Land Acquisition and Industrial Growth

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Abstract

Purpose – The paper aims to understand the impact of land acquisition and the provision of rehabilitation and remuneration (R&R) transfers included in it, towards the short-run and long-run growth of an economy as well as on the welfare of farmer and industrialist over time.

Design/methodology/approach – The authors' develop a two-sector model of growth with agriculture and manufacturing, in which land is an essential input to production in both sectors. Industrialist buys land from farmer and deals include R&R payments. Individuals live for one period and at its end bequeath land and capital assets to their child. There is Hicks-neutral technical progress in each sector.

Findings – Besides the standard convergence effect, as land is acquired by the industrial sector it increases the growth rate of capital. This may lead to non-monotonic growth rate of capital. The R&R policy has no effect on the long-run sectoral growth or land allocation. While such a policy benefits the farmers initially, after a certain time period, it reduces their welfare. The R&R scheme makes the industrialist worse-off in all time periods.

Research limitations/implications – Our model abstracts from labor and the labor market. Hence, we do not capture sectoral employment mobility or changes in skill-wage premium over time.

Originality/value – First, this paper develops a two-sector growth model with land as a factor of production and an asset. Second, it examines growth and distributive impacts of the R&R package embodied in land transactions.

Keywords – Land Acquisition; Unbalanced Growth; Overshooting; Rehabilitation and Resettlement; Agriculture, Manufacturing

Paper Type – Research Paper

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"Buy land, they are not making it anymore."
- Mark Twain

1 Introduction

The land debate is again at the forefront of Indian politics. The 'Right to Fair Compensation and Transparency' in Land Acquisition, Rehabilitation and Resettlement Act, 2013' was put into effect on 1 January 2014. The aim of this law is to "establish a humane, participative, informed and transparent process for land acquisition for industrialisation, development of essential infrastructural facilities and urbanisation with the least disturbance to the owners of the land and other affected families." The Act is primarily applicable when government acquires land (a) for its own use and control, (b) for public private partnership projects, where government continues to own the land, or (c) for private companies for public purposes. The law proposes two types of payments to landowners: (i) compensation for land acquired and (ii) rehabilitation & resettlement (R&R) payments. The mandated compensation for land is at the rate of two to four times its value in rural areas and twice the value in urban areas. The law also furnishes that for private land transactions for private purposes, the industrialist is required to provide R&R but not the enhanced compensation for land (that is (ii) but not (i)) to the farmer and other displaced people if the area of the acquired land is more than a limit specified by the appropriate government. This paper aims to understand the impact of land acquisition for private purposes, which include R&R provisions, on the growth of an economy as well as on the welfare of farmers and industrialist over time.

R&R entitlements in the law, whether attached to cases of land purchase by government or private parties, entail that the land owners or those families whose livelihood depended on the acquired land be given three types of remunerations: a set of finite-time payments, a choice of annuity or employment, and infrastructure facilities. First, the set of finite-time payments include a house, one-year subsistence allowance, transportation allowance and some specific payments for cattle-shed owners, artisans and traders. Second, the affected families may opt for training and employment in the new proposed project or an annuity for 20 years of ₹2000 per month with appropriate indexation, or a one-time payment of ₹5,00,000. Third, the infrastructural amenities include irrigation and sanitation facilities, schools, health centres, roads and electric connections, village level post offices, fair price shops, etc.

In June 2014, several state governments expressed their difficulty in procuring land due to the consent clause mandating at least 80% of the affected people agreeing to their land being acquired (Economic Times (2015)). They also complained of another provision of the law, namely the 'social impact assessment,' a study of socio-economic benefits and costs of a proposed project, which has caused delay in land acquisition. These state governments recommended that the provisions of consent clause and social impact assessment be diluted to facilitate smooth and timely land acquisitions. Based on these developments and to fulfil the industrial sector's growing need for land, the new central government in early 2015 proposed to remove the these two causes in case of land acquisition for five purposes, namely defence, rural infrastructure including electrification, industrial corridors, public private partnership projects and affordable housing. This proposed change in the Land Acquisition Act seems to make the small farmers vulnerable as they now have less room for negotiation (Makkar (2015), Indian Express (2015)). The latest debate points the merits and demerits of this proposed amendment to the rules governing land procurement (Madhavan (2015)).

This amendment will make land acquisition easier for industry. Foster and Rosenzweig (2010) calculate that about 20% of labor in agriculture sector is in surplus and these surplus workers need to find jobs in other more productive manufacturing and services sectors (also noted in Rodrik (2013)). To propel economic growth and to generate jobs, India needs manufacturing sector to grow,[1] which in turn requires vast expanse of land. This is where the Land Acquisition Act helps to structure the process of land procurement. The above arguments however do not take into consideration the practical difficulties in reallocating labor from agriculture. Factors like inability to acquire education, poor skill development and social and financial backwardness have contributed to the job market frictions and are major impediments for a farmer to get jobs in non-agriculture sectors. If the government takes away their only asset, land, without any negotiation or rendering adequate compensation and assistance it may spell disaster for their lives and will prove to be politically very costly.

Bardhan (2011) notes that as in India, land acquisition from farmers has become a contentious issue in other high-growth densely populated countries, like China, sometimes leading to political unrest and violence. German et al. (2011) present a collection of case studies from sub-Saharan Africa on land acquisition practices. They focus on four countries – Ghana, Mozambique, Tanzania and Zambia– and find that in many cases land acquisition for industry has caused upheavals in the lives of the indigenous communities. Irrespective of the differences in institutional and legal framework, they opinionate that in practice, the land acquisition process across these four countries have not adequately addressed the compensation demands of the farmers and local people.

This paper frames itself around some of the provisions of India's Land Acquisition Act, but the preceding discussion suggests that its applicability is more universal. Our paper does *not* however consider how land acquisition affects the employment mobility or how the proposed amendment of removal of consent clause and social impact assessment requirements from the Indian Land Acquisition Act would affect the economy. We also do not address whether the law would enable the farmer to participate in the industrialization process. Our focus is on the process of capital accumulation, facilitated by land acquisition and the effects of rehabilitation & resettlement (R&R) payments on growth and distribution *when the manufacturing sector acquires land from agriculture sector for private purposes.*[2]

We aim to understand the impact of land acquisition and the provision of transfers embodied in it, towards the short-run and long-run growth of an economy as well as on the welfare of farmer and industrialist over time. More specifically, this paper has three contributions: (a) develop a growth model with two sectors, agriculture and industry (or manufacturing), along with land as a traded input for production in both sectors,[3] (b) characterize the growth processes of capital and outputs and (c) examine growth and distributive impacts of the proposed R&R package.

This paper is organized as follows. A finite lifetime, two-sector growth model is developed in Section 2. We assume household-producers in each sector. In Section 3, we analyze the transitional dynamics and thereby the short-run growth effects of the R&R scheme. Distributional effects of the R&R scheme are examined in Section 4. Section 5 concludes the paper.

The main results of the paper are:

1. the R&R package does not affect the long-run growth rate of either sector or the long-run levels of land allocation between the two sectors.
2. As industrialist accumulates capital, he also purchases land from the farmer. Land acquisition by manufacturing sector, in turn, positively affects the growth rate of capital. If the initial industrial land holding is low in comparison to capital stock, then the growth rate of capital may not monotonically fall (i.e., convergence effect may not hold true). We note the possibility of the initial growth rate of capital

being sluggish (possibly negative), i.e., less than its steady-state rate, and over time, it shoots beyond the steady-state rate before declining monotonically toward the steady-state rate. This may be termed as growth overshooting of capital.

3. In the distributional side, the industrialist is worse-off in the presence of R&R scheme for all time periods. While this is expected, perhaps the most interesting finding is that there is a strong presumption that despite short run gains to farmers it will adversely affect their welfare in the long run. Put differently, the R&R scheme that is primarily motivated on the basis of protecting farmers' interest is likely to hurt them in the long run. It may happen because of the negative effect of the R&R policy on growth of industrial output, which is also essential for consumption by the farmers.

