent level for manufacturing and self employment in non-farm activities. The positive interaction effect implies that the impact of LDO is more negative at locations which have better market access. In the remoter places, LDO restrictions have much smaller effect. Similarly, the probability of participation in wage employment in manufacturing and skilled services declines with an increase in distance from major urban centers. The effect is negative for self employment, but it is not estimated with statistical precision. In the case of manufacturing and skilled services, the total effect of distance depends on the extent of LDO restrictions. Distance's impact on the probability of having employment in manufacturing and skilled services is moderated in areas with higher LDO restrictions. For self employment in non-farm activity, marginal effects of distance or its interaction with LDO are not statistically significant when they are evaluated at the mean of all explanatory variables. This finding is not surprising as several studies also reported more even distribution of unskilled services activities in rural areas [Foster and Rosenzweig, 2004; Deichmann, Shilpi and Vakis, 2009].

In contrast with non-farm employment, the marginal effects of LDO restrictions and distance on the probability of participation in agricultural wage work are positive. These marginal effects are also estimated with high statistical precision (p-value less than 0.01). The result implies that participation in agricultural wage labor is higher in areas with higher LDO restrictions. The same is true for self-employment in agriculture (though marginal effects are not shown in Table 6). The higher incidence of agricultural wage labor may be due to lease restrictions embedded in the LDO leases though village level case studies uncover considerable informal leasing of LDO land (World Bank, 2008).

As probability of being employed in a sector is also sensitive to values of the explanatory variables, we estimate the predicted probability of participation in different alternatives for a range of values of percentage of area under LDO restrictions. Figures 2a and 2b plot these predicted probabilities which are estimated for different values of area under LDO while holding other variables constant

at their mean. The predicted probability declines consistently with an increase in percentage of area under LDO leases for all categories of non-farm employment except unskilled services (Figure 2a). In contrast, probabilities of being self-employed in farming and agricultural wage work increase consistently with an increase in the share of area under LDO leases (Figure 2b). Figure 2a thus confirms the significant negative marginal effects of LDO on participation in all types of non-farm activities (except for unskilled services) reported in Table 6. The positive marginal effect of LDO on agricultural wage work is also confirmed by Figure 2b.

As to other explanatory variables for the employment choice, education improves the probability of participation in self employment and skilled services activities and reduces it in all other cases (Table 6). Male workers have lower probability of being employed in agricultural wage labor or manufacturing (which is dominated by female garment workers). The ethnicity variables are also statistically important in determining participation in different sectors. The results also show that control function term is statistically significant for all alternatives. This implies that unobserved location attributes are important in determining the substitution probability among alternatives. The comparison with simple multinomial logit reported in appendix Table A.5 shows that ignoring the impact of unobserved location specific heterogeneity would result in underestimating the adverse impact of LDO on self employment in non-agriculture and overestimating it for employment in manufacturing and skilled services activities.

4.3 Robustness Check

In this section, we report some results from the robustness check. The multinomial logit model estimated above assumes that substitution probabilities across alternatives are constant and that there is no correlation in utility over alternatives. We relax this assumption and estimate the following specification of utility that includes an alternative specific error component:

$$u_{ijk} = \gamma_0 + \gamma_1\theta_k + \gamma_2d_{kh} + \gamma_3\theta_kd_{kh} + \gamma_4E_k + \gamma_5Z_{ijk} + \gamma_6\eta_{jk} + \sigma\omega_iC_j + \varepsilon_{ijk} \quad (8)$$

where C_j is a dummy which takes a value of one if alternative is j and zero otherwise, ω is an iid standard normal covariate and σ is the standard deviation of this error component. Note that this parsimonious specification assumes all other regression coefficients to be fixed. Equation (8) is estimated using the standard mixed logit estimation routine which relies on numerical simulation (Train, 2009). For the simulation, ω is drawn from standard normal density, the logit formula is calculated for this draw. The process is repeated for 50 draws, and the results are average of these draws. To improve accuracy, we use Halton (1960) draws instead of independent random draws.²¹

The marginal effects from the mixed logit estimation are presented in Table 7. The standard deviation of the error component is statistically significant for all alternatives except for skilled services. With the exception of skilled services, the standard deviation has a positive coefficient. This suggests that heterogeneity in workers' preference for an alternative is statistically important for most cases. The estimates of the marginal effects of percentage of area under LDO restrictions on the probability of choosing self employment in non-agriculture or wage employment in manufacturing and skilled services are all negative and statistically significant at 5 percent or less. The opposite is true for wage employment in agriculture. Comparison of the marginal effects reported in Table 6 shows that mixed logit estimation produced slightly larger marginal effects in absolute value. The same is true for the marginal effects of travel time and its interaction with area under LDO leases. As expected, the standard errors in mixed logit estimation are somewhat larger than those in multinomial logit estimation. But the magnitudes of the estimates suggest that allowing correlation among alternatives reinforces the overall conclusions from the simple multinomial logit model. Because of the computation difficulty in the estimation of mixed logit model, in the following, we revert back to simple logit

²¹Bhat (2001) found that 100 Halton draws perform better than 1000 independent random draws.

estimation.

