PSL Quarterly Review

vol. 75 n. 302 (September 2022)

Article

Land-constrained growth in a developing economy: A Kaldorian perspective

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Abstract:

The paper develops a two-sector model of economic growth, using agriculture and industry. The distinguishing feature in this analysis is that land is an essential input in the agricultural sector, but it is also used in the production process of industrial sector, which is assumed to be imperfectly competitive. The significant role of land allocations is highlighted for a developing economy like India, where any constraint on land transfers from agricultural to non-agricultural sectors imposes a constraint on the overall growth process of the economy. Using the two-sector Kaldorian framework, we analyse the complementary interactions between agriculture and industry through trade flows, labour movements, and land transfers in this setup. We characterize the balanced growth path for such an economy in the long run using two scenarios: a) equilibrium growth with fixed distribution of land by the centralized authority in each sector and b) equilibrium growth with inter-sectoral land transfers accompanied by land-saving innovations in each sector.

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How to cite this article:
Gupta I. (2022), "Land-constrained growth in a developing economy: A Kaldorian perspective", *PSL Quarterly Review*, 75 (302) 263-284.

DOI: https://doi.org/10.13133/2037-3643/17614

JEL codes:
E10, O40, O41, Q150

Keywords:
two-sector growth model, agriculture, industry, land-constraint, balanced growth path

Journal homepage:
http: //www.pslquarterlyreview.info

As countries develop and undergo structural transformation, economic activity reallocates across the broad sectors of agriculture, manufacturing, and services. The experience of developed countries indicates that in the initial stages of structural change, agriculture accounts for a majority share of both output and employment, but as the industrial sector expands and its productivity growth rate rises, the share of agricultural sector in total output starts to decline. During this transition phase, as industry becomes more productive, the inter-sectoral productivity differential between agriculture and industry widens, which results in farm incomes lagging behind the incomes earned in the non-agricultural sectors. But with rapid economic growth in industry and services, surplus labour is pulled out of agriculture and absorbed in non-agricultural sectors, which consequently leads to falling share of labour in agriculture so that the productivity gap across sectors starts to reduce. However, for the developing economy of India, this process of structural transformation has been slow and unusual. This is observed from the fact that while the share of agricultural sector in Gross

Domestic Product (GDP) decreased from 28.3 per cent in 1993-94 to 14.4 per cent in 2011-12, its employment share has declined unevenly from 64.8 per cent to 48.9 per cent over the same period. This implies that nearly half of the total workforce in India continues to be dependent on agriculture, and that this workforce earns much lower incomes compared to those employed in industry and services sectors, considering the low and falling share of agriculture in GDP (NITI Aayog, 2015). In addition, as the Indian economy adopted liberalization and globalization policies in 1991, these economic reforms helped in accelerating its GDP growth rate to an average of 7-8 per cent per annum during the past three decades. But this pattern of growth did not result in a major shift in employment from lower productivity agriculture to higher productivity, labour-intensive, manufacturing. This is because, in India's case, manufacturing share did not increase much as a share of GDP. So while agriculture's share in GDP has declined, its employment share has been slower to change. On the other hand, high-skilled services sectors in India, including software and information technology-enabled services, have contributed significantly to accelerated growth in the post-reform period (Sanyal A. and Singh N., 2021). This also explains why the absorption of surplus unskilled rural labour in the urban economy slow, and rural-urban migration has been far less than what could have been expected in a rapidly growing economy. As a consequence, the accelerating growth rate of the economy propelled by fast growing non-agricultural sectors did not lead to an acceleration of the agricultural growth rate, which is why labour productivity growth differences between the non-agricultural and agricultural sectors have widened at an accelerating rate during this post-reform period, where this ratio increased to a value of over 4.2 (Binswanger-Mkhize, 2012). This indicates that despite the divergence in the productivity growth rates of agriculture and non-agriculture sectors, the shares of agriculture in both GDP and labour force is still far from the point of convergence in the case of Indian economy.

Even though India's production of food grains has been increasing every year and there has been remarkable progress in the recent past when it comes to self-sufficiency in food staples, the agricultural yield (quantity of a crop produced per unit of land) of Indian farms remains very low compared to farms in China, Brazil, the United States and other nations (Deshpande, 2017). For example, India produces one-third of the wheat per hectare per year that farms in France produce and the productivity of rice farms in India is less than half of China's (Kainth and Bawa, 2013). This shows that even as India consumes large quantities of rice and wheat and leads the world in how much land it devotes to these crops, it produces far lower quantities of these grains than it could (MINT, 2014). Not only are the yield rates for rice and wheat in India drastically lower than its BRICS counterparts, but if India's yield rates for these two staple crops were at China's levels, then it could either double its productivity or halve the land used for this purpose. By increasing its yield rates, not only can India reduce the amount of land required to produce the current quantity, but it can also free up the allocated land for other purposes. Also, according to the tenth Agriculture Census (Government of India, 2019), the share of small and marginal holdings of less than 2 hectares of land increased to 86.08 per cent of the total land holdings in India in 2015-16, where the average holding size in the country is 1.08 hectares. This means that as land holdings are fragmented into smaller and numerous farms driven by rural population growth, it acts as a deterrent towards access to non-land inputs such as formal credit, input subsidies, or crop insurance schemes, which diminishes technological investments in agriculture and results in a robust negative effect on country-wide productivity growth (PRS Legislative Research, 2017; Das, 2021). This is because small farms struggle to generate enough income for everyone in a household and often lack alternative sources of income (MINT, 2018). This is supported by the report on "Agricultural households and land holdings of households in rural India, 2019" (Government of India, 2021), which reveals that on average, about 49.7 per cent of small and marginal households' incomes comes from farming, where these households depend mostly on wage work and have essentially become wage earners. This leads to lower rates of mechanization and capital investment on these farms, where the majority of small farmers continue to follow traditional farming practices with family members mainly involved as labour. This suggests that even as agriculture in India has achieved grain self-sufficiency, its production continues to be both labour- and land-intensive.