2 Model

Population of this economy is fixed. Following Aghion and Bolton (1997) and Das and Ghate (2004), individuals live for one period and have one child at the end of the period, to whom assets are passed as bequest. Bequests constitutes a person's savings. Land and capital are the two kinds of assets available. These are used to make goods, hence have an income value (yield). They are also tradeable, so they carry market prices. Apart from own consumption, a parent gains utility from the future income value of bequeathed assets, not from their market value. Hence, demand for assets is affected by their current price and income value, not price expectations or capital gains.[4]

As in Jiny and Zengz (2007), it is the households who produce goods. The economy has two representative households/individuals – farmer(s) and industrialist(s). The former produce food in the agriculture sector and the latter produce manufactures in the industrial sector. Food is produced by land only, whereas the manufactures, the numeraire good, are produced by land and capital. We abstract from labor and labor markets to avoid considerable analytical complexity, particularly if we wish to distinguish between unskilled and skilled labor – which is relevant. In the process, our focus on land acquisition and growth through capital accumulation remains in tact. Akin the literature on multi-sector growth models, such as Kongsamut et al. (2001), Gollin et al. (2007), Ngai and Pissarides (2007), each sector experiences an exogenous Hicks-neutral technical progress.

2.1 The Farmer

At time t, the farmer, denoted by superscript ^{F}, is endowed with some land, denoted by D_t^F. Food production function is given by $Q_{at} = A_t D_t^F$, where A_t is the technology parameter. Let $A_{t+1}/A_t \equiv \gamma_A$ (≥ 1), a constant. The market for food is competitive. The farmer derives utility from consumption of food and manufactures and income value of of land bequeathed. Her utility function is given by

$$U_t^F = \left[c_{at}^{F\,\frac{\phi_1}{\phi_1+\phi_2}} c_{mt}^{F\,\frac{\phi_2}{\phi_1+\phi_2}} \right]^{\phi_1+\phi_2} B_t^{F\,\phi_3}, \; \phi_1+\phi_2+\phi_3 = 1, \; \phi_1, \; \phi_2, \; \phi_3 \in (0,1) \tag{1}$$

Here c_{at}^F and c_{mt}^F stand for consumption of food and manufactures by the farmer at time t and $B_t^F = p_{at+1} A_{t+1} D_{t+1}^F$ is the future income value of land bequeathed. Manufacturing goods are the numeraire, so that p_{at+1} is the next-period relative price of food in terms of manufacturing and D_{t+1}^F the farmer's land-gift to his child. The term in the square brackets can be interpreted as the farmer's (sub)-utility from own consumption and the term $B_t^{F\,\phi_3}$ is the sub-utility from bequethed land. Revenues from the sale of food, land and R&R payments finance the farmer's consumption.

As discussed in the Introduction, the R&R norms have three basic features:

1. Most provisions essentially are a finite payment that is to be paid by the land acquiring entity to the affected farmer. This fixed compensation per household can also be viewed as a discounted sum of a per period payment of a smaller amount, where the discount rate may be determined by the preference parameter for bequests. In other words, the total finite-time payment is equivalent to a constant (time-invariant) stream of payments per period, denoted by R.

2. As the buyer of land provides most of the R&R provisions in terms of manufacturing goods (say in bricks and mortar), the payment R can be considered in terms of manufacturing goods. The R&R payments partly takes into account the flow of services from provisions of the law like roads, schools, alternate housing, employment in manufacturing firm, transportation costs etc.- all of which are quite sensitive of price of manufactures.

3. As more land is purchased, more people get affected and hence greater would be the R&R payments. Thus, total R&R payments are also proportional to land purchased.

In view of the above and for the sake of simplicity the R&R scheme is modeled as a fixed annuity payment R in terms of manufacturing good per period multiplied by total land purchased, for all periods starting from the date of purchase. Given this R&R scheme, it is easy to see that at a given point of time, the total R&R compensation would be based on the amount of land being sold currently and land already sold by the family in the past. Denoting price of land by q_t, the farmer's budget constraint can be written as

$$p_{at}c_{at}^F + c_{mt}^F = p_{at}A_tD_t^F + q_t\left(D_t^F - D_{t+1}^F\right) + R(D_0^F - D_{t+1}^F). \tag{2}$$

It is presumed that the initial land holding by the farmer is large enough, so that he is a net seller of land, that is, $D_t^F > D_{t+1}^F$. Hence total R&R payments equal $\sum_{j=0}^{t} R(D_j^F - D_{j+1}^F) = R(D_0^F - D_{t+1}^F)$. It will be instructive to write (2) as

$$p_{at}c_{at}^F + c_{mt}^F + (q_t + R)D_{t+1}^F \equiv E_t^F = p_{at}A_tD_t^F + q_tD_t^F + RD_0^F. \tag{3}$$

We may interpret $q_t + R$ as the *effective price of land*. The farmer's choice variable at time t are c_{at}^F, c_{mt}^F and D_{t+1}^F, the terms in the left-hand side of (3). We shall term the right-hand side as *gross worth* (in terms of manufacturing). It has three components - revenues from production of food, value of the farmer's land asset and payments received through the R&R scheme. The first two of the three terms are obvious. The last term captures that if the farmer sold off his entire land then he would get R&R compensation proportional to the sum of the land that he sells this period *and* what his family had sold in the past, which totals to the initial land endowment of the farmer's dynasty.

The farmer maximizes U_t^F, subject to (3). The first-order conditions imply the the following demand functions for food, manufactures and land:

$$c_{at}^F = \frac{\phi_1 E_t^F}{p_{at}}; \quad c_{mt}^F = \phi_2 E_t^F; \quad D_{t+1}^F = \frac{\phi_3 E_t^F}{q_t + R}. \tag{4}$$

The last equation in (4) is the demand function for land, which varies positively with his gross worth and inversely with the effective price of land.

2.2 The Industrialist

The industrialist, denoted by by superscript ^{I}, is endowed at time t with some land (D_t^I) and capital (K_t). These are inputs to produce manufactures. The manufacturing production function is Cobb-Douglas: $Q_{mt} = M_t(D_t^I)^\alpha K_t^{1-\alpha}$, where M_t is the technology parameter growing at a constant gross rate, γ_M (≥ 1), i.e. $M_{t+1}/M_t = \gamma_M$. The market for manufactures is perfectly competitive. These are consumable and can also be converted to capital one-to-one.

The industrialist's preferences over own consumption and bequests are same as those of the farmer, that is, the expression for U_t^I is analogous to (1). However, the difference is that bequests consist of income from two assets (land and capital), that is, $B_t^I = M_{t+1}{D_{t+1}^I}^\alpha K_{t+1}^{1-\alpha}$, the joint future yield from the two assets. His budget is:

$$p_{at}c_{at}^I + c_{mt}^I + K_{t+1} + (q_t + R)D_{t+1}^I \equiv E_t^I = M_t(D_t^I)^\alpha K_t^{1-\alpha} + K_t + q_t D_t^I + RD_0^I, \quad (5)$$

where E_t^I is the gross worth of the industrialist at time t.[5] The choice variables are: c_{at}^I, c_{mt}^I, D_{t+1}^I and K_{t+1}. The resulting demand functions have the following forms:

$$c_{at}^I = \frac{\phi_1 E_t^I}{p_{at}}; \quad c_{mt}^I = \phi_2 E_t^I; \quad D_{t+1}^I = \frac{\alpha\phi_3 E_t^I}{q_t + R}; \quad K_{t+1} = (1-\alpha)\phi_3 E_t^I, \quad (6)$$

2.3 Static Equilibrium

The total land endowment of the economy is fixed, equal to $\bar{D}$. The following three equations spell market clearing for land, food and manufacturing.

$$D_t^F + D_t^I = \bar{D} \quad (7)$$

$$c_{at}^F + c_{at}^I = A_t D_t^F \quad (8)$$

$$c_{mt}^F + c_{mt}^I + K_{t+1} - K_t = M_t(D_t^I)^\alpha K_t^{1-\alpha}. \quad (9)$$

The equations for demand for land (4) and (6), along with the land market clearing condition (7) 'solve' the land price:

$$q_t = \frac{\phi_3(E_t^F + \alpha E_t^I)}{\bar{D}} - R. \quad (10)$$

It is presumed that R&R payments are not too large, such that $q_t > 0$. Eq. (10) says that the *effective* land price is proportional to the fraction of households' gross worth that is invested in land.

Goods demand equations (4) and (6), along with the farmer's budget (3), and, (8), (9) and (10) constitute eight equations in eight variables c_{at}^F, c_{mt}^F, E_t^F, c_{at}^I, c_{mt}^I, E_t^I, p_{at}

and q_t.

