

Infrastructure Development in a Dual Agricultural Economy: Implications for Economic Growth and Income Distribution

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Abstract

Provision of adequate infrastructure has been a major responsibility of the state in many developing countries over the course of their development. However, various case studies indicate that infrastructure policies have not been very effective both in terms of their influence on economic growth and income distribution. Not only has infrastructure become a major bottleneck for economic development, infrastructure policies aimed at targeting the poor have also failed to achieve their objectives. Typically the poor subsidize the rich in the process of public infrastructure delivery. Such subsidization is particularly rampant in the agricultural sector that often dominates the developing country economies before a structural transformation has taken place, which is often the case in the initial economic development stages.

We attempt in this study to analyze the efficacy of public provision of infrastructure in the initial economic development stages when agriculture is often the dominant sector. A system dynamics model of a dual economic system pervasively found in the developing countries was originally developed by Saeed (1980, 1988, 1994) to search for fiscal and institutional policy instruments to affect income distribution. We have extended Saeed's model to include decision rules affecting infrastructure provision, so the efficacy of the infrastructure policy as a lever to improve income distribution could be evaluated. Computer simulation is used as an experimental process to examine the impact of the various policy options tested.

Key Words: economic development, public finance, infrastructure planning, agricultural systems, system dynamics, computer simulation

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Introduction

Infrastructure investment is an important instrument employed by the developing country governments over the past forty years to affect economic development (Krueger 1992). A World Bank study examining a cross-section of developing countries shows that infrastructure typically represents about 20 percent of their total investment and 40 to 60 percent of their public investment. Although private sector participation in infrastructure services delivery is on the rise, its volume remains small. Of the US\$200 billion invested in infrastructure in the developing countries in 1993, only 7 percent originated from the private sector (World Bank 1994). Since the governments in most developing countries do not have the necessary institutions to implement many fiscal policies to facilitate economic growth and influence income distribution, infrastructure policy is often seen as an effective tool to achieve those ends (van de Walle and Nead 1995, Israel 1992, Boadway and Marchand 1995). However, it is not clear whether the public sector provision of infrastructure can be an effective instrument for facilitating economic growth and delivering welfare.

In order to understand the potential for public provision of infrastructure as an effective policy instrument for development, it is necessary to understand the dynamic interaction between public infrastructure provision with the socio-economic structure in place. Many scholars have considered agricultural development to be the foundation for further economic development while governments have also used infrastructure investment as a major tool to achieve agricultural development (Mellor 1967). World Bank Development Report (World Bank 1994) shows that during the early stages of the development, infrastructure resources are primarily invested in the agricultural sector - in irrigation and transportation. It has been observed, however, that in many developing countries the spread of the benefits of the infrastructure investment is limited and large farmers receive more benefit from infrastructure provision than small farmers (Knudsen et. al 1990, World Bank 1994, van de Walle and Nead 1995). We feel that the failure of the infrastructure policy to create a larger spread of benefits arises from the fact that the economic models underlying policy design are unrealistic. While the economic

models assume a homogenous socio-economic structure, in reality, there pervasively exists a dual economic system consisting of a profit maximizing formal sector and a consumption maximizing peasant sector no matter how one slices the economy. Any infrastructure policies implemented by the government will alter resource reallocation between these two sectors. Policies ignoring the dynamic interaction between these two sectors may not perform as expected.

In this paper, we analyze the efficacy of public provision of infrastructure in the initial economic development phases of the developing countries when agriculture is often the dominating sector. We accomplish this by constructing and experimenting with a System Dynamics model of public provision of infrastructure in a dualist agricultural economy. This model provides an opportunity to experiment with the various infrastructure policies proposed and implemented in the past and to understand their performance under controlled conditions. Such experimentation also helps to resolve some of the debates on development policy arguing for and against infrastructure provision. Finally, they help to outline an operational policy framework for an effective intervention.

Experiments with our model show that infrastructure development alone - even if targeted to the poor - will not improve income distribution. Only, when this instrument is combined with the taxation of unearned income, as suggested earlier in Saeed (1988), will the income distribution improve. We also observe that building public infrastructure may not be as effective as providing modern private capital for facilitating economic growth.

Technical details of the model, including a machine readable listing in Vensim simulation software,¹ for replicating the experiments discussed in this paper and for further experimentation, are available from the authors on request.

Observed patterns of economic growth and infrastructure performance

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Since infrastructure services have special economic characteristics that make them difficult to be handled by the private sector, provision of infrastructure has traditionally been a responsibility of the government. Infrastructure is a “basic good” in economic terms (Brown and Sibley 1986, Barkovich 1988). Many infrastructure services lie in the ranges between non-rival to rival goods and from non-exclusive to exclusive goods (Shah 1992, World Bank 1994). The demand for infrastructure does not change significantly with the change in the price of the infrastructure service. The supply-side characteristics of infrastructure feature a high sunk cost and increasing returns to scale (World Bank 1994). Public investment is essential, as private investment is unable to provide these basic goods without risking market failures, especially for major infrastructure, such as irrigation and rural roads (FAO 1996).

The precise link between infrastructure and economic development is not clear. The literature indicates that infrastructure research has developed in isolation from the extensive literature on economic growth (Holtz-Eakin and Schwartz 1995). Researchers gradually began to pay attention to this topic after Aschauer (1989a and 1989b) attempted to explore the relationship between infrastructure services and economic growth. Aschauer assumed that infrastructure is an unpaid factor in the production function and he placed the public infrastructure stock in the production function to estimate private production. The marginal returns to workers and to capital with the unpaid factor in the production function diverge from the marginal returns without the unpaid factor. Therefore, the production factors get reallocated with infrastructure provision. Indeed, the reallocation of production resources would improve economic efficiency and generate a higher output. An opposite view appears when infrastructure costs are considered. Most researchers argue that infrastructure is not an unpaid production factor and is always financed by tax money. The price of infrastructure consumption is the tax rate that reduces the return on capital investment, thus decreasing the incentive for the private sector to invest (Munnell 1990). The high cost and the long delay in the delivery of infrastructure by government further reduces its efficacy (World Bank 1994). Both these arguments receive support from empirical research on the estimation of elasticity of infrastructure investment with respect to total output. Contradictory empirical results are created probably by unreliable measures of public capital stock (Duffy-Deno and Eberts 1991, Eberts and Fogarty 1987, Munnell 1992). Munnell (1992) argues that researchers should focus on explaining the variations obtained in these

studies. Policy design based only on estimates of elasticity of infrastructure stock or infrastructure investment with respect to regional production or regional income cannot provide any real confidence in the suggested policy. It is unclear what the consequences of new infrastructure policies are, and whether they are effective or not in the long run.

Public provision of infrastructure has been considered an instrument for economic development and welfare delivery, although its efficacy varies in the developing countries, which is not fully understood. Hirschman (1958) suggested that infrastructure investment be used as an initiative for economic growth. It was generally believed that allocation of expenditures within the infrastructure sub-sectors could yield high investment returns when guided by consideration of the country's underlying development goals. Infrastructure investment was accorded high priority in stimulating economic growth in the 1950s, particularly in China, India and Taiwan (Minami 1994, World Bank 1993).

Infrastructure services have lately become a bottleneck in most developing countries, necessitating a call for foreign investment in infrastructure. In Thailand, Indonesia and the Philippines, electric power, water supply and transport have been the principal targets for foreign investment (Abegglen 1994). Meanwhile, since the governments have a propensity to consider economic efficiency more than the welfare delivery, public provision of infrastructure has usually resulted in delivering a subsidy to the rich instead of helping the poor (Clements 1995, World Bank 1994). Therefore, the view that infrastructure is essential to economic development and the delivery of welfare to the public has come under serious criticism (Stephanedes 1974, Israel 1992). In today's leading development economics textbooks (for example: in Todaro, 1994), there is only a brief reference to infrastructure. On one hand, present theories attempt to demonstrate that public provision of infrastructure is not an effective tool for achieving development targets and that the public provision of infrastructure should be replaced by the private sector. On the other hand, it has been pointed out that no matter how much an economy is opened to the private sector, government still must provide a substantial share of infrastructure, hence, the government still needs to plan the allocation of resources (Israel 1992). Unless a clear understanding of the relationship between the infrastructure sector and the rest of the economy is achieved, the efficiency of infrastructure policy will be ridden with uncertainty.