The regression in Tables 5 did not include a dummy for urban areas, whereas all wage regressions in Table 4 included it. The urban dummy could not be included as agricultural employment is not present in urban areas. The upper panel in Table 8 reports results from regressions when urban areas are dropped from the sample. The results indicate even stronger adverse effect of LDO on manufacturing and self-employment in non-farm activities. The interaction effects of LDO with distance are more precisely estimated for non-farm self employment and manufacturing employment. The overall results discussed earlier remains unchanged.

We also explore if our results are driven by employment composition in Colombo district which achieved greater specialization and has much less land under LDO leases. The results are shown at the lower panel of Table 8. Comparison with Table 6 shows that the qualitative results remain remarkably unchanged. Percentage of area under LDO has an adverse effect on all types of non-farm activities except for unskilled services and the interaction effect is significant for manufacturing and skilled services. This comparison of results from this truncated sample with that of full sample confirms that district level fixed effect are indeed capturing much of the locational sorting of activities and the results are not sensitive to the exclusion of Colombo district where a large fraction of manufacturing and services activities are clustered.

We also re-estimated wage regressions after dropping Colombo district from our sample. The results are reported in Table 9. The results from this sample show significant negative effect of LDO on agricultural and manufacturing wages which are consistent with results reported in Table 4. The results also confirm that LDO's adverse effect is larger in areas near urban centers. The results with regard to proximity of urban centers are also similar to those found in Table 4.

The results from wage and employment regressions suggest that areas with higher LDO leases not only have larger proportion of people dependent on agricultural wage labor but they tend to earn less per unit of labor. Employment in these locations is less diversified towards non-farm activities in

manufacturing and skilled services, but those employed in non-farm also earn much less on average. These results are quite remarkable as we already control for much of agglomeration externalities related to urbanization and increased density through district level fixed effect. The regressions also controls for differences in service provision as well as overall endowment of resources across districts. As already pointed out, the fixed effect regressions utilize only within district variations in dependent and explanatory variables, and thus are likely to provide the lower bound estimates of the effect of market access in particular.

5 Conclusions

A large body of literature on land markets documented the effects of restrictions on land market transactions on agricultural productivity, incentive to make agricultural investment and access to credit. Only a small number of recent papers looked at the possible labor market impacts of land restrictions (Hayashi and Prescott, 2008; Field, 2007). None of the papers have examined the impact of land market restrictions on employment pattern and labor market integration across a large number of areas in a country. In this paper, we examine these issues in the context of Sri Lanka.

Under the Land Development Ordinance (LDO) leases, private farmers in Sri Lanka can cultivate publicly-owned land in perpetuity. But these leases come with restrictions on subdivision, inheritance, leasing, mortgage and sales. As LDO leases co-exist with fully privately owned and cultivated agricultural land in an area, we utilize the spatial variations in the incidence of LDO leases to tease out its impact on employment pattern and wages.

The empirical estimation in this paper utilizes a three-stage structural estimation procedure suggested by Petrin and Train (2007). At the first two-stages, an instrumental variable approach is utilized to estimate the wage equations. In addition to including a district level fixed effect, the wage regressions control for own area physical geographical characteristics. Physical characteristics of other

areas in the district are then used as identifying instruments. At the final stage, residuals of the wage regressions are used to define a control function term for the estimation of the employment choice regression.

The empirical analysis using the HIES 2002 data from Sri Lanka shows that an increase in the incidence of LDO leases is associated with lower employment diversification out of agriculture. Areas with higher percentage of land under LDO have disproportionately more people dependent on agricultural wage labor. The non-farm self- and wage employment also decline with an increase in the share of LDO land. An outcome of a lack of non-farm employment is that wages for all types of workers have been depressed in the areas with higher incidence of LDO leases. Thus, while LDO leases have created a middle class peasantry in Sri Lanka due to generous public investment in irrigation and other infrastructure, it seems to have contributed to lowering the income prospects of the poorest of the poor in the rural areas, namely the agricultural workers.

A recent review of the land markets in Sri Lanka finds that privately owned land commands a premium of 15 to 25 percent over LDO land in the same village (World Bank, 2008). Despite restrictions on land leasing and mortgages, village level studies also find evidence of high incidence of informal leases and mortgages. The findings in this paper suggest that labor markets across areas remain poorly integrated, depressing wages in areas with higher incidence of LDO leases. Moreover, employment pattern is less diversified in areas with higher share of LDO leases. We also find that the adverse effect of LDO leases are larger in areas with better access to urban markets. These findings are consistent with Hayashi and Prescott's (2008) argument that mobility barriers embedded in land sales restrictions can lead to misallocation of labor across activities and persistent gaps in incomes across areas.

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Table 1: Sectoral Employment Composition in Sri Lanka

Provinces	Self-Employment			Wage Employment		
	Agriculture	Non-		Manu- facturing	Services	
		Agriculture	Agriculture		Unskilled	Skilled
	(%)	(%)	(%)	(%)	(%)	(%)
Western	6.2	17.5	5.6	23.8	15.6	31.4
Central	15.0	14.2	20.2	12.8	15.6	22.3
Southern	17.4	15.6	20.2	16.2	10.2	20.4
North-West	17.4	16.4	13.2	19.1	14.8	19.2
North-Central	29.0	13.8	18.2	7.8	9.9	21.2
Uva	31.0	9.0	32.2	5.6	8.9	13.4
Sabaragamuwa	17.7	13.0	22.1	13.4	15.5	18.3
Sri Lanka	15.9	14.9	16.4	16.2	13.7	22.9