Since the Indian economy embarked on the new regime of economic liberalization and privatization in the early 1990s, it has condensed the role of the public sector and steadily increased the share of private capital in the economy that became dominant over the past three decades. Although manufacturing sector in India did not grow substantially over this period, it unleashed a remarkable growth in the services sector through high growth rates in information technology (IT) and business process outsourcing. This IT boom contributed to a dramatic growth in demand for commercial real estate that could not be accommodated within the confines of older cities, leading to the growth of hi-tech parks on the peri-urban frontier (Levien, 2015), which subsequently brought about a second generation of reforms that liberalized the real estate and infrastructure sectors. As public-private partnerships became the preferred method for building infrastructure, the central government introduced a series of liberalized measures to attract private investment in power, roads, and ports during the 1990s. As private demand for land increased rapidly during this period for the purposes of industry, infrastructure and real estate, this involved compensating private infrastructure investors with excess land and development rights that became an increasingly popular method of cost recovery in these arrangements, whether for roads, airports, or affordable housing (ibid.). As infrastructure investment became a medium for private real estate accumulation, it transformed the way the state produced space for capital that reached maturity in the early 2000s with the culmination of privately developed Special Economic Zones (SEZ). The SEZ Act of 2005 provided a framework for building hyper-liberalized economic enclaves with minimal taxes, tariffs and regulations, with the stated purpose of promoting exports, attracting investment, developing infrastructure, and generating employment (Sud, 2017; Levien, 2013a, 2013b). As the Indian economy started accelerating towards 9 per cent growth rate during these years, the SEZ Act created an opportunity for Indian real estate companies and diversified corporate houses for windfall gains in light of the ascent of a liberalized real estate market, which further created growing demand for housing and office space. Therefore, with market orientation and privatization shaping the questions of development, transitions in land use came into focus, where land was acquired by government departments in various parts of the country and then allocated to private companies in response to an investment surge (Sud, 2014). With growing demand for land uptake from industry and services initiated by liberalization, it spawned obstacles to consolidating large chunks of rural lands that lay in the hands of India's large smallholding farmers, which created a supply barrier to land-consuming private investments (Levien, 2015). This is why buying a plot or the amalgamation of several plots of land requires the intervention of state governments, which became involved in acquiring land and selling it to the private investors. This has resulted in state governments restructuring themselves into land brokers, where their role has become limited to facilitating dispossession of land from peasants for any private economic purpose that constitutes growth (Chatterjee, 2020; Sud, 2014; Levien, 2015). Accordingly, land has been shifted out of agriculture by the governments for Export Processing Zones, Special Economic Zones (SEZs), industrial corridors, ports, highways, and real estate, and rural agrarian livelihoods have been replaced by industries providing high-skilled services and economies driven by speculative land markets (Chatterjee, 2020). However, as agricultural lands were increasingly converted into land allocated for industrial projects and urban real estate development, these sites also became associated with resistance movements against these new models of globalization in India. Land dispossession, farmer protests and peasant resistance under the SEZ policy gained infamy in 2008 when the Tata Group, one of the country's biggest business conglomerates, was forced to abandon plans for a car factory at Singur in West Bengal as the acquisition of 997 acres of land created a major political controversy (Sud, 2014).

Thus, as the subject of 'land wars' gained attention during the 2000s, one of the central issues that collected momentum in India related to the land acquisition policies in maintaining its current growth trajectory that emphasizes on how to balance agricultural growth with efforts to promote faster industrial development and push large-scale projects. Considering the technological backwardness and land intensive nature of Indian agriculture, the process of converting agricultural lands for industrial, housing, and commercial purposes not only results in a direct fall in agricultural production, but also puts a constraint on the growth of non-agricultural sectors for a fast-growing economy. Given that land is in limited supply and is the critical factor of production for all kinds of economic activities, any constraint on land transfers from agricultural to the non-agricultural sector may impose a constraint on the overall growth process of the economy. In light of these events, we analyse the land allocation issues in a two-sector model of agriculture and industry, where the distinguishing feature is that both the sectors use land as a factor input in their production process. We aim to discuss how land as a factor input influences the rate of growth along the balanced growth path in a two-sector framework of agriculture and industry, how inter-sectoral land transfers between agriculture and industry affect the long run growth process in a developing economy, and in what ways land-saving innovations across agriculture and industry influence the long-run growth rate. In this paper, we use the broad framework of Nicholas Kaldor's two-sector model, which divides the economy into the agricultural and industrial sectors, which enables us to study the issues that govern relations between the growth rates of various sectors of the economy. In section 1, we provide a literature review of dual economy models that highlight agriculture-industry interaction. In section 2, we build a growth model using the Kaldorian framework by analysing the long run balanced growth path, where the distribution of land has been fixed by the centralized authority in each sector that consequently brings in the role of land constraint issues for a developing economy. In section 3, we analyse how the long run balanced growth path changes when the inter-sectoral land transfers are accompanied by land-saving technological innovations in each sector.

1. Dual economy models: agriculture-industry linkages

In a closed economy framework, the dual economy models describe the interaction between agriculture and industry with the objective of discovering the linkages that bind these two sectors in developing and underdeveloped countries. Their emphasis lies in mapping and outlining the complementary inter-relationships between these two sectors, where the mutual interdependence between agriculture and industry is an integral component of development process, although the contribution of agriculture in explaining the growth rate of industrial output in initial stages of development plays a crucial role in the overall growth process of developing economies. This symbiotic relationship across the two sectors is highlighted through both the supply and demand-side channels. From the supply-side, agriculture supplies food grains, raw material inputs, and surplus savings to industry for mobilizing investment, whereas from the demand-side, agriculture constitutes the demand for industrial output through purchases of investment goods. In this context, the role of agriculture in economic development is emphasized in Johnston and Mellor (1961), where increased agricultural output and productivity contributes to overall economic growth in a developing economy through the expansion in food supplies, higher exports of agricultural products, provision of surplus labour for manufacturing, contribution to the capital required for overhead investments, and rising cash incomes as a stimulus to industrial expansion. On the contrary, according to Vogel (1994), the early writers – including Rosenstein-Rodan (1943), Lewis (1954), Scitovsky (1954), Hirschman and Sirkin (1958), Jorgenson (1961), and Ranis and Fei (1961) – emphasized the role of agriculture primarily as a supplier of wage goods, raw materials, and abundant labour supply to industry. This role was seen as fundamental to the central strategy of accelerating the pace of industrialization.

In his seminal work, Lewis (1954) proposed a two-sector classical growth model in which the dynamic nature of this growth process is characterized by the separation of the modern industrial sector from the traditional agricultural sector. In densely populated developing countries, labour in the agricultural sector is abundant and in surplus, having nearly zero marginal product, which leads to incomes determined at the subsistence level in the traditional sector. On the other hand, since labour in the modern industrial sector has a positive marginal product, it results in relatively higher average wages. If surplus manpower is assumed in the traditional agricultural sector, the supply of labour to the modern industrial sector becomes unlimited, where the transfer of manpower to industry is determined by the demand for labour in that sector, which in turn is limited by the rate of capital accumulation (Johnston and Mellor, 1961). This unlimited supply of labour from the traditional sector keeps the wage rate in the modern sector low, ensures that capital accumulation in the modern sector is sustained over time without lowering the agricultural output, and thus leads to economic transformation (Bhaduri and Skarstein, 2003). Kalecki (1960) and Kuznets (1968) emphasized the balanced agriculture-industry growth as a strategy for development. However, they also observed that while technological advancements support industrialization, the rapid development of industry also requires investments and improvements in agricultural productivity – which are necessary for a sustainable long-run growth path. For Kalecki (1971), the institutional reforms in land tenure systems and in credit markets became the paramount mechanisms in a successful agricultural development strategy (Vogel, 1994). The potential for the agricultural sector to stimulate industrial growth is also recognized in Mellor (1976) and Maxwell and Singer (1979), where the possibility of demand-led growth from agriculture and productive reinvestments from agricultural surpluses are underlined. Ranis (1984), comparing the performance of East Asian and Latin American countries, concludes that it is possible to avoid the conflicts between employment and growth and the distribution of income by affecting the way growth is generated, which indicates the extent of how a society's own changing endowment is effectively utilized in the course of this transition. In Adelman (1984), the manufacturing export-led growth model is reassessed as the major development dynamic for less-developed economies, where the relative merits of both the export-led and agricultural demand-led industrializations are compared by means of several simulation experiments through a computable general equilibrium, where the results support the agriculture-led industrialization approach on all counts.