By making appropriate substitutions, the system can be reduced to two equations in two variables, $e_t^F \equiv E_t^F/K_t, e_t^I \equiv E_t^I/K_t$: gross worth per unit of capital of farmers and industrialists. Normalizing $\bar{D}$ to unity from now on and defining $\kappa_t \equiv K_t^\alpha/M_t$, these two equations are:

$$\phi_2 e_t^F + [\phi_2 + \phi_3(1-\alpha)]\, e_t^I = 1 + \frac{D_t^{I^\alpha}}{\kappa_t} \tag{11}$$

$$[1-\phi_1-\phi_3(1-D_t^I)]e_t^F - [\phi_1 + \alpha\phi_3(1-D_t^I)]e_t^I = \frac{R(D_t^I - D_0^I)}{(M_t\kappa_t)^{1/\alpha}}, \tag{12}$$

which, at each t, determine e_t^F and e_t^I, given D_t^I, and κ_t. Given initial land distribution and capital stock the household producers' gross worths are related to each other in two ways – through demand for goods and land. The first equation is restatement of the manufacturing goods market clearing condition. The second equation substitutes the agricultural goods and land market clearing conditions into the farmer's budget. It is easy to see that if there are no transfer payments, R, then the gross worths of the two agents would be proportional and also would be independent of M_t.

In the static system, e_t^F and e_t^I are implicit functions of distribution of land, capital stock in the economy and productivity parameters in respective sectors, i.e., $e_t^F = e^F(\kappa_t, D_t^I, M_t)$ and $e_t^I = e^I(\kappa_t, D_t^I, M_t)$.

We note two comparative static results – effects of an increase in agricultural productivity (A_t) and those of an increase in productivity in manufacturing (M_t) – which will be of relevance in understanding the dynamics of the economy.

Proposition 1 *Given initial holdings of land by both the farmer and the industrialist and capital holding by the latter at t,*
(a) an increase in A_t reduces the relative price of food, p_{at}, proportionately along with a proportional increase in the demand for food by both agents, while it leaves unaffected the land price or gross worth of either agent in terms of manufactures;
(b) an increase in M_t leads to a less than proportionate increase p_{at}, and increases in the land price as well as gross worths (in terms of manufactures) of both agents.

Proof: We can see the static effects of change in TFP from the equations (11) and (12). An increase in A_t does not affect e_t^F and e_t^I and hence does not affect the gross worth of the agents. It follows from (10) that land price is also unaffected by change in A_t.

Eqs. (4), (6) and (8) imply that

$$p_{at} = \frac{\phi_1(E_t^F + E_t^I)}{A_t(1 - D_t^I)}$$

so price of agricultural good falls proportionately with A_t and hence from the food demand expressions (4) and (6) the demand for food by both agents rises proportionately.

However, an increase in M_t does not have equivalent opposite effects. As evident from the static system (11) and (12), E_t^F and E_t^I rise less than proportionately with M_t . Hence, p_{at} and q_t also rise. ■

Since at any time the capital stock and the R&R payments are given in terms of the manufactures, at any given price of land in terms of manufactures, an increase in A_t and a proportional decline in p_{at} keep gross worths of both agents in terms of manufactures unchanged. It follows that, as A_t increases, there is proportional decrease in the relative price of food and a proportional increase in the quantities demanded of food by both consumers. There are no changes in the land price in terms of manufactures or gross worths of either agent in terms of manufactures.

However, an increase in M_t, at any given price of land (in terms of manufactures), is accompanied by a rise in gross worths of both agents leading to rises in food and land prices.

2.4 Dynamics and the Steady State

Using (10) to eliminate q_t, the industrialist's asset demand functions in (6) can be re-written as:

$$\frac{\kappa_{t+1}}{\kappa_t} = \frac{[\phi_3(1-\alpha)e^I(\kappa_t, D_t^I, M_t)]^\alpha}{\gamma_M} \tag{13}$$

$$D_{t+1}^I = \frac{\alpha e^I(\kappa_t, D_t^I, M_t)}{e^F(\kappa_t, D_t^I, M_t) + \alpha e^I(\kappa_t, D_t^I, M_t)}. \tag{14}$$

These equations spell the dynamics of the economy in terms of two state variables, $\kappa_t \equiv K_t^\alpha / M_t$ ('normalized' capital stock) and D_t^I (an indicator of distribution of land between the two sectors). Note, M_t affects the system through R&R scheme, R/M_t. In the absence of R&R payments, $e^F(\cdot)$ and $e^I(\cdot)$ are functions of κ_t and D_t^I only; hence (13)–(14) constitute an autonomous system. But in presence of an R&R scheme, they represent a non-autonomous dynamic system. This is expected because R&R are income transfers which introduces non-homotheticity. Over time as $M_t \to \infty$, the effects of M_t on the dynamics vanishes.

Proposition 2 *Land acquisition and capital accumulation over time are affected by productivity growth in manufacturing, but not by that in agriculture.*

Proof: Eqs. (13) and (14) are dependent on M_t but not on A_t. ■.

Proposition 2 is an immediate implication of Proposition 1. We have seen that M_t, not A_t, affects the gross worth of the agents. The next period's capital stock and land allocation depends on today's gross worth and hence only manufacturing productivity affects the dynamics of K_t and D_t^I.

"Long run" or steady state is defined by $\kappa_t \to \bar{\kappa}$ and $D_t^I \to \bar{D}^I$ as $t \to \infty$.

Proposition 3 *The long-run land allocation between the sectors as well as the long-run growth rates of capital and sectoral outputs are unaffected by the R&R package.*

Proof: The R&R package parameter R appears only in the right-hand side of (12) and the it tends to zero in the long run since $\lim_{t\to\infty} M_t = \infty$. Hence, $\bar{\kappa}$ and $\bar{D}^I$ are independent of R.[6] ■

The simple intuition is that as the economy grows the R&R compensation per period becomes negligible in the long run.

The following proposition ranks sectoral growth rates in the long run.

Proposition 4 *As long as the productivity growth rate in manufacturing does not sufficiently lag that in agriculture, in the long run manufacturing output would grow faster than the agricultural output.*

Proof: From the definition of κ_t as $\kappa_t \to \bar{\kappa}$, K_t^α grows at the same rate of M_t, which is γ_M. Hence capital tends to grow at the rate $\gamma_M^{1/\alpha}$. Land allocation approaching a fixed proportion in the long run, the agricultural output tends to grow at γ_A. We have $\gamma_M^{1/\alpha} > \gamma_A$ as long as $\gamma_M \geq \gamma_A$ or $|\gamma_M - \gamma_A|$ is small enough. ■

The model thus accords with the well-known stylized fact that manufacturing output tends to grow faster than agriculture. It is because capital, as an input to manufacturing output, grows, whereas capital is not used – or more generally less intensively used – in agriculture. Higher growth of manufacturing compared to agriculture – a global phenomenon – has been typically attributed to lower elasticity of demand for agricultural good (food) and higher rate of technical or productivity growth in manufacturing. Proposition 4 offers a different rationale.

Our model offers an expression for the dynamics of land price in the long run. Define a general price index, $P_t \equiv P_{at}^{\psi}\ P_{mt}^{1-\psi}$, where P_{at} and P_{mt} are the respective nominal prices and $\psi \equiv \phi_1/(\phi_1+\phi_2)$ as the share of food in a household's (a farmer's or an industrialist's) expenditure on two consumption goods. The real price of land can be expressed as $P_{mt}q_t/P_t = q_t/p_{at}^{\psi}$, where, recall that, q_t is the price of land in terms of manufactures.

Proposition 5 *In the long run the real price of land grows at the rate, $\gamma_A^{\psi}\ (\gamma_M^{1/\alpha})^{1-\psi}$.*

Proof: From the food market clearing condition (8), p_{at} grows at the rate $\gamma_M^{1/\alpha}/\gamma_A$. In view of (10), the growth rate of q_t asymptotes to $\gamma_M^{1/\alpha}$. Hence, q_t/p_{at}^{ψ} must grow at $\gamma_A^{\psi}\ (\gamma_M^{1/\alpha})^{1-\psi}$. ■

Proposition 5 says that in the long run the real land price would grow at a rate which is an weighted average of growth rates of manufacturing and agriculture.

Similar to Kongsamut et al. (2001) and Acemoglu and Guerrieri (2008) among others, our model is consistent with Kaldor facts at the aggregate economy level, although growth is non-balanced across sectors.

Proposition 6 *In the long run the following aggregate normalities hold:*

a. real output per worker grows at a constant rate $\gamma_A^{\psi}(\gamma_M^{1/\alpha})^{1-\psi}$

b. capital per worker grows over time at the rate $\gamma_M^{\frac{1}{\alpha}}$

c. capital/output ratio is constant, and

d. the rate of return to capital is constant.