Source: HIES 2002

Table 2: Regional Distribution of Wages and Per Capita Income

province	Real Annual Wage				Per Capita Household Income
	Agriculture	Manu- facturing	Services	Unskilled	
	Rs	Rs	Rs	Rs	
Western	32236	75059	59936	106647	4432
Central	31186	54060	43685	90751	3213
Southern	29353	54995	43754	93277	3371
North-West	32707	58429	41068	96692	3405
North-Central	35554	62208	45343	95242	3235
Uva	27900	64042	35559	86723	2727
Sabaragamuwa	26273	49560	34676	81734	2317
Sri Lanka	30049	63885	47068	97153	3453

Source: HIES 2002

Table 3: Selected Indicators

Province	% of Population with			% of agri. Area under LDO lease	Travel time To Urban Centers (hour)	% of land suitable for Paddy production	
	Secondary Education	Access to Phone	Cell Phone			Good	Moderate
Western	0.15	0.35	0.24	0.05	0.80	0.02	0.38
Central	0.10	0.10	0.10	0.08	2.13	0.03	0.09
Southern	0.12	0.10	0.10	0.11	3.68	0.05	0.19
N. Western	0.10	0.13	0.14	0.09	2.02	0.57	0.10
N. Central	0.09	0.09	0.07	0.31	3.95	0.81	0.04
Uva	0.08	0.07	0.04	0.19	4.70	0.07	0.15
Sabaragamuwa	0.10	0.07	0.08	0.08	3.49	0.04	0.07

Table 4: Market Access, Land Tenure Arrangement and Income:
Fixed Effect IV Regression Results

	Log(Real Annual wage)			
	Agriculture	Manufacturing	Unskilled Serv.	Skilled Serv.
% Area Under LDO	-2.538 (5.22)***	-1.383 (2.68)***	-1.162 (1.94)*	0.071 (0.12)
Travel Time to Large City	-0.192 (5.80)***	-0.034 (1.34)	-0.038 (1.02)	0.003 (0.16)
Area LDO*Travel Time	0.497 (4.93)***	0.496 (2.98)***	0.364 (1.43)	-0.075 (0.37)
Log(Age)	-0.034 (0.87)	-0.029 (0.73)	-0.085 (2.08)**	0.420 (12.49)***
Male	0.224 (10.89)***	0.396 (16.91)***	0.345 (11.10)***	0.146 (8.83)***
Education Level (yr)	0.010 (3.27)***	0.076 (21.84)***	0.057 (16.98)***	0.093 (28.56)***
Married	0.062 (2.37)**	0.167 (6.77)***	0.156 (5.97)***	0.185 (8.63)***
SLTamil (yes=1)	0.045 (1.12)	0.067 (1.31)	-0.018 (0.39)	0.028 (0.65)
IndTamil (yes=1)	0.098 (2.41)**	0.076 (0.99)	0.053 (0.97)	-0.132 (2.04)**
SLMoor (yes=1)	0.124 (1.54)	0.003 (0.05)	0.103 (2.95)***	-0.059 (1.65)*
Agricultural Area of the DSD	2.433 (0.56)	-5.294 (2.19)**	-7.783 (2.81)***	-1.767 (0.61)
Inland Water Available	0.216 (3.00)***	0.035 (0.96)	0.024 (0.45)	0.018 (0.63)
Estate (yes=1)	0.038 (1.21)	-0.064 (0.79)	-0.039 (0.69)	-0.037 (0.76)
Urban (yes=1)		0.159 (5.45)***	0.173 (4.87)***	0.121 (6.12)***
Elevation (median)	-0.0001 (0.89)	0.0001 (0.85)	0.0004 (2.89)***	-0.0001 (1.76)*
Observations	3116	3609	3056	5110
District Fixed Effect	Yes	Yes	Yes	Yes
Under Identification Test				
LM Statistics	85.60	53.89	50.5	32.45
P-Value	0.00	0.00	0.00	0.00
Hansen's J Statistics	3.64	0.03	3.1	0.28
P-Value	0.16	0.88	0.21	0.6
Weak ID (Kleibergen-Paap)	16.35	17.52	12.69	8.95
Stock-Yogo 5% Max IV rel. bias	9.53	9.53	9.53	9.53
First Stage Regression (Relevance of Instruments)				
% Area Under LDO Equation				
F-stat (P-value)	815 (0.00)	888(0.00)	696(0.00)	1146(0.00)
Travel Time to Large City Eq				
F-stat	30.4 (0.00)	18.8(0.00)	21.0(0.00)	28.1(0.00)
Area LDO*Travel Time Eq				
F-stat	275.2(0.00)	170.6(0.00)	80.4(0.00)	129.1(0.00)

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

*Regressions for Agriculture and Unskilled Services included controls for land quality (good, moderate, marginal).