During the 1970s, in a series of contributions, the late Cambridge economist Nicholas Kaldor developed a dual economy framework where he divides the economic activities of the world economy into primary and secondary sectors (Kaldor, 1972, 1975, 1976). The main objective of these papers is to highlight the importance of complementarity between sectors by emphasizing the demand constraint of industrial output. He does this in order to explain the pace and progression of output growth of industrialized countries, which provides a new interpretation of the stagflationary phenomenon of this period. In contrast, the dual economy theories developed earlier by classical and neoclassical economists such as Lewis (1954) and Jorgenson (1961) focused on the supply-side constraint in the economy, where a lower price of agricultural (wage) goods relative to industrial goods results in higher level of industrial profits, which leads to an increased rate of investment and therefore a faster growth of industrial output. Although these models emphasize the balanced growth of the economy with complementary sectors, they are unable to show the missing link from the demand side. That is, they are unable to establish whether the excess of industrial output can be sold to the agricultural sector in a closed economy. By emphasizing the role of the agricultural sector as a generator of demand for industrial output, and not merely as a supplier of agricultural surplus, Kaldor shifted the question by giving agriculture demand a central role in generating industrial growth in a dual economy. This is achieved by providing an unconventional meaning to the terms of trade between the two sectors, which play a double role – first, by moving the surplus from agriculture to industry and second, by creating agricultural incomes which would be transformed into industrial demand. From the Kaldorian perspective, this price mechanism emerging as terms of trade between agriculture and industry plays a crucial role in balancing the growth of demand for industry's output with the growth of its potential supply. This is because if terms of trade are favourable to agriculture, it raises the purchasing power of agriculture over industrial goods, which expands the market for industry and stimulates industrial output and growth in both the short and long run. In Kaldor's (1976) words:

> Continued and stable economic progress requires that the growth of output in these two sectors should be at the required relationship with each other – that is to say, the growth of the saleable output of agriculture and mining should be in line with the growth of demand, which in turn reflects the growth of the secondary (and tertiary) sectors.

In 1984, Kaldor's Mattioli lectures analyse a two-sector model with diminishing returns in agriculture and increasing returns in industry, where the former is land-based and produces consumption goods that are sold in competitive markets, while the latter produces investment goods by using only labour and capital that are characterized by imperfect competition with mark-up pricing. Unlike land-based activities in the primary sector, industry and services tend to cluster geographically through external scale and agglomeration economies (Skott, 1999). The focus of this dual economy model is to derive inter-sectoral balance underlying Kaldor's own views, where, as Kaldor argues, the critical factor for long-term economic growth lies in the persistence and continuance of land-saving innovations in agriculture, although the causes of this land-saving technical progress in Kaldor's model are not clearly specified. However, the questions addressed in these lectures or the discussions following Kaldor (1975, 1976, 1979) lacked formalization, which means the analysis lacks precision at key points. For instance, as Skott (1999) points out, it is difficult to reconcile Kaldor's views on the constraints on world economic growth because on one hand, he states that the "manufacturing sector provides the true dynamic element and the fundamental engine of growth of an economy", while on the other hand, he suggests that primary production determines the world economic growth. In view of this, the basic model presented informally in Kaldor (1975, 1976, 1979) is formalized, developed and extended in different directions in various subsequent versions. In Targetti (1985), an economy consisting of two complementary sectors – agriculture and manufacturing – faces the constraint on the overall growth process through either the decreasing returns in agriculture or low effective demand in industry when the terms of trade fail to work due to different pricing systems in the two sectors. In comparison, Thirwall (1986) analyses the complementarity between the two sectors, which can be applied to both developing and developed countries: a healthy agricultural sector is seen as the driving force behind industrial growth in the early stages of development and is superseded by export growth in the later stages. This model thus reinforces the belated recognition of agriculture's importance in the early stages of development, and supports the export led growth theory in the later stages. By contrast, Canning (1988) demonstrates that, with increasing returns to scale in industry, diminishing returns in agriculture need not be a barrier to growth. If increasing returns in the capital goods industries are sufficient to outweigh the diminishing returns to capital in agriculture, then the growth of the economy may be unlimited, despite the increasing demand for agricultural goods without the presence of technical progress so that the engine of growth is firmly located in the industrial sector. Molana and Vines (1989) formalize Kaldor's North-South model by assuming surplus labour and fixed real wages in both regions and analysing the model with both surplus and scarce land in the South. Thus, low price elasticity of demand for agricultural goods is identified as a potential source of cyclical movement in the terms of trade, which consequently supports Kaldor's (1976) conjecture that the price mechanism tends to set up perverse cycles in global industrial activity. Thirwall's (1986) paper proves the superiority of Kaldorian models for less developed economies compared to the earlier dual economy models of agriculture-industry interaction. However, Dutt (1992) highlights the problems with Thirwall's specification of the structure of the Kaldorian model and its underlying dynamics. Drawing on Thirlwall (1986), Dutt (1992) develops a consistent model of growth and development along the Kaldorian lines, which emphasizes the disequilibrium dynamics behind the model and demonstrates its dynamic stability. The formalization in Skott (1999) shows that the presence of diminishing returns to scale in agriculture is compatible with long-run growth only if industry has increasing returns to scale, which consequently suggests that the industrial sector is the engine of long-run growth that is warranted by a passive agricultural investment function. On the other hand, Bhaduri and Skarstein (2003) emphasize the Kaldorian argument about effective demand for industrial goods being created solely by the autonomous growth of agricultural surplus. They pinpoint that this argument requires serious qualification: although the potential demand from agricultural surplus is dependent on the agricultural sector alone, the realization of this surplus into purchasing power and thereby effective demand depends on the industrial sector. In this set up, both the sectors grow in tandem, reinforcing and reinvigorating each other's growth impulse, by resolving each other's potential realization problem (Jha, 2010).

The formal setup in Roberts and McCombie (2008) represents both an interpretation and formalization of the writings of Nicholas Kaldor (1975, 1976). They analyse Kaldor's writings using two scenarios – one, where the industrial terms of trade are flexible and that growth is unconstrained by effective demand, and the other, where the terms of trade are sticky and that effective demand constraint is the norm. They use the flexible (relative) price case as a theoretical benchmark, where the terms of trade adjust to ensure simultaneous market clearing for agricultural and industrial output and contrast this with the case of constant mark-up pricing in industry that gives rise to effective demand constraints. In their model, McCombie and Roberts (2008) use a modified form of the Leontief production function for agriculture that uses land, labour, and capital, while industry's production function has a more straightforward Leontief form between capital and labour. Given these assumptions, they formalize Kaldor's work to show the long run growth rate of the economy where the rates of growth of both sectors are equalized along the balanced growth path in both the supply- and the demand-constrained situations.

In our model, we introduce land constraint by developing further on the theoretical model of Roberts and McCombie (2008). We extend their model by altering the production functions for both the agricultural and industrial sectors, allowing both sectors to use land, labour, and capital so that it consequently brings in land use in industry. While Kaldor assumed that the secondary and tertiary sectors use only capital and labour, unlike land-based activities in the primary sector, as they tend to cluster geographically through scale and agglomeration economies in the industrialized countries, we make a departure from this assumption. This is because when we employ the dual economy Kaldorian framework to a developing economy such as India, it is not only the technologically-backward agricultural sector that remains dependent on land inputs, but the significant increase in private demand for land during the post-liberalization period for the purposes of industry, infrastructure, and real estate also puts additional pressure on limited units of total land available in the economy. Consequently, agriculture supplies not only the consumption goods and surplus labour to the non-agricultural sector, but also enables the transfer of its allocated land input to industry. Given the rising land needs in non-agricultural sectors, we consider the inter-sectoral flows of commodities and labour as well as land transfers in our dual economy model framework.