Proof: As mentioned before in the steady state, $\bar{\kappa}$ and $\bar{D}^I$ are constant and hence from the static system (11) and (12), $e_t^I \to \bar{e}^I$ and $e_t^F \to \bar{e}^F$, the limit values are constant. This implies that gross worth of farmer and industrialist grows at the same rate as capital, $\gamma_M^{1/\alpha}$. Output, measured by GDP, $p_{at}Q_{at} + Q_{mt}$, equals $\phi_1(E_t^F + E_t^I) + Q_{mt}$. Thus, in steady state nominal GDP grows at $\gamma_M^{1/\alpha}$, same as the growth rate of capital – implying constant capital/output ratio. As population is constant, capital per worker grows at $\gamma_M^{1/\alpha}$. Parts b. and c. are proved.

The price index grows at the rate $\gamma_M^{\psi/\alpha}\gamma_A^{-\psi}$. Hence real output per worker grows at the rate $\gamma_A^{\psi}(\gamma_M^{1/\alpha})^{1-\psi}$, a constant. Part a. is proved Under perfect competition, the return to capital is the marginal product of capital in manufacturing, $(1-\alpha)M_t(D_t^I)^{\alpha}K_t^{-\alpha}$, which, in steady state, equals $(1-\alpha)(\bar{D}^I)^{\alpha}/\bar{\kappa}$, a constant. This proves Part d. ■

3 Transitional Dynamics

As noted above, the effects of an R&R scheme diminish over time and vanish in the limit. Hence the dynamics in the neighborhood of the steady state is the same whether or not an R&R package is in place. It is thus determined by linearizing the dynamic system (13)–(14) around $\bar{\kappa}$ and $\bar{D}^I$ and 'assuming' $R = 0$.[7] The linearized dynamic system has the standard form:

$$\begin{bmatrix} \tilde{\kappa}_{t+1} \\ \tilde{D}^I_{t+1} \end{bmatrix} = \begin{bmatrix} \dfrac{\partial \kappa_{t+1}}{\partial \kappa_t} & \dfrac{\partial \kappa_{t+1}}{\partial D^I_t} \\ \dfrac{\partial D^I_{t+1}}{\partial \kappa_t} & \dfrac{\partial D^I_{t+1}}{\partial D^I_t} \end{bmatrix} \begin{bmatrix} \tilde{\kappa}_t \\ \tilde{D}^I_t \end{bmatrix}.$$

where $\tilde{x}_t = x_t - \bar{x}$ is the deviation from the steady state, and derivatives are evaluated at the steady state.

It can be easily derived that $\partial D^I_{t+1}/\partial \kappa_t = 0$, that is, the dynamics of land acquisition is independent of the capital stock. The following is the reason. For a given land distribution at t, an increase in capital stock raises the values of sectoral outputs and the price of land. Gross worths of both the farmer and the industrialist rise. Under the technology and preference specifications, the demand of industrial land for $t+1$ depends on the ratio of gross-worths of the two agents at time t and the gross worths rise proportionately as K_t increases. Hence, the land distribution in period $t+1$ it is independent of capital stock at time t.

It does not mean however that land acquisition is independent of production of manufactures: it is partly governed by productivity of land in manufacturing through technology parameter α.

Because $\partial D^I_{t+1}/\partial \kappa_t = 0$, the diagonal elements of the Hessian matrix are the eigenvalues:

$$\mu_1 \equiv \frac{\partial \kappa_{t+1}}{\partial \kappa_t} = 1 - \alpha + \frac{\alpha(1-\alpha)\phi_3}{(1-\alpha\phi_3)\gamma_M^{\frac{1}{\alpha}}}; \quad \mu_2 \equiv \frac{\partial D^I_{t+1}}{\partial D^I_t} = \frac{\alpha\phi_3}{\phi_1 + \alpha(\phi_2 + \phi_3)},$$

where the derivatives are evaluated at the steady state. Both are positive and less than one, so that the system is (locally) stable.

Figure 1 depicts the transitional dynamics. Given initial values, $(\kappa_0,\ D^I_0)$, there must exist a unique path which converges to the steady state. The relevant initial situation is where capital stock and industrial land holdings are 'small,' i.e., $\kappa_0 < \bar{\kappa}$

and $D_0^I < \bar{D}^I$, which translates into a point in region III or IVa in Figure 1. There are, accordingly, two kinds of dynamic paths.

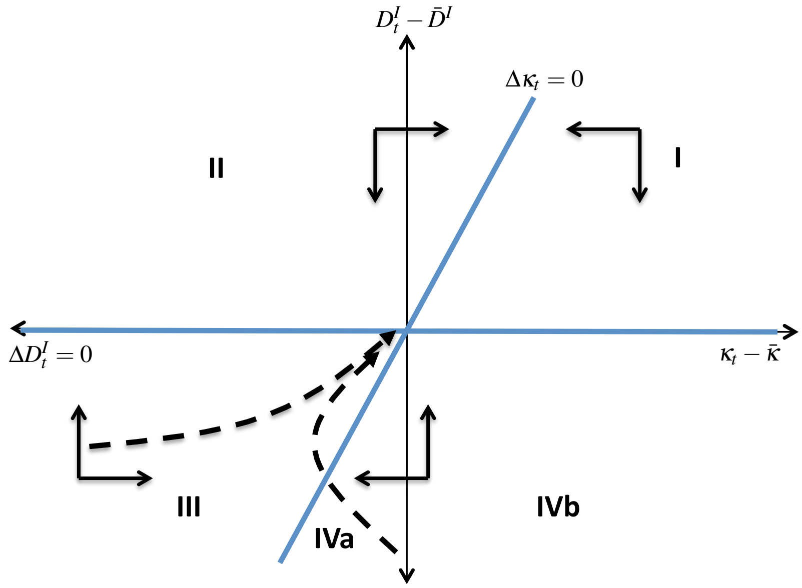

Figure 1: Transitional Dynamics and Path Trajectories

3.1 *Initial point ($\tilde{\boldsymbol{\kappa}}_0$, $\tilde{\mathbf{D}}_0^{\mathbf{I}}$) in region III*

This is the case where in the manufacturing sector 'capital deficit' is relatively large in comparison to land deficit. We see that if the trajectory begins in region III, it cannot enter region II or IVa; hence κ_t and D_t^I monotonically increase over time and converge to the steady state. From the definition of κ it follows that capital grows over time. Manufacturing output expands too, because of capital expansion, land acquisition as well as productivity growth. Food output may initially fall, depending on the relative magnitudes of increment in agricultural productivity to the decline in agricultural land. However, as the system approaches steady state, loss of land to manufacturing approaches zero and hence agricultural output must grow, towing the growth rate of productivity in that sector.

The effect of D_t^I and κ_t on gross worths E_t^F and E_t^I is not apparent and hence it does not seem possible to analytically characterize the dynamics of q_t. However, simulations excises were undertaken for various parameter values in the model's framework and in all cases, the real land price ($= q_t p_{at}^{\psi}$) rises over time.

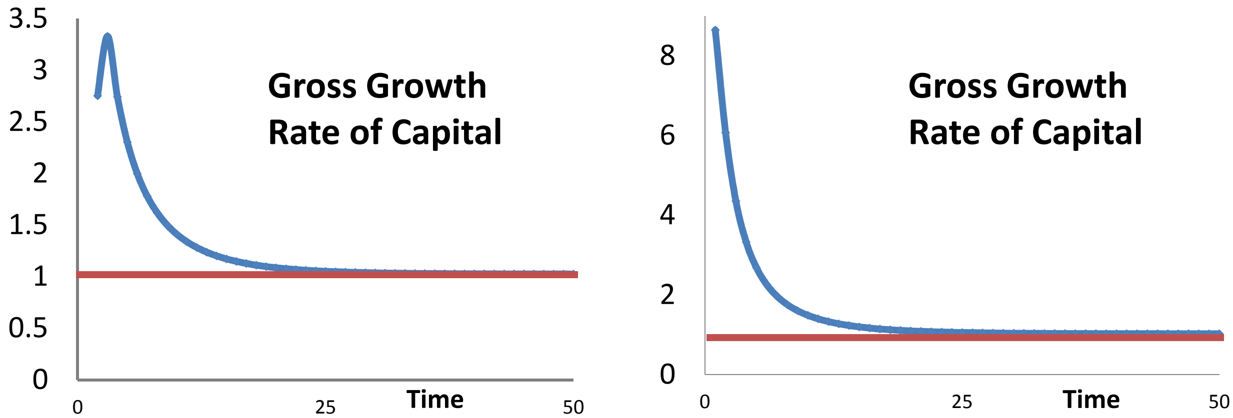

Figure 2: Dynamics of Capital Growth in Region III for Different Initial Values

Dynamics of Growth Rates

In terms of the dynamics of *growth rates*, that of capital, g_K, exceeds its steady state rate; Since κ_t grows over time,

$$g_K \equiv \frac{K_{t+1}}{K_t} = \left(\frac{\kappa_{t+1}}{\kappa_t}\gamma_M\right)^{1/\alpha} > \gamma_M^{1/\alpha}.$$

Hence, after a certain time period, g_K must decrease monotonically, but initially it may not.