Table 5: Employment Choice, Access to Market and Land Restrictions
Conditional Multinomial Logit Regression

	Self-employ.		Wage employment in		
	Non-Agriculture	Agriculture	Manufacturing	Unskilled Serv.	Skilled Serv.
% Area Under LDO	-3.810*** (-6.395)	-0.778 (-1.273)	-3.818*** (-6.189)	-2.786*** (-3.840)	-4.355*** (-7.289)
Travel Time to Large City	-0.131*** (-2.970)	0.001 (0.030)	-0.223*** (-5.787)	-0.118*** (-3.223)	-0.182*** (-5.642)
Area LDO*Travel Time	0.161 (1.031)	-0.126 (-0.746)	0.346** (2.092)	-0.103 (-0.534)	0.336** (2.404)
Log(Age)	-1.154*** (-9.673)	-2.119*** (-17.493)	-2.987*** (-25.333)	-2.081*** (-17.509)	-1.559*** (-13.739)
Male	0.642*** (8.958)	0.214*** (3.021)	0.355*** (5.075)	1.063*** (14.190)	0.389*** (5.815)
Education Level (yr)	0.106*** (12.602)	-0.122*** (-13.906)	0.034*** (3.680)	-0.050*** (-5.332)	0.385*** (28.083)
Married	0.154* (1.919)	-0.013 (-0.159)	-0.198*** (-2.771)	-0.412*** (-5.214)	0.090 (1.229)
Log(Household Size)	0.122 (1.604)	-0.174** (-2.252)	0.013 (0.183)	-0.051 (-0.654)	0.170** (2.320)
Share of Kids (0-9 yr)	0.471*** (2.938)	1.125*** (6.497)	0.403** (2.514)	0.564*** (3.167)	0.311** (1.968)
Share of Young (10-15 yr)	0.511*** (2.604)	0.804*** (3.962)	0.805*** (4.102)	0.688*** (3.334)	-0.146 (-0.731)
SLTamil (yes=1)	1.096*** (4.137)	1.087*** (4.286)	0.730*** (2.707)	1.498*** (5.795)	1.022*** (3.610)
IndTamil (yes=1)	0.962*** (3.782)	1.582*** (5.244)	0.719*** (2.694)	1.577*** (6.240)	0.834*** (2.921)
SLMoor (yes=1)	1.717*** (7.879)	0.553** (2.549)	0.321 (1.317)	1.548*** (6.751)	0.560** (2.563)
Estate (yes=1)	-1.115*** (-5.141)	1.948*** (9.511)	-0.342 (-1.337)	0.131 (0.621)	0.303 (1.132)
Residual	0.167*** (3.243)	-0.176*** (-3.364)	-0.097** (-2.059)	-0.114** (-2.326)	-0.131*** (-2.879)
Constant	5.027*** (9.400)	9.000*** (15.854)	13.265*** (25.024)	9.976*** (18.939)	4.613*** (8.796)
District Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	22323	22323	22323	22323	22323

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Base category: Self Employment in agriculture

Table 6: Employment Choice, Access to Market and Land Restrictions
Marginal Effects from Conditional Multinomial Logit Regression

	Self-employ.		Wage employment in		
	Non-Agriculture	Agriculture	Manufacturing	Unskilled Serv.	Skilled Serv.
% Area Under LDO	-0.178 (2.83)***	0.263 (4.14)***	-0.190 (2.72)***	0.009 (0.11)	-0.286 (4.19)***
Travel Time to Large City	-0.002 (0.33)	0.016 (4.38)***	-0.020 (3.93)***	0.001 (0.17)	-0.011 (3.22)***
Area LDO*Travel Time	0.006 (0.35)	-0.032 (1.76)*	0.043 (1.94)*	-0.039 (1.81)*	0.040 (2.47)**
Log(Age)	0.102 (8.33)***	-0.052 (5.03)***	-0.247 (20.57)***	-0.063 (5.50)***	0.029 (2.65)***
Male	0.032 (4.10)***	-0.033 (5.47)***	-0.022 (3.03)***	0.102 (12.92)***	-0.015 (2.34)**
Education Level (yr)	0.006 (5.79)***	-0.025 (23.15)***	-0.008 (6.76)***	-0.021 (18.50)***	0.058 (46.85)***
Married	0.040 (4.61)***	0.007 (0.91)	-0.026 (3.44)***	-0.059 (7.55)***	0.029 (3.85)***
Log(Household Size)	0.018 (1.96)**	-0.026 (3.30)***	-0.002 (0.28)	-0.013 (1.49)	0.027 (3.18)***
Share of Kids (0-9 yr)	0.001 (0.08)	0.084 (5.29)***	-0.012 (0.65)	0.017 (0.87)	-0.029 (1.66)*
Share of Young (10-15 yr)	0.012 (0.54)	0.046 (2.41)**	0.070 (2.98)***	0.042 (1.79)*	-0.111 (4.56)***
SLTamil (yes=1)	0.030 (1.56)	0.020 (1.02)	-0.039 (1.83)*	0.097 (5.55)***	0.017 (0.79)
IndTamil (yes=1)	0.003 (0.12)	0.081 (3.10)***	-0.044 (1.65)*	0.108 (4.65)***	-0.021 (0.72)
SLMoor (yes=1)	0.165 (10.98)***	-0.034 (1.55)	-0.097 (4.58)***	0.125 (7.88)***	-0.049 (3.05)***
Estate (yes=1)	-0.215 (8.54)***	0.241 (11.48)***	-0.077 (2.50)**	0.013 (0.56)	0.046 (1.44)
Residual	0.041 (6.55)***	-0.015 (3.45)***	-0.008 (1.88)*	-0.010 (2.29)**	-0.014 (3.58)***
Constant	-0.403 (8.12)***	0.226 (4.50)***	1.172 (22.19)***	0.472 (9.66)***	-0.492 (10.88)***
District Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	22323	22323	22323	22323	22323