2. Equilibrium growth with fixed land distribution

We consider a closed economy model, where our focus will be on two sectors, namely, agriculture and industry. The economy is assumed to be neatly divided into these two sectors, where each sector produces a single good – agriculture produces the pure consumption good, while industry produces the pure investment good. Agriculture is assumed to be perfectly competitive, while industry is imperfectly competitive. Since the industrial sector is imperfectly competitive, we assume that the Kaleckian mark-up pricing is followed here since Kaldor also adopted the Kaleckian framework of cost-determined price with a constant rate of mark-up (Bhaduri and Skarstein, 2003). In this dual economy framework, we consider three kinds of inter-sectoral transfers: trade flows, labour movements, and land transactions. Therefore, this dual economy modelling provides an extension to the existing forms of inter-sectoral transactions in the Kaldorian model and its subsequent formal versions, where agriculture acts as a supplier of not only the conventionally considered wage goods and surplus labour, but also of land units to industry that consequently determines the equilibrium level of terms of trade.

In order to introduce land constraint in our model setup, we assume that the total quantity of land in the economy is limited and that land allocation is neatly divided between agriculture and industry by the centralized authority. We assume that the government plays a central role in distributing the total available land in the economy between the two sectors. This assumption follows from our aforementioned discussion in section 1, where land is acquired by government departments in various parts of India and is then allocated to private companies in response to an investment surge in the post-liberalization period. Government intervention is required to facilitate the transaction of various plots of land from large smallholding farmers in order to fulfil the growing demand for land uptake from industry and services and overcome the supply barrier to land-consuming private investments. This, therefore, implies that *both* agriculture and industry use land, labour, and capital in their production process to produce their respective commodity.

We take $\bar{R}$ to be the total available land in the economy at any given point of time, which is divided by the government in fixed amounts between agriculture and industry so that,

$$R_a + R_i = \bar{R}(0 < R_a, R_i < \bar{R}) \quad (1)$$

where, R_a is land units with agriculture and R_i is land units with industry. Agriculture and industry are denoted throughout using the subscripts 'a' and 'i' respectively.

The production function in agriculture and industry takes the following modified Leontief form:

$$Y_a = min\{A_a K_a R_a^{\alpha}, B_a L_a\} \qquad (\alpha < 1) \quad (2)$$

$$Y_i = min\left\{A_i K_i R_i^{\beta}, B_i L_i\right\} \qquad (\beta < 1) \quad (3)$$

where 'Y' denotes sectoral output. 'A' and 'B' are respectively the levels of capital/land- and labour-saving technology parameters. 'R', 'K' and 'L' respectively represent the inputs of land, capital, and labour employed in each sector. Given the existence of surplus labour in developing economies, the modified Leontief production function in each sector reduces to the following:

$$Y_a = A_a K_a R_a^{\alpha} \qquad (\alpha < 1) \quad (4)$$

$$Y_i = A_i K_i R_i^{\beta} \qquad (\beta < 1) \quad (5)$$

Output increases over time due to capital/land-saving technical change, which requires capital investment and land inputs. We assume constant returns to capital and diminishing returns to land in each sector by taking $0 < \alpha, \beta < 1$. This is consistent with Kaldor's model, where he deems capital accumulation necessary for the implementation of new technology in each sector, which is just sufficient to offset any tendency towards diminishing marginal returns within each sector (Kaldor, 1975). However, Roberts and McCombie (2008) specify the condition of diminishing returns to land only for agriculture. We use their Cobb Douglas production function and extend the condition of diminishing returns to land for *both* the agricultural and industrial sectors. Although capital accumulation is necessary for the implementation of new technologies in industry, there is also a need for land inputs in this sector for either drawing raw materials, locating plant facilities, or setting up office spaces and residential facilities. Thus, the Cobb Douglas production function for agriculture is also similarly extended to this sector in order to highlight the role of land allocations between the two sectors. In addition, R_a and R_1 are fixed by the government, so that throughout this exercise they will be treated as constants. This implies that once the distribution of $\bar{R}$ is fixed by the centralized authority, there is no further land transaction between the two sectors.

Using equations (4) and (5), we now define the rate of growth of output in each sector as:

$$g_a = \frac{\dot{Y}_a}{Y_a} = \frac{\dot{K}_a}{K_a} \tag{6}$$

$$g_i = \frac{\dot{Y}_i}{Y_i} = \frac{\dot{K}_i}{K_i} \tag{7}$$

In order to finance capital accumulation, agricultural actors save a fixed fraction s_a of output with the intention of purchasing investment goods from industry at price P_i, so that we get:

$$s_a P_a Y_a = P_i \dot{K}_a \tag{8}$$

Industrial sector firms are assumed to reinvest their profits within the sector itself. Industrial sector workers, on the other hand, spend all their income on consumption goods so that their saving propensity is zero. Therefore, we have:

$$[P_i Y_i - W_i L_i] = P_i \dot{K}_i \tag{9}$$

P_a and P_i denote (money) price for agricultural and industrial goods respectively. W_i is the industrial (money) wage, L_i= $[Y_i \,/\, B_i]$ and $W_i L_i$ represents the nominal wage cost for industry. For simplicity, we assume a zero depreciation rate. Dividing through by K_a in equation (8), and denoting the rate of growth of capital stock in agriculture (in the absence of depreciation) by g_a, we get:

$$g_a = \frac{s_a A_a R_a^{\alpha}}{p} \tag{10}$$

where $p = P_i \,/\, P_a$ represents the industrial terms of trade.

As observed from equation (10), the rate of growth in agriculture is inversely related to industrial terms of trade since a higher value of 'p' raises the capital-output ratio in agriculture and consequently lowers its rate of growth.

Considering the nature of industrial pricing, the existence of imperfect competition in industry implies the prevalence of mark-up pricing, where the price of industrial good is fixed as a constant mark-up on unit labour costs. We follow Kaldor (1975, 1979), Targetti (1985) and Thirlwall (1986) by using the Kaleckian pricing formula (Kalecki, 1971), where the price of the industrial good is:

$$P_i = (1 + z)\frac{W_i}{B_i} \tag{11}$$

where 'z' is the constant rate of mark-up determined by the degree of monopoly in industry. By dividing the above pricing equation by P_a, we get the following relationship between the industrial terms of trade 'p' and the real wage rate $\omega = (W_i \,/\, P_a)$:

$$p = (1 + z)\frac{\omega}{B_i} \tag{12}$$

From equation (12), we observe that the terms of trade are proportional to the real wage rate in industry for given values of labour-output ratio B_i and constant mark-up rate z. When it comes to the flexibility of terms of trade, Kaldor and his followers seemed to be unclear on this point: Kaldor's own writings tried two entirely different routes and provided inconsistent accounts (Roberts and McCombie 2008). According to Bhaduri and Skarstein (2003), along one route, Kaldor drew attention to the importance of effective demand and trade balance between the sectors as the governing mechanism, whereas along the other route, he suggested that the agricultural and industrial growth rates are respectively decreasing and increasing functions of the terms of trade due to supply incentives generated by relative prices, which results in a uniform equilibrium growth rate in both sectors at the equilibrium value of the terms of trade. In our model, we assume perfect flexibility in the terms of trade between the two sectors because it places central reliance on the price mechanism as strongly emphasized by Kaldor himself. Since we assume the terms of trade to be fully flexible, which adjusts to clear both the markets, this implies flexibility in real wages 'ω' because with the assumption of fixed mark-up rate 'z' and constant output-labour ratio 'B_i' from equation (12), this necessitates that the flexibility in terms of trade is derived from the flexibility in real wages in this dual economy. In order to highlight the crucial role played by the terms of trade with an imperfectly competitive industrial sector, where the price mechanism between agriculture and industry is intended to bring into balance the growth of demand for industry's output with the growth of its potential supply, it becomes imperative that both 'p' and 'ω' are treated as perfectly flexible in this model.