It is evident from (13) and the definition of κ_t that

$$g_K = g_K(\underset{-}{\kappa_t}, \underset{+}{D_t^I}).$$

Thus the dynamics of the growth rate of capital has two opposing forces - a negative effect of an increase in capital stock – the convergence effect – and a positive effect of industrial land increment. We illustrate the operation of these forces in Figure 2 for specific parameter values, $\phi_1 = 0.4$, $\phi_2 = 0.3$, $\phi_3 = 0.3$, $\alpha = 0.2$, $\bar{D} = 10$, $\gamma_M = 1.005$, $\gamma_A = 1.05$ and $M_0 = A_0 = 1$. The steady state solutions are $\bar{\kappa} = 0.349$ and $\bar{D}^I = 1.304$. The two panels differ in terms of initial conditions. The left panel assumes $\kappa_0 = 0.07$ and $D_0^I = 0.2$, and the resulting transition path of the growth rate of capital is hump-shaped, while the right panel assumes $\kappa_0 = 0.03$ and $D_0^I = 1$ and the growth rate of capital decreases monotonically over time.

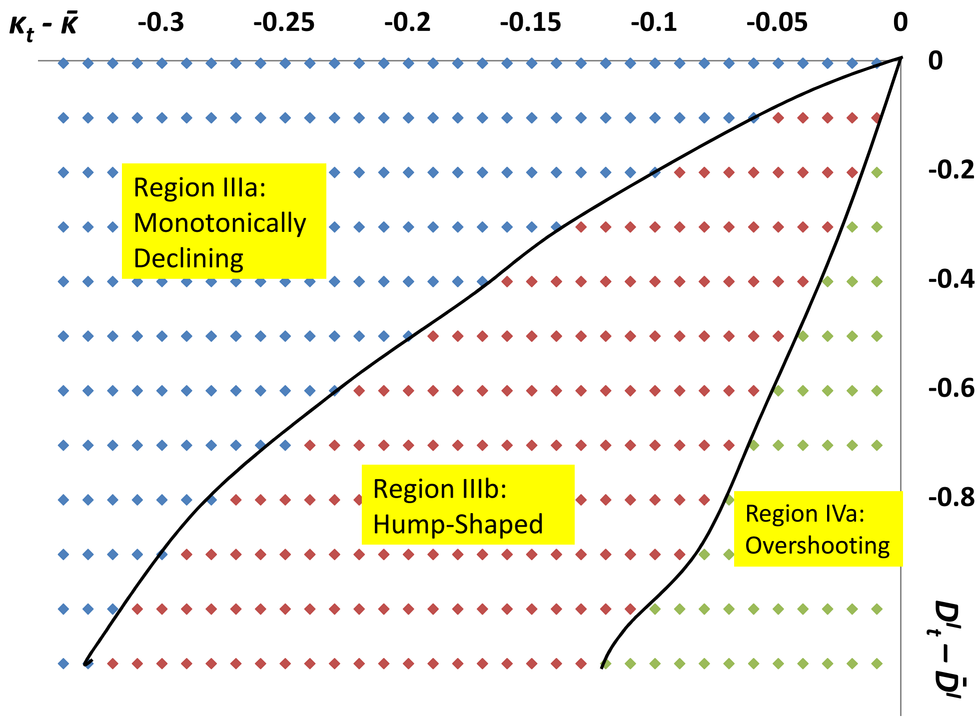

Figure 3: Growth Rate of Capital in Region III

If we interpret $|\kappa_0 - \bar{\kappa}|$ and $|D_0^I - \bar{D}^I|$ as *capital gap* and *land gap* in manufacturing, then in the left panel, the land gap relative to capital gap is 3.96 and that in the right panel is 0.95. Figure 2 is indicative of the hypothesis that if the ratio of industrial land gap to capital gap is relatively large, then the land acquisition effect dominates initially and the dynamic of g_K is hump-shaped; otherwise, if the ratio is relatively small, the convergence effect dominates and the growth rate of capital falls over time for all t. Indeed, simulations of dynamics of capital growth for various combinations of capital gap and land gap give rise a demarcation of region III, as shown in Figure 3.

Denoting by "(S)" a proposition based on simulations, in summary,

Proposition 7 *(S) As long as the initial point is in region III, land acquisition take place in all periods, and, the initial growth rate of capital exceeds its steady state rate but it may or not may fall monotonically towards its steady state rate.*

Proposition 8 characterizes the dynamics of output in the two sectors, which is partly based on simulations.

Proposition 8 *(S) If the initial point is in region III, The growth rate of agricultural output rises and that of manufacturing falls over time.*

Proof: We have

$$D_t^I - \bar{D}^I = (D_0^I - \bar{D}^I)\mu_2^t,$$

where $D_0^I - \bar{D}^I < 0$ and $\mu_2 \in (0,1)$. The rate of land acquisition is equal to $(D_0^I - \bar{D}^I)(\ln \mu_2)\mu_2^t$, a decreasing function of t.[8] This implies that growth rate of agricultural output rises over time.

Since κ_t and D_t^I grow over time, the growth of manufacturing output is

$$g_{Qm} \equiv \gamma_M \left(\frac{D_{t+1}^I}{D_t^I}\right)^{\alpha} \left(\frac{K_{t+1}}{K_t}\right)^{1-\alpha} > \gamma_M \left(\frac{\kappa_{t+1}}{\kappa_t}\gamma_M\right)^{\frac{1-\alpha}{\alpha}} > \gamma_M^{1/\alpha}.$$

Hence the growth rate of manufacturing output exceeds $\gamma_M^{1/\alpha}$, its steady state growth rate. Further, it increases with the growth rates of capital and industrial land holding. Since the rate of land acquisition falls, the presumption of a monotonic decline in the growth rate of manufacturing is strong. Indeed, all simulations undertaken with different parameter specifications as well as initial conditions yielded that growth rate of manufacturing output falls monotonically with time. ■

3.2 The initial point $(\tilde{\kappa}_0, \tilde{D}_0^I)$ in region IVa

In this region the land deficit is large relative to the capital deficit. Note in Figure 1 that a trajectory beginning in region IVa *must* enter region III before converging to the steady state. Thus, while industrial land rises monotonically towards $\bar{D}^I$, κ_t initially falls and later expands, implying that the initial growth rate of capital is less than $\gamma_M^{1/\alpha}$, its steady-state rate. There is even a possibility of *negative* initial growth of capital, if the TFP growth of manufacturing (γ_M) is low enough.

Furthermore, as the system enters region III we know that the growth rate of capital exceeds $\gamma_M^{1/\alpha}$. Hence, as shown in Figure 4, the growth rate of capital must be hump-shaped for *any* initial point in region IVa. That is,

Proposition 9 *If the initial point is in region IVa, land acquisition takes place in all periods, the growth rate of capital is initally less than its steady state rate (possibly* *negative), it then increases over time and shoots over the steady state rate, and, finally it falls monotonically towards its steady state rate.*

It is noteworthy that, even though there is a capital gap, in initial periods capital would grow at a rate less than its steady state rate. The reason is that the relatively high land gap would need to be narrowed rapidly, and, this would necessitate a lower growth rate of capital, possibly de-accumulation. Once the land gap is narrowed sufficiently, the growth rate of capital shoots beyond its steady state rate in the intermediate period since capital gap is now sufficiently large relative to land gap. In this sense, there will be *growth overshooting*.

To understand the growth overshooting of capital in more detail, assume that $\gamma_M = 1$, so that there is a steady state *level* of capital stock, i.e., the steady-state growth rate of capital zero. As noted earlier, the growth rate of capital at any given point of time decreases with its stock and increases with the size of industrial land holding at that time. In region IVa, the capital gap is relatively small compared to the land gap. Hence, on account of convergence effect and industrial land holding effect, the initial growth rate of capital is negative (more generally, it is smaller than the steady state rate). Over time, it rises due to the convergence effect. At some point of time, it becomes zero (the steady state rate), while the capital stock is still less than its steady state level, i.e., there still exist capital and land gaps. Because industrial land continues to be acquired, capital begins to grow, i.e., the growth rate of capital overshoots its steady state rate. The dynamic system enters region IIIb. The growth rate of capital rises, peaks at some date and then falls gradually to its steady state rate (zero).