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Base category: Self Employment in agriculture

Marginal Effects are evaluated at the mean of explanatory variables

Table 7: Employment Choice, Access to Market and Land Restrictions
Marginal Effects from Mixed Logit Estimation

	Self-employ.		Wage employment in		
	Non-Agriculture	Agriculture	Manufacturing	Unskilled Serv.	Skilled Serv.
% Area Under LDO	-0.217 (2.25)**	0.437 (3.45)***	-0.221 (2.04)**	-0.03 (0.20)	-0.411 (2.89)***
Travel Time to Large City	-0.004 (0.57)	0.026 (4.02)***	-0.021 (3.04)***	-0.002 (0.27)	-0.018 (2.30)**
Area LDO*Travel Time	0.016 (0.62)	-0.057 (1.61)	0.046 (1.58)	-0.051 (1.39)	0.062 (1.89)*
Standard Dev. Of Error Component	0.183 (4.97)***	0.156 (12.64)***	0.065 (6.15)***	0.172 (11.92)***	-0.06 (1.01)

* significant at 10%; ** significant at 5%; *** significant at 1%

Marginal Effects are evaluated at the mean of explanatory variables

Table 8 : Robustness Check for Employment Choice
Marginal Effects from Conditional Multinomial Logit Regression

	Self-employ.		Wage employment in		
	Non-Agriculture	Agriculture	Manufacturing	Unskilled Serv.	Skilled Serv.
Excluding Colombo district					
% Area Under LDO	-0.227 (3.74)***	0.279 (3.75)***	-0.248 (3.68)***	-0.013 (0.16)	-0.254 (4.20)***
Travel Time to Large City	-0.004 (0.77)	0.017 (4.04)***	-0.021 (4.38)***	-0.001 (0.29)	-0.010 (3.37)***
Area LDO*Travel Time	0.014 (0.79)	-0.035 (1.63)	0.047 (2.30)**	-0.039 (1.84)*	0.032 (2.22)**
No. of Observations	19649	19649	19649	19649	19649
Excluding Urban Areas					
% Area Under LDO	-0.265 (3.57)***	0.294 (3.93)***	-0.270 (3.88)***	0.036 (0.45)	-0.232 (3.89)***
Travel Time to Large City	-0.012 (1.99)**	0.017 (3.97)***	-0.019 (4.05)***	0.002 (0.65)	-0.005 (1.60)
Area LDO*Travel Time	0.030 (1.49)	-0.038 (1.74)*	0.044 (2.14)**	-0.047 (2.22)**	0.023 (1.76)*
No. of Observations	19250	19250	19250	19250	19250

* significant at 10%; ** significant at 5%; *** significant at 1%

Marginal Effects are evaluated at the mean of explanatory variables

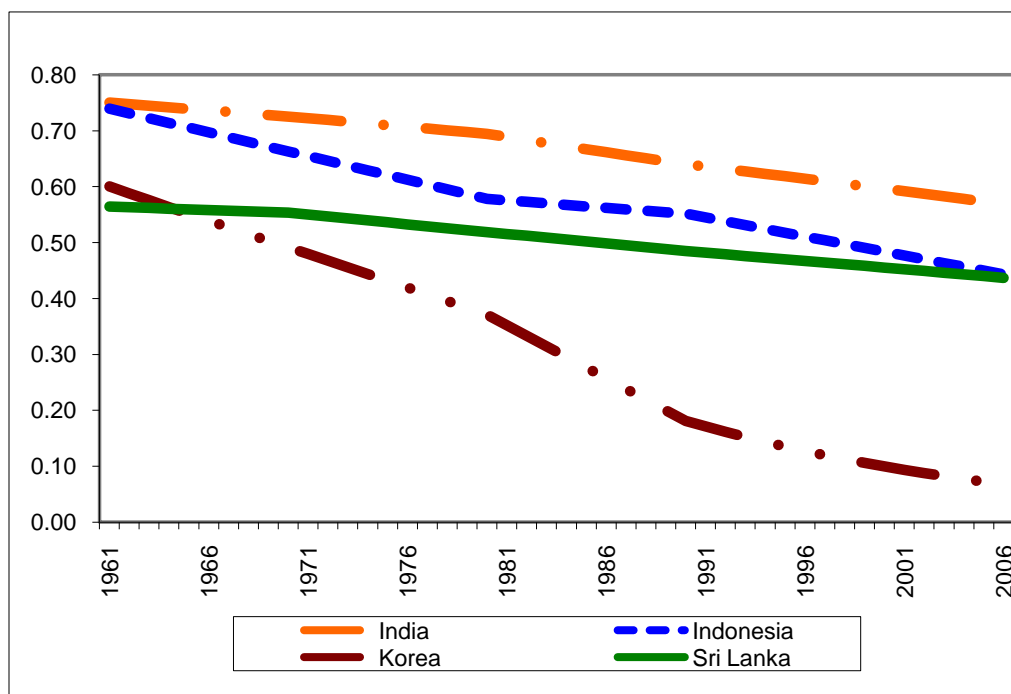
Table 9: Market Access, Land Tenure Arrangement and Income
Fixed Effect IV Regression Results (Excluding Colombo District)