On making substitutions in equation (9) and dividing through by K_i, we get the following expression for the rate of growth of capital stock in industry, g_i:

$$g_i = A_i R_i^{\beta} \left(\frac{z}{1+z}\right) \tag{13}$$

As observed from equation (13), the rate of growth of industrial output is independent of the terms of trade 'p', while it is proportional to both the profit share $\left(\frac{z}{1+z}\right)$ and land-units allocated to industry R_i. This also implies that the rate of growth of the industrial sector in our model is exogenously determined.

Considering the market clearing conditions for both the consumption and investment good, we have the following:

$$P_a Y_a = (1 - s_a) P_a Y_a + W_i L_i \tag{14}$$

$$P_i Y_i = P_i \dot{K}_i + P_i \dot{K}_a \tag{15}$$

It must be pointed out that since we are assuming that all saving is respectively invested within each sector, equations (14) and (15) are not independent because equations (8) and (9) guarantee that these are satisfied. Since all saving is invested within each sector and trade across sectors is balanced, we find that the equilibrium in one market implies equilibrium in the other market. That is, the industrial market would be in equilibrium if the agricultural market clears and vice versa so that the Walrus' law applies in our model.

In order to study the long run dynamics of the economy, we assume that the relative price 'p' varies to clear both the markets in the short run. That is, both the terms of trade and the real wage rate are assumed to be flexible, while the levels of capital stock are allowed to change only in the long run period. By focusing just on the agricultural goods market, which would then automatically result in equilibrium in the market for the industrial good.

Since the terms of trade are perfectly flexible, we assume that 'p' responds positively to excess supply in the agricultural market, which is formalized by the following equation:

$$\frac{dp}{dt} = \dot{p} = \theta\left[s_a A_a R_a^{\alpha} k - A_i R_i^{\beta}\{1 / (1 + z)\}p\right] \tag{16}$$

where $k = K_a / K_i$ and $\theta > 0$ is price adjustment coefficient.

The term within the brackets is the excess supply of agricultural goods divided by K_i. According to equation (16), given k, p adjusts in the short run by increasing when there is an excess supply of agricultural goods and decreasing when there is an excess demand. Also, since $\frac{dp}{dt}$ is negatively related to p, the short run adjustment process is stable. This is simply because when there is an excess supply of agricultural goods and excess demand for industrial goods, there is an upward pressure on the terms of trade. But as p rises, $\frac{dp}{dt}$ decreases, given k, which then results in the economy converging to a new short run equilibrium as $\frac{dp}{dt}$ becomes equal to zero, thereby clearing both the markets. Equation (16) can therefore be reduced to the following with $\frac{dp}{dt} = 0$:

$$\dot{p} = 0 \leftrightarrow p = \left(\frac{s_a A_a R_a^{\alpha}}{A_i R_i^{\beta}}\right)(1 + z)k \tag{17}$$

Equation (17) can be represented by an upward sloping graph on the left-hand side of figure 1, while the graphs for g_a and g_i are represented on the right-hand side as derived from equations (10) and (13). As observed from figure 1, g_a is a downward sloping curve as the rate of capital accumulation in agriculture is inversely related to the industrial terms of trade whereas the graph for g_i is vertical since the rate of capital accumulation in industry is independent of the terms of trade. For any given k, the left-hand side of this figure determines the short run equilibrium value of p and the right-hand side determines the corresponding value of g_a by reading off from the g_a curve. Since g_i is a constant, its value remains the same in the short run as well as the long run.

In the long run, 'k' moves over time according to the following equation:

$$\frac{dk}{dt} = \dot{k} = k[g_a - g_i] = \left[\frac{s_a A_a R_a^{\alpha}}{p} - A_i R_i^{\beta}\left(\frac{z}{1+z}\right)\right] \tag{18}$$

Along the balanced growth path for this economy, $\dot{k} = 0$ at the long run equilibrium, which implies that the growth rate across the two sectors are equalized with $g_a = g_i$. By equating $\dot{k} = 0$ from equation (18), we get:

$$\dot{k} = 0 \leftrightarrow g_a = g_i \leftrightarrow p = \left(\frac{s_a A_a R_a^{\alpha}}{A_i R_i^{\beta}}\right)\left(\frac{1+z}{z}\right) \tag{19}$$

Solving for $\dot{k} = 0$, we obtain the long run equilibrium value of the terms of trade p. Consequently, by substituting this long run value of p in equations (10) and (12), we respectively get the long run equilibrium values of growth rate and real wage rate. Thus, the balanced growth path for this economy can be represented by the following set of values:

$$p^* = \left(\frac{s_a A_a R_a^{\alpha}}{A_i R_i^{\beta}}\right)\left(\frac{1+z}{z}\right) \tag{20}$$

$$\omega^* = \left(\frac{s_a A_a R_a^{\alpha}}{A_i R_i^{\beta}}\right)\left(\frac{B_i}{z}\right) \tag{21}$$

$$g^* = A_i R_i^{\beta} \left(\frac{z}{1+z}\right) \tag{22}$$

Considering the long run stability, we find that when $k > k^*$, p increases as $\frac{\mathrm{dp}}{\mathrm{dt}} > 0$ with respect to k (from equation (16)), which results in a decline in the rate of capital accumulation since $\frac{\mathrm{dk}}{\mathrm{dt}} < 0$ with respect to p (from equation (18)) so that the economy converges to the long run equilibrium value of k^* (figure 1). For any k greater than (less than) k^*, g_i becomes greater than (less than) g_a, which implies that k falls (rises) over time to take the economy to the long run equilibrium value at k^*. Thus, the long run equilibrium is determined at the intersection of g_i and g_a curves to give g^* along the balanced growth path.

In order to analyse how the balanced growth rate changes over time, we notice that the long run rate of equilibrium growth is entirely determined by the industry parameters so that it becomes an exogenously determined constant in the model. This implies that for the long run balanced growth path to be stable, the rate of growth of the agricultural sector must be equal to this exogenous rate. This is because in the initial stages of growth in a developing economy, both agriculture and industry invest their savings to buy capital goods, which determines the rate of accumulation of capital stock in each sector and hence the rate of growth for each sector. Since these capital goods are produced only by industry, we find that the overall growth rate of the economy is also governed only by the imperfectly competitive industrial sector in a developing economy.