We feel that a positive policy design framework cannot be divorced from a concerted effort to understand the logic of the information relationships underlying past performance. Public infrastructure provision in a developing economy is a complex process. The infrastructure service includes a large category of "basic services - public utilities, which are necessary to production". The degree of usage of public infrastructure depends on the nature of the production process in a firm, while the efficiency of infrastructure policy is usually related to the economic structure (Nadiri and Mamuneas 1994). Meanwhile, the economic structure of the developing countries is more dynamically changing than the developed countries. The developing country economies are dominated by the agricultural sector in the early stages of development, while coexistence of the agricultural and industrial sectors appears in the transition stages and the industrial sector becomes the dominant sector in the later stages. The dynamically changing economic structure constantly changes the optimal composition of the infrastructure needed. There being considerable delays in changing this composition, bottlenecks will invariably hamper economic performance over the course of development.

A developing economy is also characterized by its duality. In each stage of development, there often exist two subeconomies side by side (ILO 1972, Meier 1989). In the agricultural stage, large-scale commercial farms co-exist with the small self-employed peasant sector. In the industrial stage, large formal industrial firms co-exist with the self-employed entrepreneurs in the self-employed sector. In the transition stage, the duality becomes more complex. The rural economy, in which large-scale commercial farmers co-exist with the small self-employed peasant sector, also coexists with the urban economy, in which large formal industrial firms co-exist with the self-employed entrepreneurs in the self-employed sector. An aggregate formal sector, including the commercial farms in the rural sector and capitalist firms in the urban sector, attempts to maximize profit. On the other hand, an aggregate informal sector, including small peasant farms in the rural sector and informal family work units in the urban sector, attempts to maximize consumption. This classification has been referred to variously in the literature, for example, as formal and self-employed or commercial and peasant sectors, capitalist and worker sectors (Pasinetti 1989, Dalziel 1991, Fazi and Salvadori 1985), capitalist and subsistence sectors (Lewis 1954) and modern and traditional subeconomies (Fie and Ranis 1966), but all those

contexts refer to the existence of an economic duality. Due to this duality, economic growth may not necessarily signal a general improvement in welfare, when the distribution of income in the dual economy and the transfer of value between the formal and self-employed sectors are also taken into consideration. Any policies implemented in the face of this duality would cause a reallocation of resources between the formal and the self-employed sectors. Neglecting this duality will give unexpected results as has been borne out by experience. Some infrastructure policies have attempted to target the poor, but the results are far from satisfactory. In the end the rich have usually received the lion's share of the benefits (Ravallion and Sen 1994).

Although we address in this paper mainly the public infrastructure provision in the initial development stages when the agricultural sector dominates the economy, the results of our analysis can be generalized to some degree to formulate an analytical framework for policy design on infrastructure provision during the transition period and also in the newly industrialized countries where the duality takes the form of an aggregate formal sector consisting of the capitalist urban-rural coalition and the informal sector appears as an aggregate of the urban as well as rural self-employed sub-economies.

In a dualist agricultural system created in the early stages of development, the economic structure is characterized by the side-by-side existence of two equally significant sub-economies - a profit-maximizing formal sector and a consumption-maximizing peasant sector. There is empirical evidence of a pervasive existence of a dualist structure in the agricultural economies of the developing countries. Table 1 shows the proportions of wage-employed rural workers in selected Asian countries, which range between 30-70 percent, meaning that the self-employed peasant sector and its counterpart commercial formal sector are equally significant.

Table 1. Percentage of wage rural workers of the rural workforce in selected Asian countries

Countries	Wage employed labor		Time	Sources
	Male	Female		
Bangladesh	39.6%	32.9%	1980	Muqtada 1984
India	41.4%	39.2%	1987-1988	Sarvekshana , 1990 cited by

				Chadha 1994
	total			
Indonesia	70%		1983	ILO 1986
Nepal	66%		1981	ILO 1983
Pakistan	50%		1981	ILO 1983
Philippines	66%		1988	Worldwatch Institute 1990

It is widely recognized that the levels of financial capacity, labor productivity, capital intensity, and accessibility to public infrastructure are much higher for the commercial farmers than for the peasants, who are basically self-employed workers (Lewis 1954 and Boeke 1976). Although the factor proportions, the productivity of labor, and capital-worker ratio in the two production modes vary from country to country, there appear to be many similarities in the overall pattern. These similarities are manifest in the side-by side existence of both production modes with a relatively low productivity in the self-employed peasant sector and a relatively high capital-worker ratio in the formal sector.

Prior to the commencement of the economic development effort, the developing countries were largely closed economies. Most production was carried out in family work units, both for producing agricultural commodities and other services. These family units often worked in a feudalist environment with a dichotomy between ownership and labor. The mechanism of renting allowed farmers to get access to absentee-owned land and production capital (Lipton 1977, Samuelson and Nordhaus 1985, Hunt 1989). When the government used infrastructure investment as a policy to increase land productivity through irrigation, and to expand trade through transportation, landowners began to shift a part of their land and capital from renting to production. Evidence of this phenomenon has been found in Japan, Taiwan, Korea and Pakistan (Kikuchi and Hayami 1979, Akino 1979 and Burki 1976). The emergence of the formal production mode prepared the way for the pervasive dual economy when modern capital was introduced in the rural areas. The penetration of modern capital further expanded production in the formal sector and made the dualist economic structure more distinct.

The first system dynamics model incorporating a dual economic structure was developed by Saeed (1980) to explain the income distribution and wage determination in a rural economy. This

model was later extended to explain the behavior of the capitalist systems operating under different social and legal norms (Saeed 1987, 1988, 1994). The model was also extended later to incorporate endogenous technological growth to replicate the behavior of the present day technological and economic system and to understand the implications of technology policy levers (Saeed and Prankrakma 1997), and also to explain the implications of free trade and capital movements in a dual global economy (Saeed 1998).

We have in this paper extended Saeed's original model to incorporate public infrastructure provision in a dual agricultural economy. Experimentation with this extended model shows that many proposed and implemented policies related to infrastructure - for example, the mobilization of government resources for infrastructure investment, targeting the poor, and improving the efficiency of government bureaus - are not effective in alleviating income disparities if they are implemented alone. However, both an increasing income level in the peasant sector and an increasing rate of the economic growth can be obtained when especially targeted infrastructure policies are implemented together with a critical income distribution policy suggested by Saeed (1980, 1994), namely the taxation of the unearned income. The way infrastructure policies are targeted may, however, dilute or enhance the effect of the impact of the taxation policy.

A system dynamics model of public provision of infrastructure in a dualist agricultural economy

The information structure of the model of this paper is adapted from Saeed (1980). Saeed's original model draws on neoclassical economics to construct a basic economic growth and market clearing system, he modifies this system by relaxing its simplifying assumptions about aggregation of sub-economies, saving and investment behavior, and wage determination. His model subsumes the concept of economic dualism first recognized by Boeke (1953) and developed further by Lewis (1954), Sen (1966), Bardhan (1973) and others to represent the multiple sub-economies coexisting in developing countries. In such a dual economic system two sub-economies function side by side, a formal production sector operating on the premises of profit maximization, and a peasant production sector attempting to maximize consumption for the labor it internalizes. The two sectors interact with each other in that they bid for the resources

of the economy and the surplus labor not hired by the formal sector is accommodated in the peasant sector, while surplus capital and land resources not employed by the formal sector are rented out to the peasant sector. Saeed's original model incorporated the following behavioral assumptions governing the roles of its actors:

1. Both the formal and peasant sectors of the economy carry out production using capital, workers and land. Capital investment is driven by profitability, which is given by the marginal revenue product of capital and the interest rate, but is constrained by the financial capacity of the sector.
2. Workers can be wage earners or self-employed. They are hired on the basis of their marginal revenue product of workers compared with their average wage. Workers unable to find employment in the formal sector are absorbed in the peasant sector.
3. The average wage rate is set not according to the average marginal revenue product of workers as postulated in the equilibrium models of economic growth, but according to the bargaining power of the workers which depends on the opportunity cost for a worker to leave self-employment that is given by the average consumption expenditure of workers (Sraffa 1960 and Sen 1966).