If capital stock grows, it is clear that manufacturing output must expand. But, if the former falls over time, it is unclear whether manufacturing output rises or falls. However, simulations show that manufacturing output always expands over time and the growth rate manufacturing output does not overshoot.

The growth rate of agricultural output increases, converging to γ_A. However, if γ_A is small, the initial growth rate may be negative.

Finally, simulations exhibit that if, initially, the growth rate of capital is negative and sufficiently large in magnitude, the (real) price of land initially falls and then rises over time; otherwise, it rises monotonically over time.

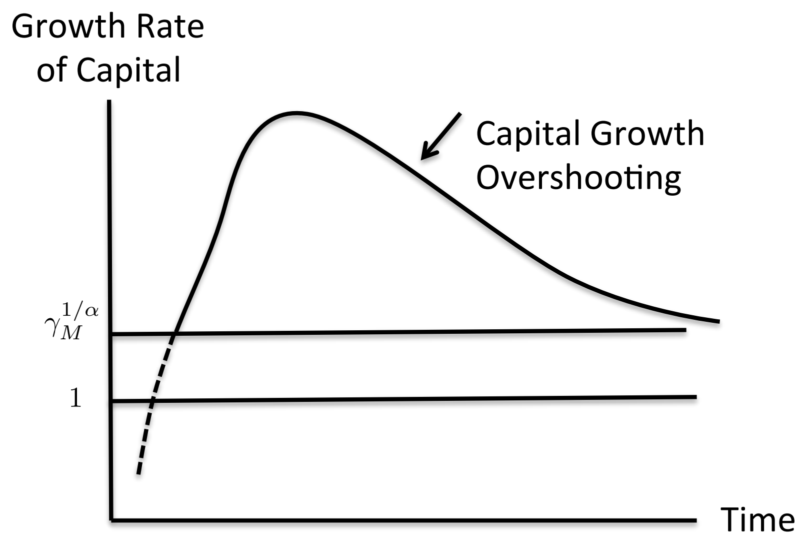

Figure 4: Growth Overshooting of Capital in Region IVa

3.3 Effects of an R&R Scheme

While the R&R scheme does not have any long-run growth effects, it would affect the (transitional) dynamics of the economy. But, as stated previously, it does not seem possible to analytically determine its effects. Numerical simulations were undertaken for various combinations of parameter values as well as initial conditions. The qualitative effects were robust.

As the measure of the effect of an R&R scheme on the *level* of a variable x, we define $\epsilon_x = x_t^+/x_t^0 - 1$, where the superscripts $^+$ and ^{0} denote respectfully the presence and absence of the scheme. Regarding the growth rates, we are interested in their differences with and without R&R . Hence for a growth rate variable y_t, we define $\epsilon_y = y_t^+ - y_t^0$. To illustrate, Figures 5 and 6 depict the effects using parameter values: $\phi_1 = 0.31$, $\phi_2 = 0.26$, $\phi_3 = 0.43$, $\alpha = 0.20$, $\gamma_A = 1.02$, $\gamma_M = 1.0155$ and $M_0 = A_0 = \bar{D} = 1$.[9] The R&R payment R per period was chosen to be 20% of the equilibrium land price at time 0 in the absence of any R&R scheme.[10]

At the steady state, $\bar{\kappa} = 0.362$ and $\bar{D}^I = 0.143$. We chose initial values $(\kappa_0, D_0^I) = (0.361935,\ 0.01)$, so that the dynamic system originates in region IVa.

Figure 5 shows that the R&R scheme lowers the levels of capital stock, industrial land and manufacturing output. There is a gain of agricultural output at each instant of time. These effects are expected.

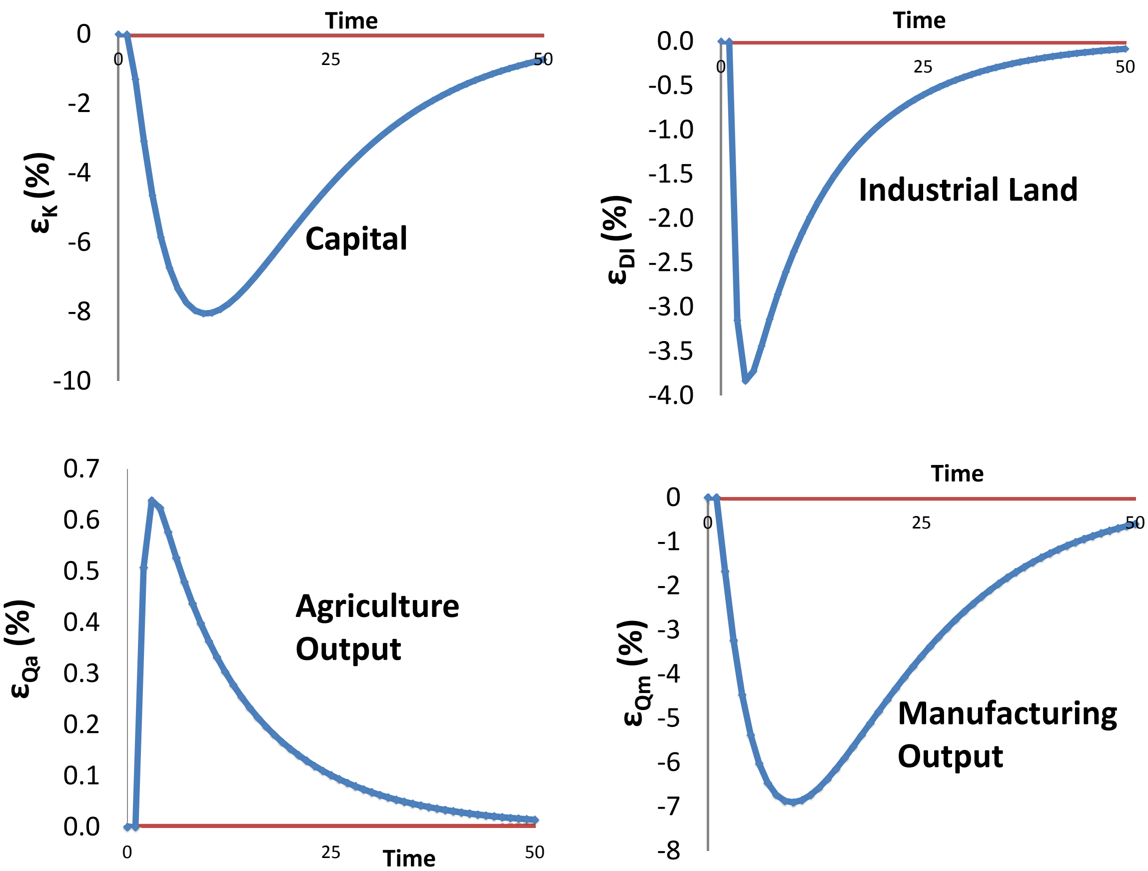

Figure 5: Effects of R&R scheme on Capital, Industrial Land, Agricultural Output and Manufacturing Output