Figure 1 – *Convergence to long run equilibrium*

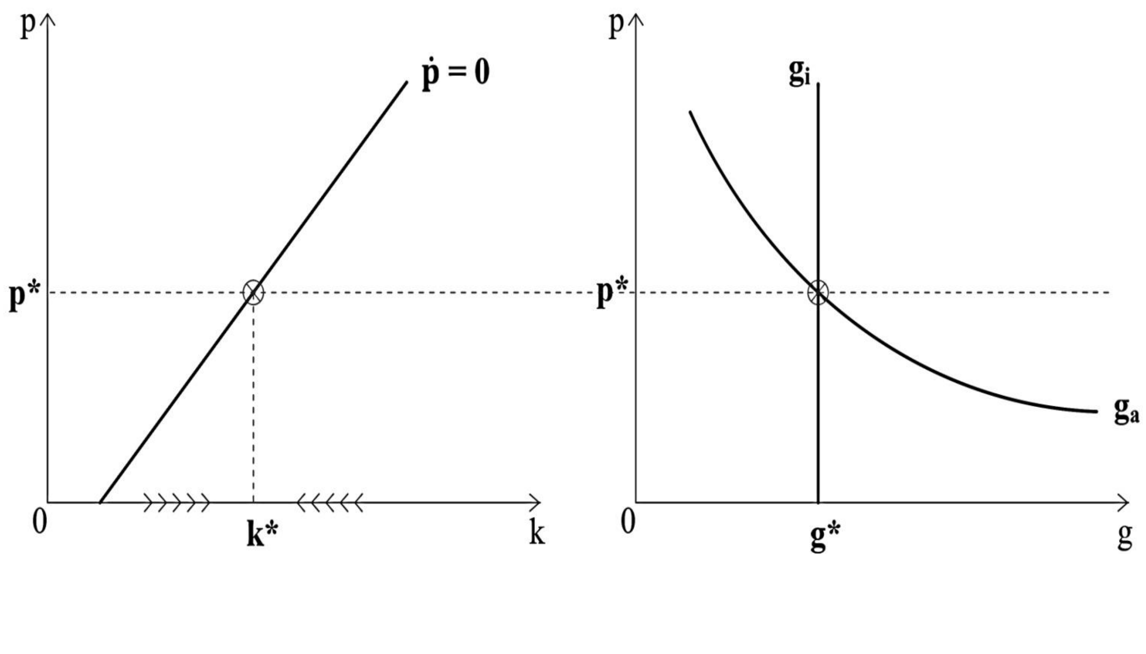
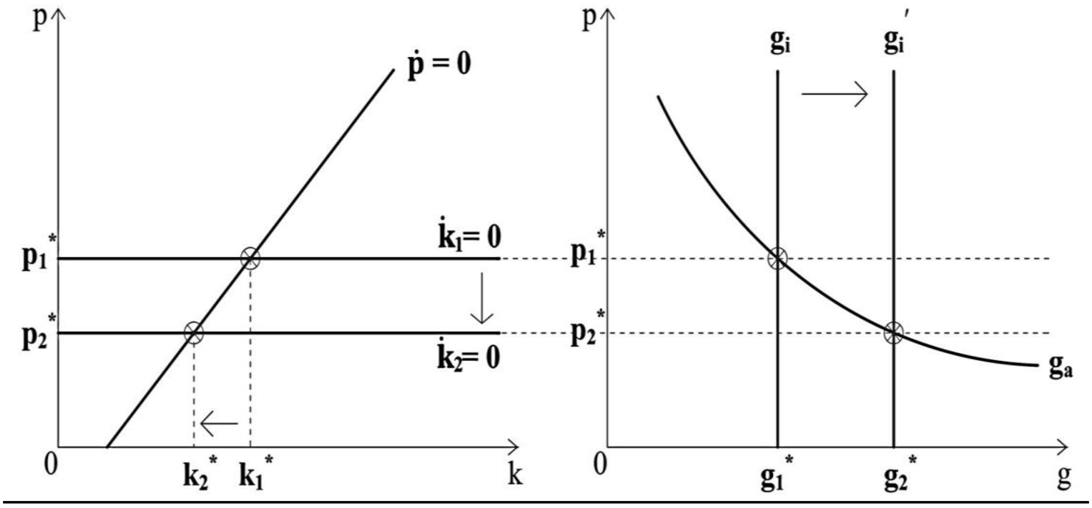


Figure 2 – *Downward pressure on the terms of trade for industry*



In addition, when we consider the stability of the balanced growth path in our model, we observe that it is primarily because of the assumption of perfect flexibility of the terms of trade between industry and agriculture, which is allowed for by the assumption of perfect flexibility of the real wage rate in industry. The process by which the economy converges to the balanced growth path can be explained as follows. Suppose, beginning from a situation of balanced growth, A_i or R_i increases, which raises g_i. Since g_i is now greater than g_a, at the old equilibrium terms of trade there is now an excess demand for the consumption good and an excess supply of the investment good that exerts a downward pressure on the terms of trade for industry (figure 2). But as p reduces, the agricultural growth rate increases in the process, which results in a higher demand for capital goods from this sector, while the rate of growth of the industrial sector remains unaffected by the change in k. As a result, the growth rate of agriculture approaches the growth rate of industry and the process continues so long as the rate of growth of agriculture remains below that of industry. Thus, the economy reaches a new balanced growth path, where the equilibrium growth rate is higher along with lower levels of p^* and k^* in the long run.

Considering equation (22), we find that g^* is positively and non-monotonically related to land units with industry. This is given by the first- and the second-order derivative conditions:

$$\frac{\partial g^*}{\partial R_i} = \beta A_i R_i^{\beta-1}\left(\frac{z}{1+z}\right) > 0 \qquad (23)$$

$$\frac{\partial^2 g^*}{\partial R_i^2} = \beta(\beta-1) A_i R_i^{\beta-2}\left(\frac{z}{1+z}\right) < 0 \qquad (0 < \beta < 1)\ (24)$$

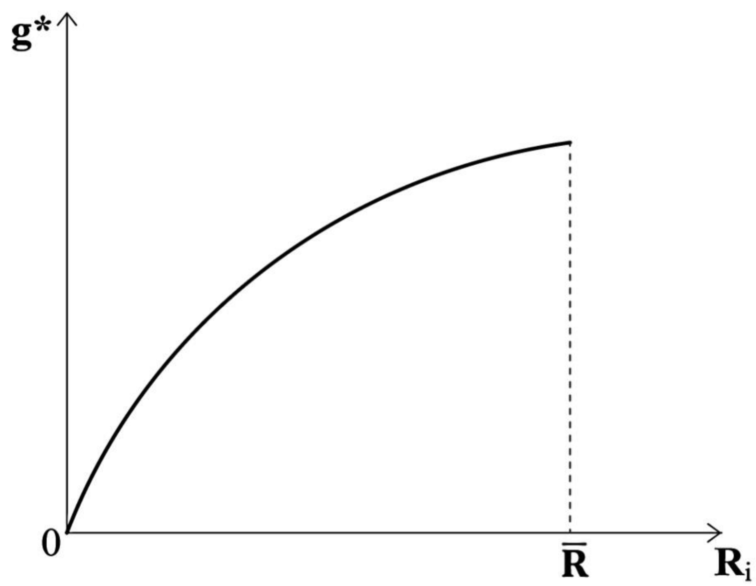
As observed from equations (23) and (24), higher land allocations to industry raise the long run equilibrium growth rate. This is because when land allocation to industry (R_i) is increased, it reduces the equilibrium terms of trade p^*. Thus, as the terms of trade become favourable to agriculture, it raises the purchasing power of agriculture over industrial goods, which expands the market for industry and thereby stimulates industrial output and growth in the long run. This analysis, therefore, lends support to the conclusions made by Kaldor (1976), which assigns agricultural demand a central role in generating industrial growth—achieved through movements in terms of trade—in a dual economy. However, in our dual economy model, this downward movement in industrial terms of trade is generated because, as land input is transferred from agriculture to industry, it results in a direct fall in agricultural production (from equation (10)), which consequently raises the relative price of consumption goods, increases the income levels in agriculture and thereby stimulates demand for industrial goods and promotes long-run growth. Primarily, this is because we consider agriculture as a supplier of consumption goods and surplus labour as well as land input to industry in a developing economy, where a significant increase in private demand for land, accompanied by the existence of land-intensive agricultural sector, puts enormous pressure on limited units of total land available in the economy.