The model of this paper further incorporates the structure representing government provision of economic infrastructure through taxation. Public infrastructure provision in the model is assumed to be rationally determined by the government depending on the infrastructure productivity and the financial capacity of the government. The revised model tracks the decisions of the government concerning infrastructure provision and their impact on resource allocation, economic growth and income distribution. An overview of the revised model is shown in Figure 1.

The infrastructure sector we have added to the model includes three sub-sectors: allocation of resources by the government to its various service functions, including infrastructure; the development of infrastructure facilities consisting of transportation and irrigation services; and

the product mix determination as effected by the transportation service level.

In the sector allocating government resources, it is assumed that government collects taxes and makes decisions to allocate collected funds to public expenditure. The government is the only provider of the infrastructure services in the model. Financial resources for infrastructure building are obtained by the government through general tax collection. These simplifying assumptions are supported by earlier research, e.g., Munnell (1990) points out that the price of infrastructure consumption is the tax rate. Musgrave and Musgrave (1976) also argue that even though resources can be borrowed from banks, the payback would still be through taxation. Thus, our model structure does not strictly exclude the building of infrastructure by the private sector. Public infrastructure provision only means that the public sector makes the investment decision and provides the resources for infrastructure building.

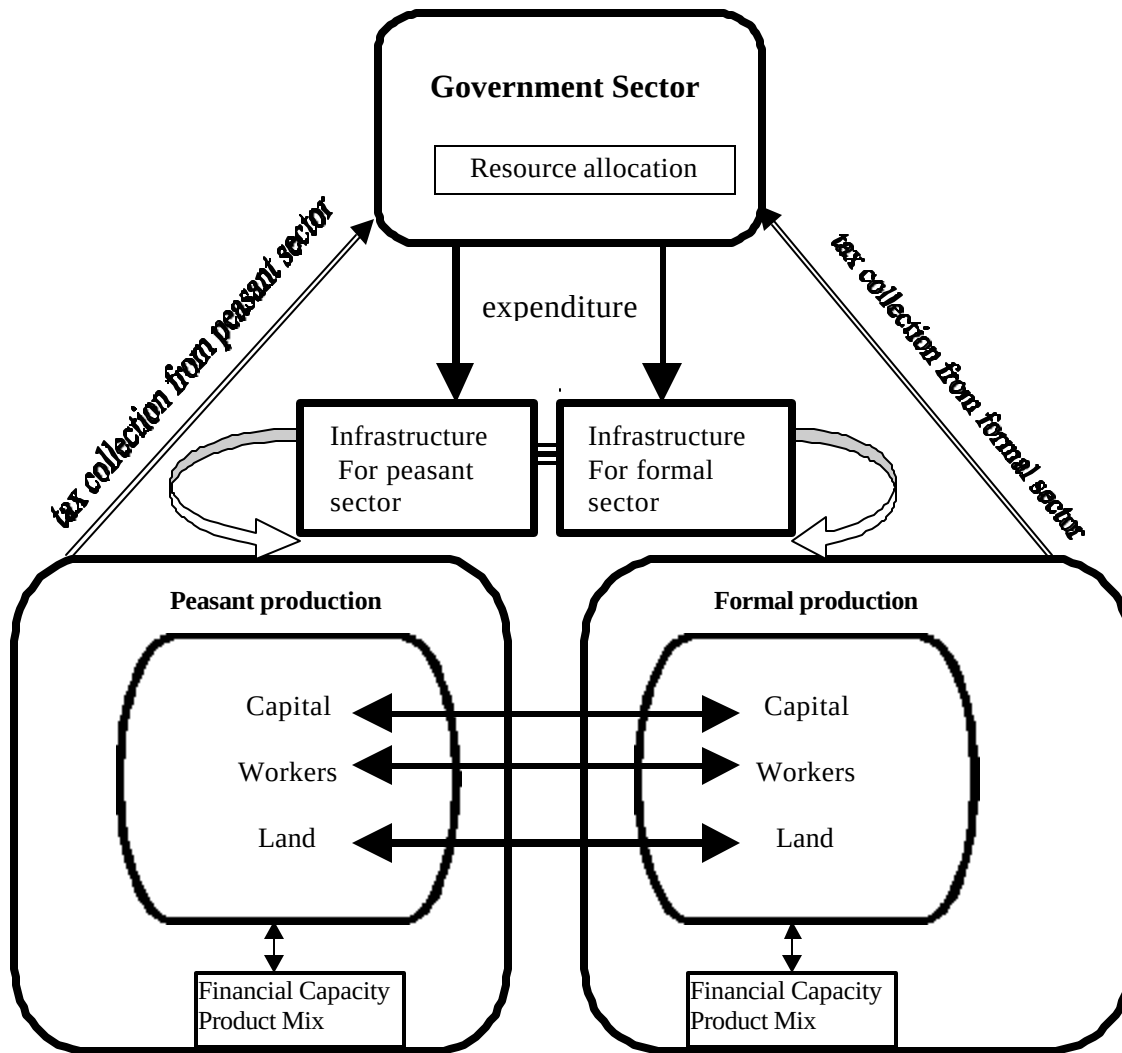


Figure 1 An overview of the model

The model also assumes that the resources allocated by the government to infrastructure building must compete against resources transferred out of the rural area and those consumed for government services delivery. The resources consumed for government services delivery are linked to the number of infrastructure projects and the stock of infrastructure in service as suggested by Hirschman (1967, 1977) and UNPAD (1977). The allocation of infrastructure resources is determined by the financial capacity of the government, infrastructure resources demanded to finance ongoing projects and the economic returns on infrastructure. The fraction of

resources transferred out of the rural area is a fixed fraction based on the empirical studies conducted by Lipton (1977), Parker (1995), Schiff and Valdes (1992), and Winters, et al. (1996). The literature on the determination of infrastructure resource allocation is quite fragmented. The determination of the allocation of infrastructure resources by the financial capacity of the government is supported by the work of Dudley and Montmarquette (1992), Musgrave and Musgrave (1976), and Raj (1993). These authors and IMF (1995) also point out that whenever the government is facing a financial shortage, infrastructure investment is the first expenditure to be cut off. The process of allocation of infrastructure resources to finance ongoing projects is supported by the work of Hirschman (1967), UNDP (1977), Garn and Fosler (1987) and Mashaiyekhi (1996). Allocation based on the economic returns on infrastructure is supported by the work of Simon (1975), Glover and Simon (1975), Frederiksen and Looney (1980), Frederiksen (1981), Munasinghe (1987), Kikuchi and Hayami (1979) and Clements (1995).

There are two categories of infrastructure facilities in the model: irrigation and transportation. The allocation of infrastructure resources between irrigation and transportation is assumed to be based on their respective productivity and the demand to finance the ongoing projects. The infrastructure subsector takes into consideration the long supply chain for infrastructure planning, design and construction before it becomes available for use. This long delay embodied in the supply chain of the infrastructure has been recognized by many researchers (Rondinelli 1977, Hirschman 1967, Saeed and Brooke 1996). The infrastructure project startup rates for planning are determined by the availability of infrastructure resources and the productivity of the infrastructure. Infrastructure project startup rates for construction are also affected by the availability of infrastructure resources. The rates for infrastructure projects to be completed are determined by the available infrastructure resources and the unit costs of infrastructure facilities. The unit costs of the infrastructure facilities are endogenously determined by the model. They are increased by resource scarcity, due to the creation of bottlenecks and delays, and decreased by the economy of scale (World Bank 1994, Hirschman 1967 and Mashaiyekhi 1996).