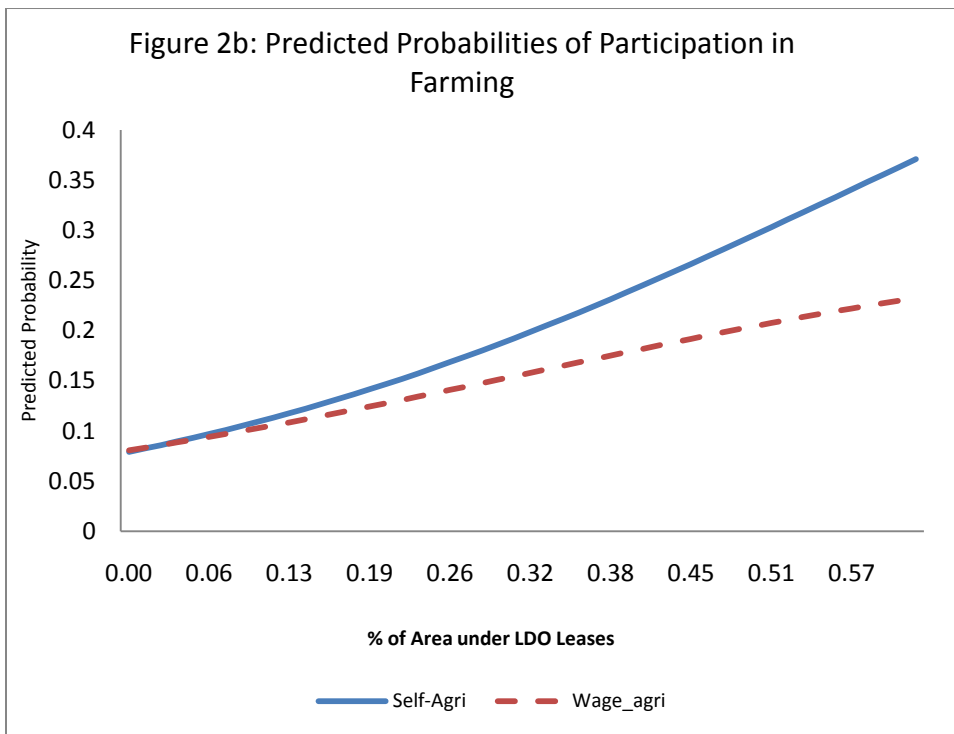
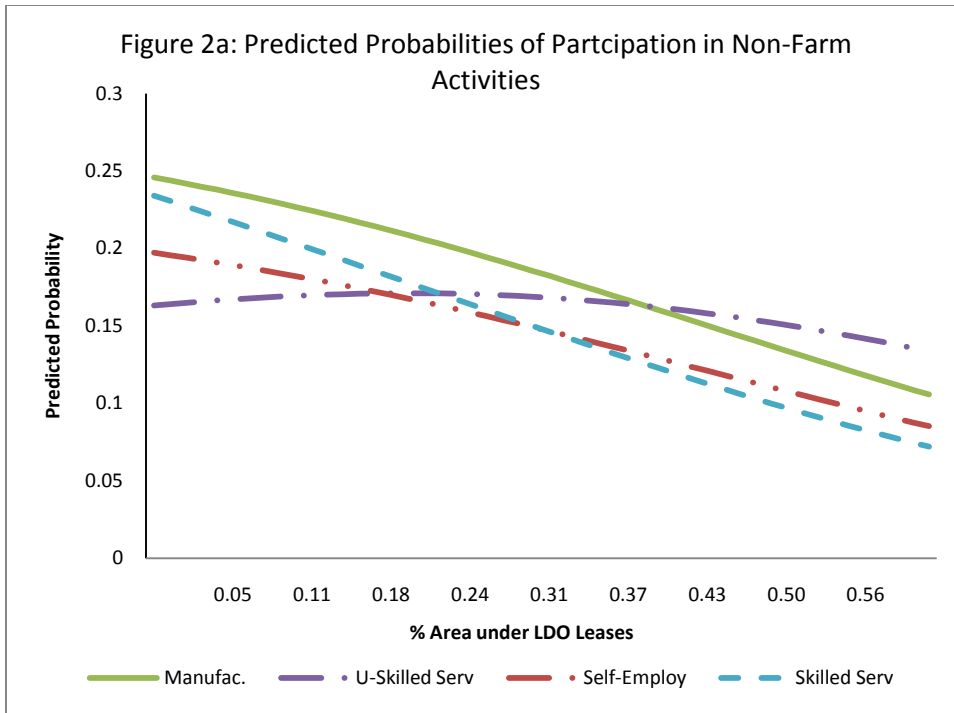
	Log(Real Annual wage)			
	Agriculture	Manufacturing	Unskilled Serv.	Skilled Serv.
% Area Under LDO	-2.469 (5.11)***	-1.131 (2.08)**	-0.890 (1.42)	0.253 (0.58)
Travel Time to Large City	-0.186 (5.69)***	-0.034 (1.37)	-0.024 (0.64)	0.078 (1.10)
Area LDO*Travel Time	0.479 (4.78)***	0.402 (2.33)**	0.208 (0.79)	-0.143 (0.96)
Observations	3072	3032	2585	4097