Also, as more and more land is transferred from agriculture to industry, g^* increases at a decreasing rate, which implies that g^* is non-monotonically related to R_i. This is indicated in figure 3. Since total land units in the economy is limited to $\bar{R}$, we find that g^* reaches a maximum value when all the land in the economy is allocated to industry. This is given by:

$$g^*_{Max} = A_i \bar{R}^{\beta} \left(\frac{z}{1+z}\right) \tag{25}$$

In such a case where $R_i = \bar{R}$ and $g^* = g^*_{Max}$ the economy reduces to a one-sector model, where only the industrial sector is existent, while agriculture disappears. In this setup, industry thrives by producing the industrial good that is used for investment so that g^*_{Max} is sustained by the reinvestment of all savings from industrial profits within the sector.

Figure 3 – *Increase in g^* as land is transferred from agriculture to industry*



The inferences made in this section are summarized in the following propositions:

Proposition 1: An imperfectly competitive industrial sector determines the overall growth process of the economy, when the land allocations between agriculture and industry are fixed.

Proposition 2: Any rise in industry parameters results in higher equilibrium growth rate along the balanced growth path in the long run if the terms of trade and the real wage rate are assumed to be perfectly flexible.

Proposition 3: An increase in land allocations to industry non-monotonically increases the equilibrium growth rate of the economy.

Proposition 4: In a situation where all the land in the economy is transferred to industry, the economy reduces to a stable one-sector model, where only the industrial sector is existent, while agriculture disappears.

3. Equilibrium growth with existence of land transfers

In this section, we now allow for inter-sectoral land transfers to take place between agriculture and industry accompanied by the existence of land-saving innovations in each sector. We assume that land is transferred across sectors by the centralized authority, where land is acquired by the government from agricultural farmers and then allocated to private companies. Since government intervention is required in inter-sectoral land-transfers, we assume the absence of any separate land markets so that the focus of this exercise is to highlight the essential role of land-saving innovations in each sector on the long-term growth process of a developing economy.

Given limited units of land $\bar{R}$ in the economy as observed in equation (1), land transfers imply the following:

$$\dot{R_a} + \dot{R_\iota} = 0 \quad or \quad \dot{R_a} = -\dot{R_\iota} \tag{26}$$

In the previous section, we used Cobb-Douglas production functions, which allowed for some degree of substitutability between land and capital. However, there is an irreducible amount of land required in the industrial sector that cannot be substituted for by the capital stock, which is, for instance, needed for drawing natural resources or setting up production plants. In view of this, we now change the specification of the production functions for each sector and see how the balanced growth processis different here. To do so, we use the Kaldorian setup with a few modifications.

Consider the following Leontief production functions, where there is strict complementarity between capital, labour, and land in each sector:

$$Y_a = min\{A_a K_a, B_a L_a, C_a R_a\} \tag{27}$$

$$Y_i = min\{A_i K_i, B_i L_i, C_i R_i\} \tag{28}$$

Since there is assumed to be a labour surplus in both sectors of a developing economy, these production functions are reduced to the following:

$$Y_a = min\{A_a K_a, C_a R_a\} \tag{29}$$

$$Y_i = min\{A_i K_i, C_i R_i\} \tag{30}$$

We further assume that capital and land are fully utilized in each sector, so that the above production functions can be rewritten as follows:

$$Y_a = A_a K_a = C_a R_a \tag{31}$$

$$Y_i = A_i K_i = C_i R_i \tag{32}$$

In addition, we introduce technological change in each sector by assuming land saving innovations with a constant rate of growth of land productivity in both sectors. Let ρ_a be the rate of growth of land productivity in agriculture and ρ_i be the rate of growth of land productivity in industry ($\rho_a > 0, \rho_i > 0$). Therefore, this implies the following:

$$C_a = C_a(0)e^{\rho_a t} \tag{33}$$

$$C_i = C_i(0)e^{\rho_i t} \tag{34}$$

From equations (31), (32), (33) and (34), it follows that:

$$\frac{\dot{K}_a}{K_a} = \frac{\dot{R}_a}{R_a} + \rho_a \tag{35}$$

$$\frac{\dot{K}_i}{K_i} = \frac{\dot{R}_i}{R_i} + \rho_i \tag{36}$$

Considering the growth rates for agriculture and industry, we get:

$$g_a = \frac{\dot{Y}_a}{Y_a} = \frac{\dot{K}_a}{K_a} = \frac{\dot{R}_a}{R_a} + \rho_a \tag{37}$$

$$g_i = \frac{\dot{Y}_i}{Y_i} = \frac{\dot{K}_i}{K_i} = \frac{\dot{R}_i}{R_i} + \rho_i \tag{38}$$

Now, we analyse the balanced growth path for this economy by using the following equation of motion for relative capital stock:

$$\frac{\dot{k}}{k} = \frac{\dot{K}_a}{K_a} - \frac{\dot{K}_i}{K_i} = [g_a - g_i] = \frac{\dot{R}_a}{R_a} + \rho_a - \frac{\dot{R}_i}{R_i} - \rho_i \tag{39}$$

Suppose in the long run, the economy approaches a state of stable output shares in both sectors. That is, in the long run, both agriculture and industry grow at the same rate and the economy is on a sectorally balanced growth path. We now try to characterize how the rate of growth of the economy behaves along such a balanced growth path. At the long run equilibrium, we have $\dot{k} = 0$, which results in:

$$\frac{\dot{R}_a}{R_a} + \rho_a - \frac{\dot{R}_i}{R_i} - \rho_i \tag{40}$$

Using equations (26), (37), (38) and (40) to make the necessary substitutions, we get:

$$\left(\frac{\dot{R}_i}{R_i}\right)\left[1 + \frac{R_i}{R_a}\right] = \rho_a - \rho_i \tag{41}$$

$$(g^* - \rho_i)\left[1 + \frac{R_i}{R_a}\right] = \rho_a - \rho_i \tag{42}$$

where $g^* = g_i = g_a$ is assumed to be the long run equilibrium growth rate of the economy at which $\dot{k} = 0$. Thus,

$$g^* = \left[\frac{\rho_a - \rho_i}{1 + \frac{R_i}{R_a}}\right] + \rho_i \tag{43}$$

Now, let 'r' be the ratio of land under industry to land under agriculture along the balanced growth path and let r_0 be the initial value of this ratio. We therefore have:

$$r = \frac{R_i}{R_a} \rightarrow \frac{\dot{r}}{r} = \frac{\dot{R}_i}{R_i} - \frac{\dot{R}_a}{R_a} = \rho_a - \rho_i \rightarrow r = r_0 e^{(\rho_a - \rho_i)t} \tag{44}$$

According to equation (44), the proportional rate of change of 'r' is given by the difference between the rate of land-saving innovations in agriculture and industry respectively. We now simplify the expression for g^* in equation (43) to get:

$$g^* = \left[\frac{\rho_a - r\rho_i}{1+r}\right] \tag{45}$$

Due to inter-sectoral land transfers by the centralized authority, 'r' changes over time and so does g^* from equation (45). We consider the rate of change of g^* as follows:

$$\frac{dg^*}{dt} = \frac{\dot{r}(\rho_i - \rho_a)}{(1+r)^2} \tag{46}$$

From equation (46), we now infer how the long-run balanced growth rate of the economy behaves under the three cases (i) $\rho_a = \rho_i$ (ii) $\rho_a > \rho_i$ and (iii) $\rho_a < \rho_i$.