As suggested by Biehl (1986), Nadiri and Mamuneas (1994) the stock of public capital must be adjusted by an appropriate index to demonstrate the degree of their usage by the producers. In the model, the impacts of infrastructure on production are determined by the infrastructure

service levels and not by the infrastructure stocks *per se*. The irrigation service level is the accessible irrigation facility per unit of cultivated land. The irrigation service levels in the formal and in the peasant sectors can be different depending on their respective irrigation accessibility parameters. The transportation service level depends on the market accessibility represented by road capacity per unit of demand for tradable products as suggested by Liang [1981]. The transportation service levels in the formal and peasant sectors can be different and are controlled in the model by the respective transportation accessibility parameters. Literature has well documented the differences in the accessibility to the infrastructure service for the formal and peasant sectors. A higher accessibility to the infrastructure service is reported in the formal sector than in the peasant sector (Samuel 1991, Ahmad and Sampath 1994, FAO 1996, Broersma 1975, Hirschman 1967 and World Bank 1996). In the model a high irrigation service level brings more land into cultivation as well as a higher return on land, as suggested by Kichuchi and Hayami (1979), Oshima (1987) and Akino (1979). A high transportation service level has an impact on the preference for tradable goods production and improves the marketability of tradable goods which, in turn, impacts on the total demand and sales in the two sectors, as pointed out by FAO (1996), Khan (1984) and Richards (1982).

The goods market consists of tradable and non-tradable goods (Myint 1985). The production mix sector determines the proportions of tradable and non-tradable goods in each sector. Both the formal and peasant sectors produce tradable as well as non-tradable goods. The non-tradable products are to meet the demand for government service consumption, rural traditional capital, and rural traditional service consumption. Tradable goods depend on the market demand. Each sector maintains its own tradable products inventory, has its own tradable goods distribution system and its own market share. The allocation of the capacity to the production of the two types of goods depends primarily on their respective demands, but the preference for tradable goods rises with the availability of transportation facilities. The total sales revenue in each sector is generated both by the sale of the tradable and the non-tradable goods.

Simulation Experiments to test model behavior against historical experience

Four simulation experiments were conducted to test the model behavior against historical experience. The results of these experiments are summarized in Figure 2.

The first experiment represented in the plot of Figure 2(a) is replicated from Saeed (1980) as a starting point for further analysis. In his original model, Saeed conducted this experiment to explain how a feudal economic pattern emerges in the absence of technological differentiation between the two sectors when the simplifying assumptions of an aggregate neo-classical system are relaxed. Saeed's model showed that resources get concentrated in an absentee ownership mode creating the occurrence of what has been described in the literature as feudalism, which has been quite pervasive in the developing country agricultural economies before development effort was undertaken. The implicit assumption about infrastructure in this experiment is that its supply is completely elastic.

The second experiment represented in the plot of Figure 2(b) repeats the first experiment with the extended model imposing restrictions on infrastructure supply depending on government financial capacity and infrastructure productivity. The behavior in this experiment is more or less similar to the first experiment except that there is a slight falling off in output due to the limitations of the infrastructure supply.

The third experiment represented in Figure 2(c) assumes that the access to infrastructure for the producers in the two sectors is different - peasant sector having limited access. This unequal access arises out of the technological differences between the two sectors - as is often the case in reality. This experiment shows that production in the formal sector increases while production in the peasant sector decreases until the two sectors have comparable capital productivities. This creates side by side existence of both capitalist and self-employed production modes, which is quite widely experienced including in the well documented case of Japan when it embarked upon expanding rural infrastructure over the 19th century (Akino 1979, Kikuchi and Hayami 1979).

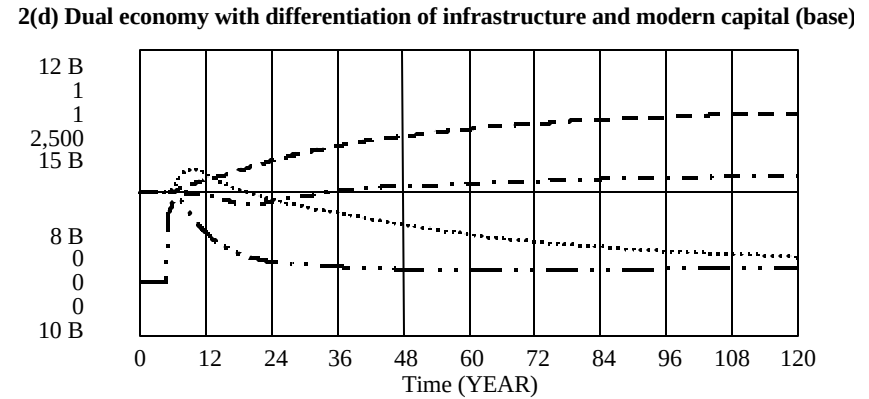
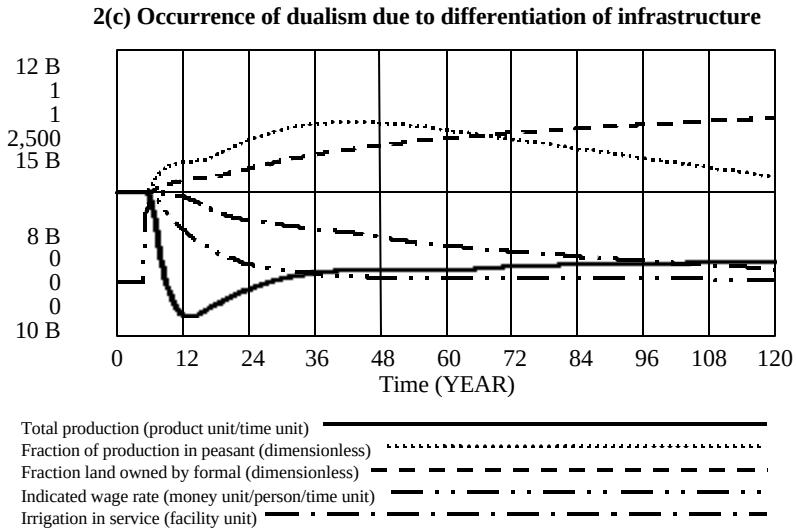
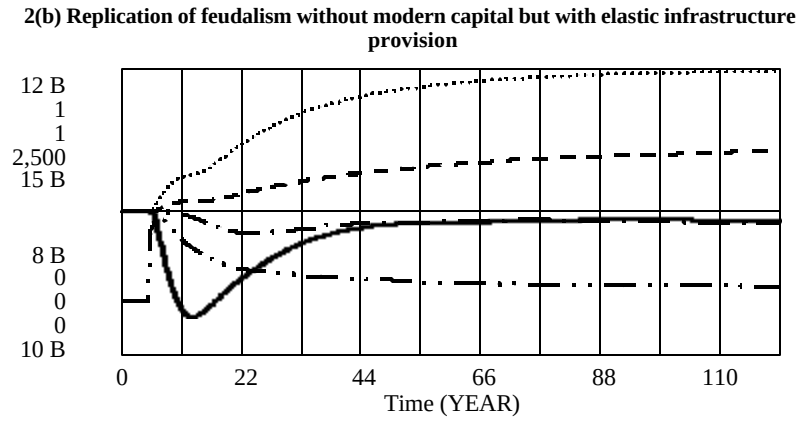
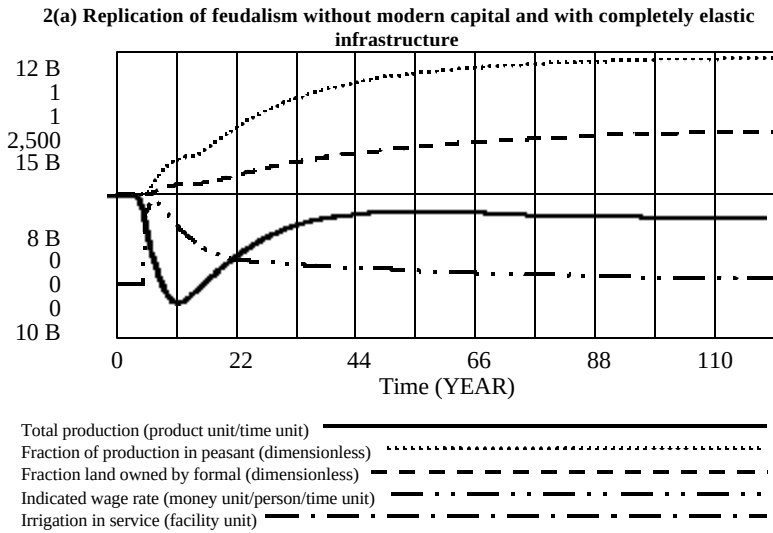


Figure 2: Testing model behavior against historical experience

The fourth experiment represented in Figure 2(d) assumes a further technological differentiation created between the two sectors by making modern capital available to the formal sector and maintaining the assumption of differentiation in the accessibility to infrastructure between the two sectors. This is the background in which many development policies have been implemented. Due to the combined influence of differentiation in capital and infrastructure access, the formal sector production gets a further impetus, reinforcing the dual economic structure, but with a larger role for formal production than in the last case.