Robust z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Figure 1: Agriculture's share in total employment in selected countries





Appendix A: Land Development Ordinance

The present land tenure system has been the outcome of colonial laws and its subsequent amendments. The Crown Lands Encroachment Ordinance of 1840 transferred all lands without private title—forests, waste, unoccupied or uncultivated land -- to state. An outcome of the Ordinance was that local population, accustomed to exercising traditional claims on territory were classified as encroachers on lands that had previously been open and unoccupied. The new Crown lands were also sold and/or leased out to the individuals. As result, prime lands, especially those in the wet zone, were quickly bought up by those who most afford it: namely British planters, government officials and rich merchants from Colombo and other coastal areas. The Ordinance thus created a class of poor peasantry in rural areas who could not afford to purchase Crown Lands and who found themselves barred from exercising their traditional rights on communal land.

The Land Development Ordinance (LDO) of 1935 initiated a program of making government-owned agricultural land available for private household use. The original objectives of the LDO were to protect the interests of the peasantry and to encourage economic development. The State introduced a system of protected tenure under which the recipients of LDO land had the right to occupy and cultivate the land in perpetuity subject to restrictions imposed on sale, leasing and mortgaging, and conditions related to abandoning or failing to cultivate the land.

With various amendments over time, some the restrictions on succession, mortgage have been weakened. Today the grant provides a clear title but denies the owner the right of freely disposing of the land as is possible in the case of privately owned land. The restrictions on LDO lands now consist of the following:

- The land cannot be sold or disposed of except with the prior consent of an authorized Government Agent.
- The land can be mortgaged but only to selected financial institutions (public) stipulated by the Government.
- The allottee cannot lease or sub-lease the land, except in cases of extenuating circumstances, such as illness, and then only for up to one year.
- The allottee cannot dispose of a portion of the land, which is less in extent than the prescribed minimum unit of subdivision.
- The allottee cannot dispose of the land or a part of it that would lead to co-ownership.
- Transferability of land is restricted to persons belonging to the same class with the prior approval of the Government Agent.

Appendix Table A.1: Summary Statistics

	mean	maximum	minimum
Log(Age)	3.637	4.2	3.0
Male	0.685	1.0	0.0
Education Level (yr)	8.291	16.0	0.0
Married	0.764	1.0	0.0
Log(Household Size)	1.460	2.9	0.0
Share of Kids (0-9 yr)	0.154	0.8	0.0
Share of Young (10-15 yr)	0.089	0.8	0.0
SLTamil (yes=1)	0.049	1.0	0.0
IndTamil (yes=1)	0.059	1.0	0.0
SLMoor (yes=1)	0.056	1.0	0.0
Agricultural Area	0.012	0.0	0.0
Elevation (meter)	248.708	1702.0	7.0
Land quality (% marginal)	0.579	1.0	0.0
Land Quality (% moderate)	0.185	1.0	0.0
Land Quality (% Good or better)	0.130	1.0	0.0
% land with Inland Water	0.259	1.0	0.0
Estate (yes=1)	0.086	1.0	0.0
Urban (yes=1)	0.133	1.0	0.0
% Area Under LDO	0.099	0.6	0.0
Travel Time to Large City (hour)	2.363	15.2	0.0
Area LDO*Travel Time	0.360	4.9	0.0

Table A.2: Market Access, Land Tenure Arrangement and Income:
Fixed Effect OLS Regression Results

	Log(Real Annual wage)			
	Agriculture	Manufacturing	Unskilled Serv.	Skilled Serv.
% Area Under LDO	-0.949 (1.70)	-0.233 (0.70)	-0.580 (1.86)*	-0.080 (0.42)
Travel Time to Large City	-0.042 (2.22)**	-0.026 (1.37)	-0.055 (4.69)***	-0.018 (1.83)*
Area LDO*Travel Time	0.203 (1.90)*	0.083 (0.94)	0.161 (2.45)**	-0.008 (0.16)
Log(Age)	-0.045 (1.23)	-0.029 (0.42)	-0.090 (1.93)*	0.420 (7.65)***
Male	0.232 (7.89)***	0.390 (11.98)***	0.343 (8.32)***	0.146 (9.00)***
Education Level (yr)	0.012 (2.89)**	0.076 (10.60)***	0.057 (7.29)***	0.093 (17.99)***
Married	0.053 (1.61)	0.166 (4.71)***	0.158 (4.42)***	0.184 (7.69)***
SLTamil (yes=1)	0.073 (1.16)	0.066 (1.65)	-0.015 (0.33)	0.028 (0.46)
IndTamil (yes=1)	0.197 (2.34)**	0.054 (0.91)	0.053 (0.74)	-0.130 (1.36)
SLMoor (yes=1)	0.127 (1.04)	-0.016 (0.16)	0.093 (1.78)*	-0.059 (1.53)
Area of the DSD	-9.217 (2.74)**	-4.085 (1.34)	-6.143 (2.01)*	-1.191 (0.60)
Inland Water Available	-0.067 (1.07)	0.046 (0.96)	0.045 (0.91)	0.031 (0.73)
Estate (yes=1)	0.066 (0.97)	-0.044 (0.44)	-0.029 (0.61)	-0.038 (0.46)
Urban (yes=1)		0.160 (2.92)***	0.167 (3.97)***	0.116 (3.54)***
Elevation (median)	0.000 (0.19)	-0.000 (0.28)	0.000 (2.14)**	-0.000 (1.16)
Land quality (marginal)	-0.211 (1.94)*		-0.206 (1.77)*	
Land Quality (moderate)	-0.069 (0.83)		-0.021 (0.19)	
Land Quality (Good or better)	-0.308 (1.82)*		0.272 (1.58)	
Observations	3116	3609	3056	5110
District Fixed Effect	Yes	Yes	Yes	Yes