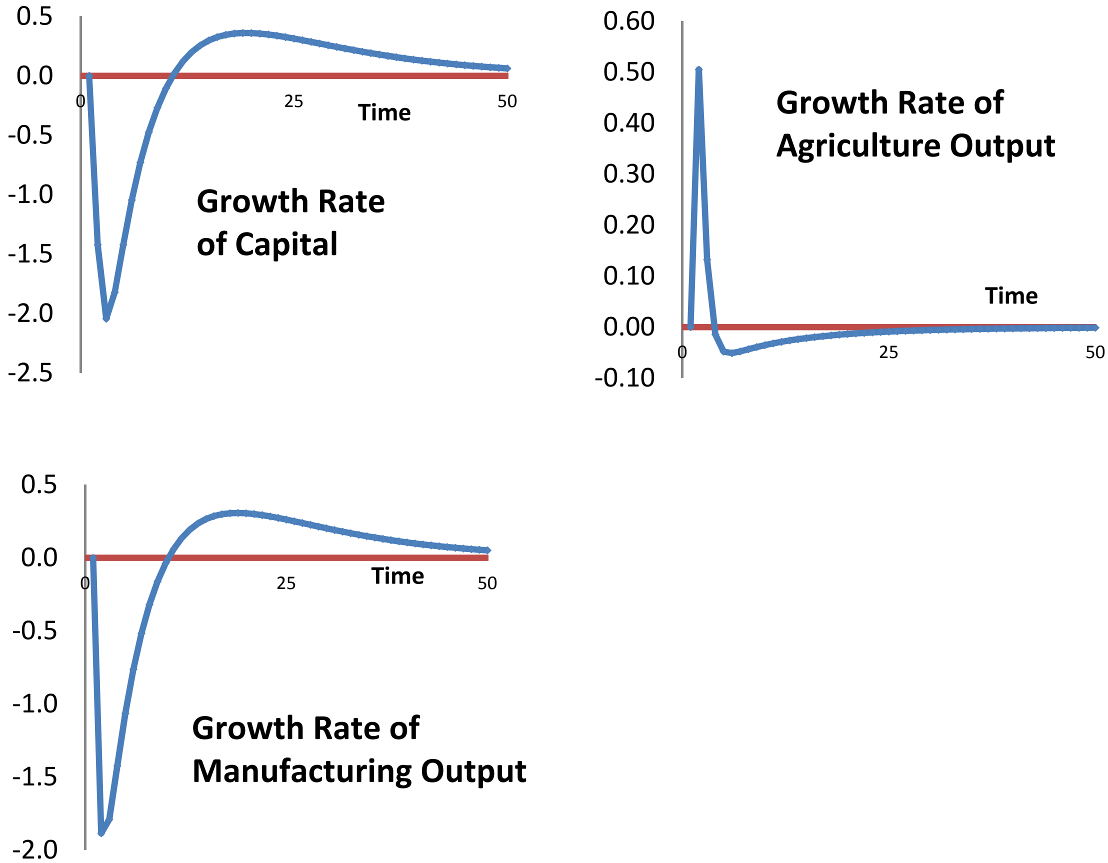

Figure 6: Effects of R&R Scheme on Growth rates of Capital, Agricultural Output and Manufacturing Output (in percentage deviation)

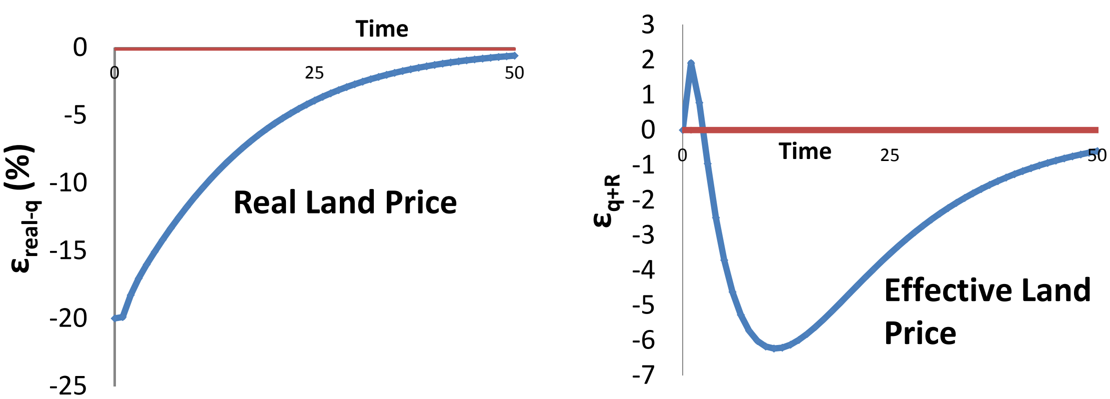

Figure 7: Effects of R&R scheme on Real Land Price and Effective Land Price (in terms of Manufactures)

Figure 6 depicts the effects of the scheme on growth rates. As seen in Figure 5, the difference in capital stocks with and without R&R plan widens and reaches a minimum at some time period. This implies that, during this period, the growth rate of capital in the presence of R&R scheme is lower. This initial 'shortfall' in the growth rate of capital is 'compensated' by a higher growth rate of capital associated with the scheme later, because as $t \to \infty$, along the steady state the time paths of capital stock with and without R&R are the same. The growth rates of manufacturing and food outputs also exhibit reversals overtime; while the former shows the same pattern as growth rate of capital, the latter is in opposite order.

Turning to Figure 7, we see that the scheme has a negative effect on the real land price, the magnitude of which gradually declines. The effects over the initial periods are strong, beginning with a fall of 20% in the first period. This is due to supply and demand side forces. The scheme directly increases the farmer's willingness to sell more land and lowers the industrialist's demand of land. Furthermore, it adversely affects capital accumulation, which also lowers the demand for land. Although not graphed, the effects on land price in terms of manufacturing are similar to the effects on real land price defined on the price index.

Last but not least at all, consider the effect of the R&R scheme on the *effective land price*, $q_t + R$, which is the terms of trade between the two agents. The effect in initial periods is positive, because the direct effect of the scheme outweighs the decline in land price. In subsequent periods however, the land-price decrease is more persistent as it is also impacted by the decline in capital accumulation due to the scheme; the direct effect is outweighed by the decline in land price. Paradoxically, the farmer faces a worsening of his terms of trade vis-a-vis the industrialist.

To summarize, while in long run the R&R scheme has no effect on the economy, its short and medium run effects are:

a. at each period, lower *levels* of capital stock, industrial land and manufacturing output but higher level of agricultural output,

b. lower growth rate of capital in the initial periods, but higher growth rate of capital in the later periods; same (opposite) trend in the growth of the manufacturing (agricultural) output, and,

c. lower (real) price of land.

4 Distributional Effects of the R&R Scheme

The R&R scheme is founded on distributional grounds: 'fair' compensation to families of farmers for the 'loss' of their land. We can think of an agent's welfare in two ways: in terms of total utility, ${c_{at}^{J}}^{\phi_1} {c_{mt}^{J}}^{\phi_2} {B_t^{J}}^{\phi_3}$, or, 'own welfare' defined as the sub-utility from own consumption, ${c_{at}^{J}}^{\psi} {c_{mt}^{J}}^{1-\psi}$, where $\psi \equiv \frac{\phi_1}{\phi_1+\phi_2}$ and $J = F, I$.

The model brings out three channels or effects through which the scheme affects the welfare of the two agents. First, being a direct transfer it tends to increase the gross worth of the farmer and decrease that of the industrialist. Total and own welfare of the farmer tend to improve and those of the industrialist tend to decline. Second, although it is a direct transfer and thus non-distortionary in a static scenario, it affects capital accumulation and adversely so. Hence, it creates dynamic inefficiency, which would tend to lower the welfare of both agents. Third, note that the effective land price is a terms of trade between two agents and it is directly affected by the transfer as well as by capital accumulation, which is impacted by the transfer. An improvement of such terms of trade would benefit the farmer and be detrimental to the industrialist.

While it is not possible to analytically derive the direction of welfare changes for the two agents, a robust pattern of distributional effects of the R&R scheme emerges from simulation exercises. Figures 8 and 9 graph the percentage deviation from the case of no R&R scheme in terms of total utility and sub-utility from own consumption for both the farmer and the industrialist, where the same parameter values as in Section 3.3 are used.