These experiments lead to the conclusion that a dualist agricultural economy is created when the production in the peasant sector is constrained due to its limited access to infrastructure as well as to modern capital. The former policy is a manifestation of capital formation in the public sector that mostly supports the large scale formal production mode, while the latter arises from the promotion of capital formation in the private sector also mainly supporting the large scale formal production mode. Both these policies have formed an important part of the developmental agenda in the developing countries over the past half century. Indeed the pervasive duality experienced in the developing countries is mostly likely a manifestation of those two policies. The technological differentiation between the large scale formal production and small scale informal production created by technology transfer efforts further exacerbated this duality (Saeed and Prankrakma 1997).

Infrastructure provision as a policy lever for economic development

A recent review of more than 300 academic studies on green revolution during the period 1970-1989 indicates that in most cases, greater income inequalities resulted from the green revolution which was characterized by the supply of modern technology and infrastructure investment (Freebairn 1995). However, several authors, most notably Lipton and Longhurst (1989), acknowledge that some of the more persistent claims of declining welfare associated with the green revolution have little empirical support. Ireson (1987) points out that the changes in farm income distribution cannot be simply attributed to one cause or another, or even to a combination of factors. Saeed (1987) attributes the failure of the green revolution policies in poverty

alleviation to the dual structure of the economy, which has built-in mechanisms to transfer value from the poor to the rich.

The experiments in this section of the paper attempt to understand the variability of performance of selected development policies, including public infrastructure provision, and also to identify guidelines for an effective infrastructure strategy that could serve as an alternative policy lever for economic development. The policies selected for the experiments are based on two considerations:

- 1) The promise of infrastructure provision as a policy lever should be investigated against the backdrop of the dual economic system to understand its performance and ways found to increase its effectiveness.
- 2) The performance of the widely implemented and proposed development policies should be understood with realistic infrastructure constraints added.

In the absence of an explicit infrastructure supply process, Saeed's original model assumed in default that infrastructure supply is infinitely elastic, hence, infrastructure could not be factored in as a policy lever. In the extended model, we provide policy space to control the magnitude, the supply delay, the mix and the targeting of infrastructure, so these attributes could be tested for their implications in meeting objectives of growth and equity laid out in the original model.

Two experiments were conducted for addressing the first consideration. These explored the explicit infrastructure policies suggested by researchers or used by the infrastructure policy decision-makers. They included mobilization of funds to upgrade infrastructure (Hirschman 1958, Hansen 1965) and targeting infrastructure supply for the poor (Besley and Kanbur 1993, World Bank 1994, 1996).

Additionally, three policies were selected for experimentation with our extended model to address the second consideration. These included taxation of unearned income, improving the working of the financial markets and organization of the peasant sector into cooperatives. The

first policy was proposed as a critical instrument to redistribute income and the latter two as facilitators by Saeed (1980,1994). The facilitators were found by Saeed to be effective only when the critical policy, i.e. taxation of unearned income was in place. This was seen to be true also in the case of our extended model.

The efficacy of each policy tested was evaluated by comparing the new simulation patterns in the policy experiments with those of experiment 4 designated as the base run. All policies were implemented at time 120 when the model reached a new equilibrium with its base run assumptions. The criteria for the evaluation of the policies are summarized in Table 2.

Table 2. Indicators for policy evaluation

Indicators	Meaning
Total production	Economic growth
Production in the formal sector	Economic growth and sector contribution
Production in the peasant sector	Economic growth and sector contribution
Fractional revenue share of the formal sector	Income distribution
Land owned by the formal sector	Wealth distribution, asset ownership
Rent payment as a fraction of revenue in the peasant sector	Value transfer from the peasant sector to the formal sector
Average wage rate	Median household income level
Land worker ratio in the peasant sector	Land use intensity
Irrigation facility in service	Irrigation infrastructure provision
Transportation facility in service	Transport infrastructure provision

a) Analysis of individual policies

Policy 1: Mobilizing resources for infrastructure building

Over the past half century, many policies have been introduced to mobilize government funds for infrastructure investment in agriculture. Policy makers usually refer to these funds as subsidies to the rural area. With the base run as an ambient condition, a policy is introduced at time 120 to

reduce the resources transferred to the urban area and earmark those resources for building infrastructure in the rural area. From the simulation run, it can be observed that this policy leads to an increase in the rural output. The average wage rate rises to a higher level than in the base run. Yet, the wealth distribution and the share of revenue in the formal sector representing the inequality in income distribution do not change. Towards the end of the simulation run, the share of land owned by the formal sector reaches a new equilibrium slightly lower than the base run. The revenue share of the formal sector reaches an equilibrium level also slightly lower than the base run. Rent payments from the peasant sector to the formal sector rise to a much higher level than the base run (see Table 3). These changes are explained as follows:

When resources are mobilized to build infrastructure in the rural area, the total demand for rural products increases while the infrastructure facilities in service increase after a certain delay. Fueled by demand and increased infrastructure availability, the production in the peasant sector increases. Hence, the average consumption expenditure per worker rises. The production and revenue in the formal sector increase too because of better infrastructure facility, therefore, the marginal revenue product of workers in the formal sector also rises. However, since the average consumption expenditure of workers includes entitlements both from value additions through labor and capital, the increase of wage rate demanded by the peasant sector exceeds the increase in marginal revenue product of workers in the formal sector. The profitability of production in the formal sector, therefore, declines. The formal sector begins to lay off workers, who enter the peasant sector. The formal sector also begins to sell or rent out land and capital to the peasant sector. The demand for land and capital in the peasant sector remains high because of the crowding of workers in it and the growth in demand for the agricultural products. When the policy is initially implemented and workers are still employed in the formal sector, the financial capacity of the peasant sector improves and the peasant sector is therefore able to buy some land. As more and more workers are laid off and accommodated in the peasant sector, the financial capacity of the peasant sector worsens rapidly. Its weak financial capacity constrains its ability to acquire more land and capital. The demand for land and capital in the peasant sector can be met only through renting, hence, the total rent payments to the formal sector from peasant sector rise rapidly. However, due to the formal sector's ability to transfer resources from production to renting portfolio, the land owned by the formal sector is only slightly lower towards the end of

the simulation compared with the base run.