In case (i), we have $\rho_a = \rho_i = \rho$. It follows from equation (44) that 'r' is constant over time, which then implies that $g^* = \rho$. Thus, the long-run equilibrium rate of growth in the economy is a constant and is equal to the common rate of growth of land productivity in both the sectors.

In case (ii), it follows that 'r' increases over time. But since $\rho_a > \rho_i$, g^* decreases over time. Over time, as 'r' approaches infinity, g^* approaches ρ_i, which is the growth rate of land productivity in the sector with lower pace of land-saving innovation.

In case (iii), by contrast, 'r' is decreasing over time. But since $\rho_a < \rho_i$, g^* decreases here too. However, as 'r' approaches 0 asymptotically, it follows that g^* approachesρ_a, which, again, is the growth rate of land productivity in the sector with lower pace of land-saving innovation.

From cases (ii) and (iii), it follows that the technologically backward sector with lower rate of land-saving innovation acts as a constraint on the overall growth process of a developing economy. This is because, with lower rates of innovation in a given sector, its dependence on allocated land input becomes relatively greater. This consequently puts a constraint on the transfer of limited land inputs across sectors, which inhibits long-run growth in a rapidly growing developing economy. In extreme cases, if the land-saving innovation rate is reduced to zero in any one sector, that is, either $\rho_a = 0$ or $\rho_i = 0$, then we observe from equations (44), (45), and (46) that the equilibrium growth rate is also reduced to zero in this case. This analysis therefore implies that the long-run equilibrium growth rate of a land-constrained developing economy can be maintained only when the rates of land-saving innovations in both the sectors are equal and balanced, which consequently leads to a sustainable growth path over the long-run. This result reinforces Thirwall's (1986) conclusion that, in the long run, the growth of industry in a closed economy is fundamentally determined by the growth of land-saving innovations in agriculture as an offset to diminishing returns, which contrasts the standard neoclassical result, where the long run steady state growth of industry is determined by the exogenous growth rate of labour supply. In his model, technical progress in industry only affects the short-term changes in terms of trade, while the technical progress in agriculture (or discovery of new land) relaxes the ultimate constraints on industrial growth in the long run. Similarly, in Skott (1999), while neither sector is regarded as the sole engine of growth in the case of an independent investment function in agriculture, the same is not true for the case when agricultural investment is constrained by the availability of agricultural savings. With passive agricultural investment function, although the industrial sector is considered to be the engine of growth, it does not change the fact that agriculture imposes a limit on the rate of growth through the need for land-saving innovations, which appears in the model through the existence of a technical progress function that depends on the interaction between the two sectors. In comparison, our model emphasizes the critical role of relative growth rates of land-saving innovation across agriculture and industry, which adds to the analysis of constraint on the long run growth process of a developing economy.

The inferences made in this section are explained in the following propositions:

Proposition 5: In a labour-surplus developing economy with limited units of total land, centrally-controlled land transfers between agriculture and industry accompanied by land-saving technological growth in each sector affects the long-run balanced growth path in the following ways:

1. Long-run growth rate of the economy is a constant only if the rates of growth of land productivity are the same in both sectors.
2. If the rates of growth of land productivity are different in the two sectors, then the growth rate of the economy must decline over time and asymptotically approach the rate of growth of land productivity in the sector with the lower rate of growth of land productivity.
3. If there is no land saving innovation in the economy, then there can be no growth in the economy. Balanced growth rate is reduced to zero in this case.
4. If there is no land saving innovation even in one sector of the economy, then the rate of growth in the economy would asymptotically approach zero. That is, growth would not be sustainable in the long run.

Proposition 6: On comparing the growth models of sections 3 and 4, we make note of the following:

1. In section 3, growth can be indefinitely sustained at a constant rate despite no technological change in the economy because there are constant returns only to capital input in both sectors. In section 4, there are joint constant returns to scale in both capital and land in each sector, which implies that if there is no growth in land productivity in a given sector, then one can maintain growth in that sector by shifting land from the sector with positive land productivity growth. However, given a fixed amount of total land, this possibility gets exhausted over time so that in the absence of land productivity growth, growth of output in the sector with no land-saving innovation must come to a halt, which in turn also affects the overall growth of the economy.
2. In section 3, land serves as a constraint on the balanced growth rate of the economy, while in section 4, it serves as a constraint on growth itself in the absence of widespread technological change.

4. Conclusion

In order to maintain the current growth trajectory in developing and emerging economies, it is essential that the rate of growth of agricultural sector is balanced with efforts of rising industrialization. To consider the effects of land transfers between agriculture and industry, we use the Kaldorian framework of two-sector model and look at its influence on the long run growth process of a developing economy. In doing so, we use the formal setup of Mark Roberts and JSL McCombie (2008), in which we alter the production functions for both the sectors by including land, labour and capital as the factors of production for each of agriculture and industry.

Firstly, we consider the fixed distribution of total land between the two sectors in the economy and allow land to be substituted with capital in each sector. In this case, the economy approaches a balanced growth path in the long run, where the rate of growth is non-monotonically related to the amount of land allocated for use in the industrial sector. Growth in the economy is land-constrained, where any redistribution of land in favour of industry would lead to an increase in the long-run rate of growth of the economy. It is found that the balanced growth rate attains a maximum when the entire land is allocated to industry because in this setup, the industrial growth rate determines the overall growth rate of the economy. This is in contrast to the result obtained in Roberts and McCombie (2008), where the balanced growth rate increases with respect to R_a, no matter how high the value of R_a is. Since we have included the constraint where $[R_a = \bar{R} - R_i]$ accompanied by mark-up pricing in industry, we get different results here. The implication is that if land transfers between agriculture and industry are not allowed, then there is a constraint on increasing the long-run rate of growth. Thus, the maximum possible land which can be given for use in the non-agricultural sector determines the maximum rate of growth possible in the economy in the long run. This rate of growth itself, however, can be maintained indefinitely despite fixed amounts of land in usage in both sectors because capital can be substituted for land indefinitely and there are constant returns to capital in both sectors.

Secondly, we take the diametrically opposite case, where land cannot be substituted by capital because there is some fixed irreducible quantity of land required for producing a unit of output in any given sector. If land transfers are not possible and there is no technological growth, then output in each sector would be fixed and growth would not be possible. We therefore allow for *both* land transfers and land saving innovations in the two sectors. We consider the rate of growth of the economy along a balanced growth path, in which industry and agriculture are growing at the same rate. In this exercise, we find that the rate of growth of the economy is a constant only when the rates of growth of land productivity are equally sustained in both sectors. Otherwise, if land productivity growth rates diverge across sectors, then the growth rate of the economy declines over time and asymptotically approaches the land productivity growth rate of the slow-growing sector. In extreme cases, if there is no land saving innovation even in one sector of the economy, then the growth rate of the economy asymptotically approaches zero, where the growth itself becomes unsustainable in the long run. Thus, without any widespread technological change, land can serve as a constraint on growth itself.

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