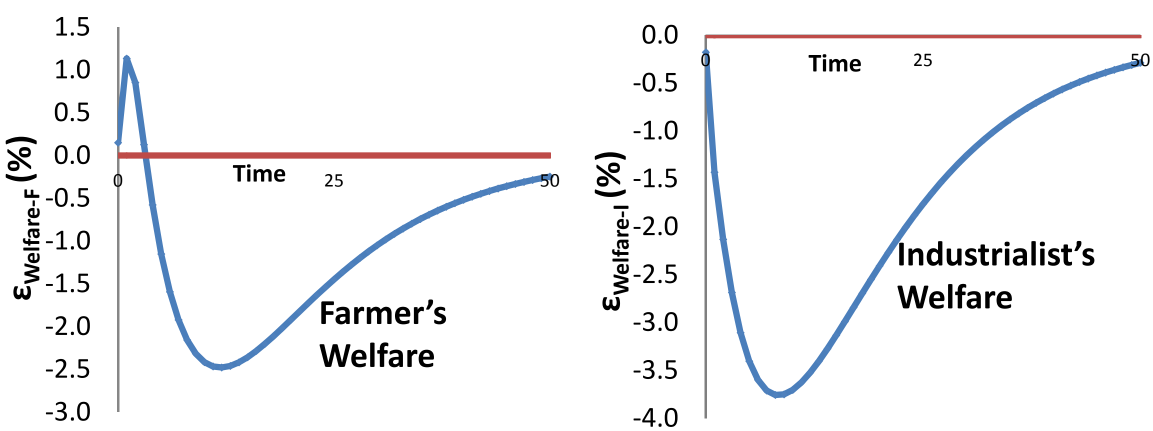

Figure 8: Effect of R&R scheme on Farmer's and Industrialist's Total Utility

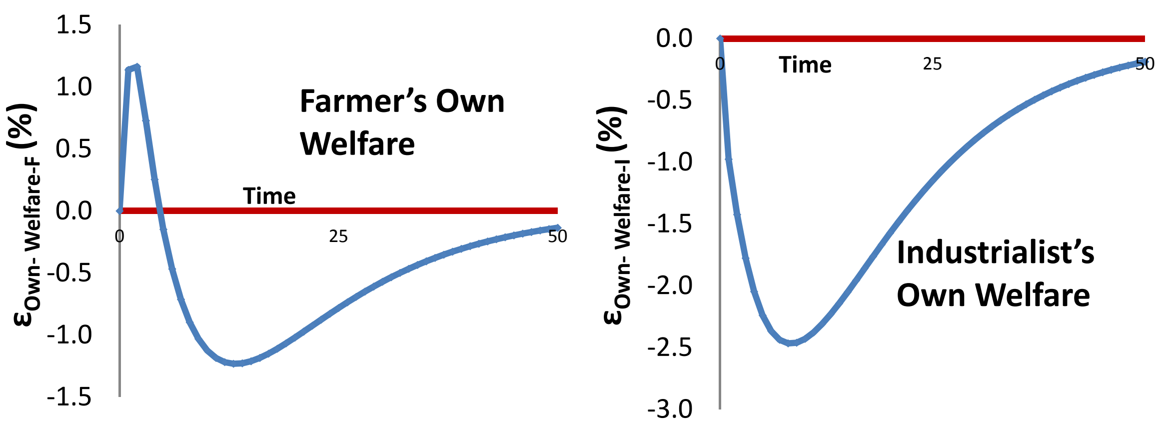

Figure 9: Effect of R&R scheme on Farmer's and Industrialist's Utility from Own Consumption

Expectedly, the industrialist loses in all time periods – in terms of total and own utility. But what is surprising is that the farmer gains *only* in initial periods: after an interval of time he also incurs utility losses over *all* time periods – and this is robust over parametric variations. The genesis of the farmer's loss from the R&R scheme lies in its negative effect on capital accumulation (which tends to adversely affect both agents) and the decline in the effective land price (terms of trade loss for the farmer) as depicted in Figure 7.

The upshot is that the scheme, primarily designed to benefit the farmers, ends up worsening their welfare after some time period.

5 Concluding Remarks

The paper has developed a simple model of growth, having agriculture and manufacturing as two sectors in the economy. Compared to a 'standard' two-sector model of growth, the distinguishing features are that land is an essential input in the production of manufacturing and as the manufacturing sector expands, land is acquired from the agriculture sector. We have characterized the growth process along as well as off the steady state. The Land Acquisition Act provides compensation to farmers in terms of a 'fair' price for the sale of land as well as a rehabilitation and resettlement (R&R) package for private as well as public land acquisitions. We have analyzed the efficiency and equity effects the R&R policy when land is being acquired through private transactions.

Unbalanced growth occurs both along and off the steady state. If the rate of technological progress in agriculture is not sufficiently higher than that in manufacturing, the latter grows faster than the former - a stylized fact. Beside the standard *monotonic* convergence effect (the higher the level of capital stock, the smaller is growth rate of capital), the model uncovers a land-acquisition effect – more land acquired from the agriculture sector implies a higher growth rate of capital. Therefore, in a 'capital-short' economy (having capital gap), the growth rate of capital may not monotonically decrease over time, and, if the land gap is relatively large compared to capital gap, land acquisition may be accompanied by a negative initial growth rate of capital. Further, there may be growth rate overshooting in the sense that an economy starts with a low (possibly negative) growth rate of capital, which, over time improves, goes past its steady state rate and then climbs down gradually towards its steady state value. In other words, the growth rate of capital exhibits non-monotonic, rather than monotonic, adjustment over time.

A surprising conclusion from our analysis is that there is a strong presumption that, over time, an R&R policy adversely affects the welfare of farmers too. There are two sources of welfare loss for them and they are: (a) a negative effect on capital accumulation (which tend to imply welfare loss for industrialists too) and (b) a lower effective price of land, i.e., a terms-of-trade loss for farmers.

Note, we modelled R&R only as payments. Another crucial aspect of R&R scheme is that it provides infrastructures like roads, schools, health centres, etc. which have long term affects on growth. In an endogenous growth model where infrastructure boosts growth, we would find that the detrimental effects of R&R on economic growth and welfare may be reduced or possibly reversed. One could also consider the effects of R&R payments in the case where government acquires land for public purposes. In this setting, there is an additional agent, the government, who buys land from the farmer and then rents it to the industrialist to build public goods. The government values the welfare of the farmer and the industrialist. In this model, as the land acquisition facilitates provision of public goods, which may be equivalent to technology enhancement, we expect the R&R scheme to be beneficial for the long run growth of the economy.

As mentioned in Section 2, our model abstracts from labor and the labor market. In the presence of this market, labor intensity differences vis-a-vis land and capital as well as that between unskilled and skilled labor would matter. Incorporating labor markets would surely enrich our understanding of how land acquisition would affect distribution. As the skilled-labor intensive industrial sector expands, it may increase the skill-wage premium.

We have also assumed that the demands for both food and manufactures have income elasticity equal to one, whereas it is more reasonable to suppose that income elasticity of demand for food is less than one. This would tend to fasten the growth rate of the industrial sector and would constitute a factor on its own towards non-balanced growth. Our analysis does not incorporate consumption value of land (residential housing). It is imperative that future research addresses these elements in order to obtain a much fuller understanding of the growth and equity effects of land acquisition from the agriculture sector.

Notes

[1]The Modi government's promulgation of 'Make in India' campaign supports this hypothesis.

[2]The concluding section comments on issue of land acquisition by the government for public purposes - which, by itself, appears to be a research endeavor on its own.

[3]There are very few works on the role of land in growth theory. In Nichols (1970), one of the early papers, land is introduced as third input in production, besides labor and capital, in a Solovian growth model, and there is land and labor augmenting technical progress at an exogenous rate. Wealth has two components: capital and the value of land, a function of price of land. Along the steady state, the land price increases at the growth rate of output. Roe et al. (2009) have several chapters on multi-sector growth, having land as a production input and an asset. Unlike Nichols (1970), Roe et al. (2009) use an infinite-horizon Ramsey framework, but the implications of the asset value of land remain the same.

[4]Allowing parental utility to depend on the market value of assets passed to the posterity will create an additional dimension to the dynamics, namely, that of price of land, and, that complicates the analytics considerably.

[5] We have assumed zero capital depreciation, but all results hold if the rate of depreciation were constant.

[6]$\bar{\kappa} = \frac{(1-\alpha)\phi_3}{\gamma_M^{1/\alpha}(1-\alpha\phi_3)-(1-\alpha)\phi_3}\left(\frac{\alpha\phi_2}{\phi_1+\alpha\phi_2}\right)^{\alpha}, \quad \bar{D}^I = \frac{\alpha\phi_2}{\phi_1+\alpha\phi_2}$

[7]The derivatives of right-hand expressions with respect to t approach zero as $t \to \infty$.

[8]That is, while more and more land is acquired over time by the manufacturing sector, the *rate* of land acquisition falls over time.

[9]The total endowment of land and the initial values of productivity parameters are simply normalized. We choose other parameter values in relation to the Indian economy for the year 2004-05 (as more recent data is unavailable). According to the online data source Trading Economics (2012), in 2004-05 the household consumption expenditure constitutes about 57% of country's GDP. This implies that the remaining share of income goes to savings, which, in our model, is sum of increments to bequests. Hence we choose $\phi_3 = 0.43$. According to a recent report Ministry of Statistics & Programme Implementation (2011), in 2004-05 the share of food in total consumer expenditure share was 55% in rural India and 42.5% in urban India. As land acquisition occurs mostly in rural areas, we derive that $\phi_1 = 0.55 * 0.57 = 0.31$ and $\phi_2 = 0.26$. Virmani and Hashim (2011) find that in the period 1981-2007, on an average, land constituted a relatively small share of manufacturing production, so α was taken equal to 0.2. The same paper notes that the growth rate of manufacturing output in the period 1981-2007 was 8.06%. Using this, we deduce the manufacturing TFP growth for our model, $\gamma_M = 1.0155$. The choice of $\gamma_A = 1.02$ was similarly based on estimates of agricultural output growth in the period 1980-2006 obtained from Tripathi (2010).

[10]Instead of this, we could have, as well, chosen any other magnitude of R, so long as it does not imply negative values of q_t.

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