Table 3 Simulation results of policies

Normalized value of the end points	Total Production	Production in Formal Sector	Production In Peasant Sector	Fraction Revenue to Formal sector	Land Owned by Formal sector	Rent Burden of peasant sector	Effective Land Worker Ratio in peasant sector	Average Wage Rate	Irrigation facility level	Transportation facility level
BASE RUN	1	1	1	1	1	1	1	1	1	1
More resource for infrastructure investment	1.05	0.76	1.85	0.92	0.92	4.41	1.31	1.43	1.2	1.39
Equal access to infrastructure	1.02	0.83	1.53	0.98	0.96	3.38	1.37	1.02	1	1
Cooperative policy	1	0.91	1.24	0.99	0.98	1.9	1.1	0.98	0.99	0.98
Financial policy	1	0.99	1.01	0.99	0.99	0.94	1	1	1	1
Rent tax policy	0.97	0.87	1.26	0.84	0.88	0	0.99	1.09	0.98	0.96
Rent tax policy with assumption of equal access to infrastructure	1	0.54	2.25	0.51	0.53	0.17	1.42	1.51	1.04	1.07
Resources for infrastructure investment +equal access	1.1	0.6	2.44	0.93	0.9	8.52	1.64	1.53	1.22	1.44
Resources for infrastructure investment +financial assist	1.05	0.75	1.86	0.9	0.9	4.02	1.3	1.43	1.19	1.38
Resources for infrastructure investment +rent tax	1	0.67	1.9	0.6	0.68	0.22	1.15	1.67	1.17	1.34
Resources for infrastructure investment +equal access + rent tax	1.04	0.52	2.43	0.48	0.52	0.56	1.44	1.98	1.2	1.4
Resources for infrastructure +rent tax + financial assist	1.01	0.66	1.94	0.59	0.66	0.18	1.18	1.65	1.17	1.34
Resources for infrastructure +rent tax + financial assist + cooperative + equal access	1.05	0.3	3.06	0.39	0.35	1.39	1.6	1.87	1.18	1.37
Financial assist + cooperative policy + equal access	1.02	0.67	1.95	0.94	0.92	5.28	1.49	1.01	0.99	0.98
Rent tax +equal access	0.98	0.66	1.86	0.63	0.67	0.06	1.29	1.23	0.98	0.97
Rent tax + financial assist + equal access	0.99	0.66	1.86	0.63	0.67	0.05	1.29	1.23	0.98	0.97
Rent tax + financial assist + cooperative +equal access	0.98	0.38	2.59	0.44	0.46	0.52	1.45	1.26	0.96	0.92

Policy 2: Equal access to infrastructure service

Although there are many technical difficulties in the design of infrastructure for the poor, the model can assume that these difficulties can be overcome so both sectors can have equal access to infrastructure facilities. When the model is simulated with this additional assumption, land acquisition by the formal sector slows down relative to the base run (see Table 3). The share of land owned by the formal sector and the revenue share of the formal sector reach new equilibria which are slightly lower than in the base run. However, land owned by the formal sector still increases after the implementation of the policy while the rent payments to the formal sector rise to a level higher than in the base run.

It is interesting to compare this run with the previous policy run. In the previous run, production and revenue in the peasant sector do not increase as rapidly because of its limited access to infrastructure. In this run, production in the peasant sector rises at a faster rate since it is able to utilize infrastructure services more effectively. The average consumption expenditure per worker in the peasant sector rises more rapidly in the beginning of the policy implementation. Subsequently, however, the wage demanded is higher and the formal sector shifts resources from production to renting more rapidly than in the last case. Therefore, workers laid off by the formal sector crowd the peasant sector faster. It follows that the policy of unequal access to infrastructure is more effective in helping income redistribution than equal access, which is a bit counterintuitive, but nonetheless logical.

Policy 3: Organizing cooperatives in the peasant sector

The policy of organizing the peasant sector into cooperatives allows this sector to compete favorably with the formal sector for modern capital, which allows it to expand production. As the demand for land and capital for production in the peasant sector rises, rents are bid up and the formal sector begins to transfer these resources from production to renting. The share of land owned by the formal sector and the revenue share of formal sector reach new equilibria slightly lower than the base run, but still higher than the policy starting point. Although a substantial part of production shifts to the peasant sector, resource ownership is still concentrated in the formal

sector.

There are many similarities between policy reforms 3 and 2. Reynolds (1975) points out that in agricultural production, infrastructure investment is a kind of modern capital investment. Therefore, both the policy of forming cooperatives, that equalizes access to modern private capital and the policy of equalizing access to infrastructure are intended to improve the production conditions for the peasant sector. The cooperatives policy operates through the market mechanism, while the policy of improving the access to infrastructure operates through the expenditure policy of the government. In both cases, production in the peasant sector increases but asset ownership by the peasant sector and the revenue share of peasant sector are not improved very much, while the total rent payments from peasant sector to formal sector rise. It seems, however, that the expenditure policy is more effective in inducing economic growth in the peasant sector and raising overall output than the cooperative policy.

The cooperatives policy creates a low efficiency due to the following reasons: (1) Labor saving modern capital is not as effective in the peasant sector as in the formal sector when an influx of surplus workers laid off by the formal sector increase labor intensity in it. (2) The production in the peasant sector is constrained by the low infrastructure service level even when it is able to acquire modern capital.

Policies 1, 2 and 3 are all effective in promoting economic growth through the promotion of production in the peasant sector. However, they all fail to change the asset ownership pattern and revenue shares of the formal and the peasant sectors. All three policies lead to increased rent payments from the peasant sector to the formal sector which constrains the former's investment ability.

Policy 4: Financial policy

The financial policy reduces the dependence of investment on internal savings in each sector. When this policy is implemented in the model, land owned by the peasant sector rises slightly, while land owned by the formal sector shows a slight decline.

There are two reasons for the ineffectiveness of the financial policy. First, when this policy is implemented, the formal sector increases its bids for land and capital for production since it can achieve a higher efficiency due to its better access to modern capital and infrastructure. The profitability of production in the peasant sector, however, remains low due to the low productivity of the traditional capital and the limited access to infrastructure service. Hence its intrinsic demand for resource acquisition is also low and improving its financial capacity does not help.

Policy 5: Taxation of unearned income

Experimenting with his original model, Saeed (1980, 1994) found that a fiscal policy to levy a tax on unearned income accrued in the form of rent on absentee owned capital and land is a critical policy for changing income distribution pattern. A rent income tax depresses renting activity, hence, the formal sector has either to transfer the rented land and capital to production or to sell the surplus land and capital to the peasant sector. When there is no capital differentiation between the sectors, the formal sector tends to sell a greater share of its land and capital to the peasant sector. Therefore, asset ownership and income distribution are improved. However, with capital differentiation, formal production appears as an alternative to renting, which limits the transfer of land and capital resources to the peasant sector.

A rent income tax is simulated in our modified model by deducting a tax equal to 20% of the rent income at time 120. Rent tax policy is not effective in changing the asset distribution pattern (see Table 3). However, since this experiment is conducted with modern capital differentiation, it is difficult to understand whether the dilution of effectiveness is only due to modern capital differentiation or if it is also effected by the public provision of infrastructure. Therefore, a comparative policy analysis is conducted with the assumption of equal access to infrastructure in both sectors. This assumption is put into place at time 120 in addition to the rent tax policy. In this comparative run, since the production of the peasant sector is not especially constrained by infrastructure service compared with the formal sector, production and revenue received in the peasant sector further rise. However, this increases also the bargaining power of the workers,

which fuels wage rate. Hence, the profitability of the formal sector to produce is reduced and it lays off workers. Meanwhile, the demand for land and capital in peasant sector increases. However, since the tax on rent income has depressed renting, the formal sector is forced to sell its surplus land and capital to the peasant sector. Hence, the income and asset distribution patterns change radically. It can be concluded that the rent tax policy is effective in changing income distribution, provided it is not off set by compensating advantages available to the formal sector in terms of infrastructure access and modern capital.

The rent tax policy, however, slightly reduces output due to two reasons: (1) Financial constraints slow down the acquisition of land and capital resources by the peasant sector, hence they must be employed meanwhile in the formal sector with a lower production efficiency. (2) Low accessibility to infrastructure reduces production efficiency also in the peasant sector.

b) Combinations of Policies

Many infrastructure researchers and policy makers have recognized that individual policies are not effective, hence combinations of policies are often suggested. These combinations typically include instruments targeting the poor, improving market functions, taxation and expenditure. Unfortunately, such policy packages fail to recognize the dynamic changes in the role of renting in a dual economic system, and their efficacy is low, which is borne out by our experiments discussed below and also summarized in Table 3.