Table A.3: Market Access, Land Tenure Arrangement and Household Income:
Fixed Effect IV Regression Results

	(Real per capita household income)	
	Agriculture	Non-farm Enterprise
% Area Under LDO	-3.872 (4.09)***	-6.068 (2.57)**
Travel Time to Large City	-0.115 (4.77)***	-0.043 (0.77)
Area LDO*Travel Time	1.479 (4.98)***	1.777 (2.32)**
Log(Age)	0.013 (0.27)	0.118 (1.90)*
Male	0.010 (0.38)	0.287 (7.37)***
Education Level (yr)	0.004 (1.14)	0.070 (13.08)***
Married	-0.000 (0.01)	0.107 (2.41)**
Log(Household Size)	0.076 (2.14)**	-0.361 (8.57)***
Share of Kids (0-9 yr)	0.009 (0.13)	0.669 (6.57)***
Share of Young (10-15 yr)	0.152 (1.68)*	0.581 (4.64)***
SLTamil (yes=1)	0.037 (0.29)	0.011 (0.13)
IndTamil (yes=1)	0.186 (1.69)*	-0.206 (1.73)*
SLMoor (yes=1)	0.305 (3.03)***	0.431 (7.66)***
Area of the DSD	-29.225 (7.40)***	-15.944 (3.68)***
Inland Water Available	0.113 (2.46)**	0.128 (1.69)*
Estate (yes=1)	0.305 (3.47)***	-0.318 (2.19)**
Urban (yes=1)		-0.224 (3.61)***
Elevation (median)	0.001 (10.29)***	0.000 (1.06)
Land quality (marginal)	0.483 (4.37)***	-0.036 (0.64)
Land Quality (moderate)	0.528 (4.46)***	
Land Quality (Good or better)	0.052 (0.44)	
Observations	8023	5660
District Fixed Effect	Yes	Yes

Table A.4: Employment Choice, Access to Market and Land Restrictions
Marginal Effects from Multinomial Logit Regression

	Self-employ.		Wage employment in		
	Non-Agriculture	Agriculture	Manufacturing	Unskilled Serv.	Skilled Serv.
% Area Under LDO	-0.088 (1.37)	0.228 (3.70)***	-0.208 (3.04)***	-0.015 (0.18)	-0.315 (4.78)***
Travel Time to Large City	0.000 (0.03)	0.015 (4.17)***	-0.020 (4.02)***	0.000 (0.06)	-0.012 (3.37)***
Area LDO*Travel Time	-0.019 (1.02)	-0.022 (1.27)	0.048 (2.21)**	-0.033 (1.56)	0.048 (3.06)***
Log(Age)	0.101 (8.24)***	-0.051 (4.93)***	-0.246 (20.53)***	-0.062 (5.43)***	0.029 (2.68)***
Male	0.035 (4.56)***	-0.034 (5.68)***	-0.023 (3.12)***	0.101 (12.80)***	-0.017 (2.57)**
Education Level (yr)	0.006 (5.89)***	-0.025 (23.07)***	-0.008 (6.81)***	-0.021 (18.51)***	0.058 (46.54)***
Married	0.041 (4.67)***	0.007 (0.92)	-0.026 (3.47)***	-0.060 (7.59)***	0.029 (3.81)***
Log(Household Size)	0.018 (1.99)**	-0.026 (3.37)***	-0.003 (0.30)	-0.013 (1.52)	0.027 (3.20)***
Share of Kids (0-9 yr)	0.004 (0.22)	0.084 (5.29)***	-0.012 (0.68)	0.016 (0.82)	-0.030 (1.74)*
Share of Young (10-15 yr)	0.014 (0.60)	0.046 (2.43)**	0.070 (2.96)***	0.042 (1.78)*	-0.112 (4.59)***
SLTamil (yes=1)	0.031 (1.55)	0.020 (1.03)	-0.039 (1.83)*	0.097 (5.53)***	0.017 (0.78)
IndTamil (yes=1)	0.002 (0.08)	0.082 (3.12)***	-0.044 (1.64)	0.108 (4.66)***	-0.021 (0.73)
SLMoor (yes=1)	0.163 (10.66)***	-0.034 (1.54)	-0.096 (4.53)***	0.125 (7.92)***	-0.048 (2.98)***
Estate (yes=1)	-0.220 (8.58)***	0.242 (11.51)***	-0.077 (2.49)**	0.013 (0.59)	0.047 (1.47)
Constant	-0.403 (8.12)***	0.224 (4.46)***	1.167 (22.18)***	0.470 (9.62)***	-0.489 (10.79)***
District Fixed Effect	Yes	Yes	Yes	Yes	Yes
Observations	22323	22323	22323	22323	22323

Absolute value of z statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Base category: Self Employment in agriculture

Marginal Effects are evaluated at the mean of explanatory variables