Policy package 1: Mobilization of government resources and targeting the poor through equal access to infrastructure

This policy package aims at mobilizing government funds for infrastructure building and designing infrastructure facilities in a way that equal access is obtained by the two sectors. The model behavior under this policy package is similar to policy 1. However, compared with the base run, policy 1, and policy 2, the overall output increases to a higher level, yet, this policy package has little effect on the improvement of asset ownership. The production in the peasant sector increases greatly and the production in the formal sector declines. Although the average wage rate rises to a higher level, the share of revenue received in the peasant sector rises only

slightly compared with the base run and stays at the same level as the policy starting point. However, rent payments from the peasant sector to the formal sector increase sharply. This infrastructure policy benefits the owners of land and capital who receive a higher level of unearned rent income in the formal sector.

Policy package 2: Implementing resource mobilization policy with financial policy

The simulation of individual policy 1 demonstrates that financial constraint is one of the limiting factors for the peasant sector to buy land when the formal sector decides to review its land ownership upon recognizing an increase in government investment in infrastructure building. Therefore, this policy package proposes that when resources are mobilized for infrastructure investment, a financial policy to improve the financial capacity of the peasant sector should be implemented simultaneously. When this policy package is implemented, more resources are invested for infrastructure building, the production and the revenue of the peasant sector increase. The average wage rate also increases, hence, profitability of production in the formal sector declines. The formal sector begins to lay off workers who then enter the peasant sector. The formal sector also begins to sell or rent out land and capital formerly employed in production. The improved financial capacity in the peasant sector allows it to buy some of the land, which lowers rent payments to the formal sector. Therefore, revenue received by the peasant sector increases. The wage rate further increases. Yet, as more workers are laid off and the financial capacity of the peasant sector worsens, the capacity of the peasant sector to buy land is reduced. Toward the end of the simulation run, the improvement in the land ownership pattern is small.

Policy package 3: Implementing resource mobilization with taxation of unearned income

From previous individual policy analysis, it is clear that when renting is an important economic activity in the dualistic economy, a rent tax is an effective tool to radically change the income distribution pattern. This policy package implies that when resources are mobilized for infrastructure investment and the peasant sector has a chance to increase its production, a rent tax should be implemented at the same time to enable the peasant sector to get a larger share of

benefits during the course of the development effort. This policy effectively suppresses the renting activity and radically changes the income distribution pattern. After implementing the policy, not only the formerly rented land and capital are gradually transferred to the peasant sector, the formal sector begins also to sell the commercially farmed land to the peasant sector when average wage rate rises. Yet, when this policy is implemented, the total output does not increase as much as when government resource mobilization policy is implemented alone, due to sub-allocation of production factors.

Policy package 4: Resource mobilization, targeting the poor through equal access to infrastructure with taxation of unearned income

This package yields drastic changes in the land ownership pattern. Rent payments are reduced, while production is shifted to the peasant sector. The share of revenue of the peasant sector in the economy rises as average household consumption increases. Average wage rate also rises to a higher level compared with Policy Package 3. However, compared with the Policy Package 1, the total production is depressed as the resource reallocation process created by the taxation policy yields a sub-optimal allocation efficiency.

Policy package 5: Implementing resource mobilization with financial policy and rent taxation of unearned income

This policy package attempts to reduce the inefficiencies created by resource re-allocation arising from taxation of the unearned income. A financial policy implemented simultaneously with the taxation of rent income enables the peasant sector to bid for the formerly rented land and capital. Simulation of this policy package returns a pattern more or less similar to policy package 3 in which the financial policy is not included, with a slight improvement in the total output, wealth distribution and a reduced rent payment to the formal sector.

This Policy Package is not as effective as Policy Package 4 which targets the improvement of the production potential of the peasant sector through increasing its access to the infrastructure services. In both policy packages the taxation of rent income is in place but in the latter case (package 4), the propensity of the peasant sector to bid for land is heightened, which makes it

more competitive with the formal sector.

Policy package 6: Implementing resource mobilization with financial policy, equal access to infrastructure, cooperative policy and rent tax policy.

This policy package is aimed at allowing the peasant sector an equal opportunity to expand production with their own resources and thereby accruing benefit when more public resources are invested in infrastructure. The increase of investment in infrastructure with equal accessibility to service for both sectors stimulates production and hence the desire to expand land and capital. The financial policy empowers the peasant sector to buy land and capital when it expands production. Cooperatives policy enables the peasant sector to increase its productivity and its capacity to compete favorably with the formal sector. All these policies are implemented simultaneously. Simulation of this policy package shows that the patterns created are the same as with policy package 4, however, a higher level of economic growth and a better income distribution can be achieved. The rent tax policy alleviates the tendency for the wealth to accumulate in the formal sector, while the financial policy improves the reallocation efficiency. When the production in the peasant sector is encouraged, a higher level of infrastructure service and accessibility to modern technology sustains economic growth in that sector and also in the overall economy.

c) Alternative policy packages without mobilizing resources to build infrastructure

Mobilizing financial resources is sometimes difficult and involves a long time delay. A policy package without mobilizing resources for infrastructure investment can fortunately also achieve the developmental goals of growth and equity. Both the cooperative policy and equal access to infrastructure can promote production in the peasant sector. When either of these policies is implemented together with the implementation of the taxation of unearned income, the development pattern obtained is equally good. If a policy to reduce financial segmentation is also implemented, resource reallocation transactions are further improved.

Four additional experiments are recorded in Table 3. The first of these (Policy Package 7) combines equal access to infrastructure, financial policy and cooperatives policy. The rent tax

policy is not implemented. The simulation results show that the total production increases and also the production is mainly carried out in the peasant sector. However, the average wage rate of the workers, land owned by the peasant sector and the revenue share of the peasant sector do not increase, since the economic benefit from increased production in the peasant sector is transferred to the formal sector through rent payments. Policy Package 8 is a combination of rent tax policy and equal access to infrastructure. Policy Package 9 is the combination of rent tax, equal access to infrastructure and the financial policy. Policy Package 10 is the combination of rent tax policy, equal access to infrastructure, financial policy and cooperative policy. The last three Policy Packages lead to a pattern of economic growth with radical changes in asset distribution and increasing wage rates (see Table 3). Comparing Policy Packages 8 and 9, the additional financial policy in Policy Package 9 does not contribute much to the improvement of land ownership since the peasant sector has improved cash flow and can self-finance its investments. Compared with Policy Packages 8 and 9, Policy Package 10 increases the production and revenue received in the peasant sector at the fastest rate and reaching the highest level.

d) Recapitulation

Our experiments show that any single development policy either targeting economic growth or targeting income distribution either is ineffective or creates a problematic transition process. While there are many policy measures to promote economic growth, the taxation of unearned income is a critical instrument to change the income distribution pattern. The efficacy of this policy and the transition process created by it are, however, influenced by how infrastructure provision and modern capital provision are targeted. Comparing the policy packages without and with the mobilization of resources for infrastructure building, it seems all policy packages which mobilize resources for infrastructure building result in a higher output and a better income distribution.

6. Conclusion

The economies of the developing countries have been observed to incorporate two equally significant production modes: a profit-maximizing formal sector and a consumption-maximizing peasant sector. Most development policies, especially the infrastructure policies discussed in this paper, have not differentiated between the two production sectors, therefore, their performance has been uncertain. This paper has attempted to explore the efficacy of infrastructure policy for the developing countries dominated by a dualist agricultural economy by using a system dynamics model of economic growth, income distribution and public infrastructure provision based on an earlier model developed by Saeed (1980, 1994). The focus of the study is to show the impact of the dualist economic structure on the efficacy of public infrastructure policies. Experimentation with this model shows that public infrastructure provision can be a promising facilitating policy to achieve economic growth and income distribution when it is implemented in conjunction with other policies, especially with a rent tax. A policy package, which relieves the financial and technological limitations of the peasant sector through the establishment of cooperatives, allows equal access to infrastructure and discourages rent income, gives the best performance in terms of meeting the development goals of growth and equity.

In the developing countries, government provision of infrastructure has been a traditional instrument to deliver social welfare, although the performance of this policy has shown a lot of variability. This policy can still be effective when it is implemented with the other policy instruments indicated in this paper. Since the developing countries often have limited policy levers to create economic growth and improve income distribution, the possibility to assure the functionality of infrastructure policy offers a promise.

An important focus of infrastructure policy over the past decade has been privatization. The authors posit that privatization of infrastructure delivery would do little to achieve the developmental objective of growth and improvement of income distribution, while it would create many organizational problems since private sector organizations are often not designed to deliver public goods.

While our analysis deals with economic duality in the agricultural sector, our conclusions and their policy implications can be extended to other contexts of dualist economies, for example,

between the agricultural sector and industrial sector, between economically growing areas and lagging areas, and between industrialized countries and developing countries. The underlying structure in other forms of duality is not fundamentally different from that elaborated in this paper. In fact, Saeed and Prankprakma (1997) have used a variation of our model to explore technological policy options in the industrial sector in developing countries, while Saeed (1998) has considered the global economic structure as having the characteristics of a dual economy in which free movement of production factors and commodities might be poised to create global feudalism. Further exploration with the dualist structure can result in more insights.

References:

- Abegglen, J. C. *SEA Change Pacific Asia as The New World Industrial Center*, Free Press, The Ontario, 1994.
- Ahmad, M. and Sampath, R.K. Irrigation Inequalities in Pakistan 1960-1980: A District Level Analysis. *The Pakistan Development Review*, 1994, **33**(1), 53-74.
- Akino, M. Land Infrastructure Improvement in Agricultural Development: The Japanese Case, 1990-1965. *Economic Development and Cultural Change*, 1979, **28**(1), 97-117.
- Aschauer, D. A. Is Public Expenditure Productive. *Journal of Monetary Economics*, 1989, **23**, 177-200.
- Aschauer, D. A. Does Public Capital Crowded out Private Capital? *Journal of Monetary Economics*, 1989, **24**, 171-88.
- Bardhan, P. K. A Model of Growth in a Dual Agrarian Economy. In *Development and Planning: Essays in Honor of Paul Rosenstein-Roden*, ed. G. Bhagwati and R. Eckus, George Allen and Unwin, New York, 1973.
- Barkovich, B. R. Regulatory Interventionism. In *The Utility Industries: Fairness, Efficiency, and the Use of Energy Conservation*, Quorum Books, Connecticut, USA, 1988
- Besley, T. and Kanbur, R. Principles of Targeting. In *Including the poor : proceedings of a symposium organized by the World Bank and the International Food Policy Research Institute*, ed. M. Lipton and J. van der Gaag, The World Bank, Washington, D.C., 1993.
- Biehl, D. ed. *The Contribution of Infrastructure to the Regional Development*. Commission of the European Community, 1986.
- Boadway, R. and Marchand, M. The Use of Public Expenditure For Redistributive Purposes. *Oxford Economic Papers*, 1995, **47**, 45-59.
- Boeke, J.H. Economics and Economic Policy of Dual Societies. In *Leading Issues in Economic Development*, ed. G.M. Meier, 3rd Edition, Oxford University Press, New York, 1976.
- Boeke, J.K. *Dualist Economics Oriental Economics*, Institute Of Pacific Relations, New York,

1953.

Broersma, K. Planning and Design Consideration for Lower and Middle-Tier Roads in Developing Countries. In *High-Way Design in Developing Countries, Proceedings of PARCH Seminar E, Summer Annual Meeting*, U.K, University of Warwick, 1975.

Brown, S.J. and Sibley D.S. *The Theory of Public Utility Pricing*. Cambridge University Press, New York, 1986.

Burki, S. J. The Development of Pakistan's Agriculture: An Interdisciplinary Explanation. In *Rural Development in Bangladesh and Pakistan*, ed. Steven's et. al., Hawaii Univ. Press, Honolulu. Hawaii, 1976.

Chadha, G. K. *Employment, Earnings and Poverty: a Study of Rural India and Indonesia*, Sage Publications, New Delhi , 1984

Clements, P. A Poverty Oriented Cost Benefit Approach to the Analysis of Development Projects. *World Development*, 1995, **23**(4), 577-592.

Dalziel, P. A Generalization and Simplification of the Cambridge Theorem with Budget Deficits. *Cambridge Journal of Economics*, 1991, **15**, 287-300.

Dudley, L. and Montmarquette, C. Is Public Spending Determined by Voter Choice or Fiscal Capacity? *The Review of Economics and Statistics*, 1992, **LXXIV**(3), 522-529.

Duffy-deno, K.T. and Eberts, R. W. Public Infrastructure and Regional Economic Development: A Simultaneous Equations Approach. *Journal of Urban Economics*, 1991, **30**, 329-343.

Eberts, R. W. and Fogarty, M. S. Estimating the Relationship Between Local Private and Private Investment. *Working Paper No. 8703, Federal Reserve Bank of Cleveland*, May 1987.

FAO (Food and Agricultural Organization). Technical Background Documents. *World Food Summit*, 1996.

Fazi, E. and Salvadori, N. The Existence of Two-Class Economy in A General Cambridge Model of Growth and Distribution. *Cambridge Journal of Economics*, 1985, **9**, 155-164.

Fie, J.C. and Ranis, G. Agrarianism, Dualism, and Economic Development. In *The Theory and Design Of Economic Development*, ed. I. Adleman and E. Thorbecke, John Hopkins Press, Baltimore, MD, 1966.

Frederiksen, P. C. Further Evidence on the Relationship Between Population Density And Infrastructure: The Philippines and Electrification. *Economic Development and Cultural Change*, 1981, **29**, 749-58.

Frederiksen, P. C. and Looney, R. Road Investment And Regional Development: A Philippine Case Study. *Naval Postgraduate School Working Pager No. 80-3*. Naval Postgraduate School, Monterey, CA, 1980.

Freebairn, D.K. Did The Green Revolution Concentrate Incomes? A Quantitative Study Of Research Reports. *World Development*, 1995, **23**, 265-279.

Garn, H.A. and Fosler, R.A. *Economic Consideration In Infrastructure Decision Making*, Washington, D.C, Garn Research, 1987.

- Glover D. R and Simon J. L. The Effect Of Population Density On Infrastructure : The Case Of Road Building. *Economic Development And Cultural Change*, 1975, **23**, 453-468.
- Gordon, D. M. *Theories of Poverty And Underemployment; Orthodox, Radical, And Dual Labor Market Perspectives*, Lexington Books, Lexington, Mass., 1972.
- Hansen, N. Unbalanced Growth and Regional Development. *Western Economic Journal*, 1955, **4**, 3-14.
- Hirschman, A. O. *The Strategy of Economic Development*, Yale University Press, New Haven, Connecticut, 1958.
- Hirschman, A. O. *Development Projects Observed*, The Brookings Institution, Washington, D.C., 1967.
- Holtz-Eakin, D. and Schwartz, A. E. Infrastructure in a Structural Model of Economic Growth *Regional Science And Urban Economics*, 1995, **25**, 131-151.
- Hunt, D. *Economic Theories of Development: An Analysis of Competing Paradigms*, Harvester Wheat Sheaf, London, 1989.
- ILO (International Labor Organization). *Employment, Incomes, and Equality: A Strategy for Increasing Productivity Employment in Kenya*. pp. 5-8, 503-8. International Labor Organization, Geneva, 1972.
- ILO (International Labor Organization). *Poverty in Rural Asia*, International Labor Organization, Geneva, 1983.
- ILO (International Labor Organization). *Hired Labor and Rural Labor Markets in Asia*. International Labor Organization, Geneva, 1986.
- IMF(International Monetary Fund). Unproductive Public Expenditure: a Pragmatic Approach to Policy Analysis. *International Monetary Fund Working Paper No. 48*, 1995.
- Ireson, W. R. Landholding, Agricultural Modernization and Income Concentration: a Mexican Example. *Economic Development And Cultural Change*, 1987, **35**(2), 351-366..
- Israel, A. Issues for Infrastructure Management in The 1990s. *World Bank Discussion Paper 171*, 1992.
- Khan, M.L.R *Rural Road Planning in Developing Countries: A Network Modeling Approach*. AIT Dissertation IE-84-1, Asian Institute of Technology, Bangkok, 1984.
- Kikuchi, M and Hayami, Y. ed. *Agricultural Growth in Japan, Taiwan, Korea, And The Philippines: (Proceedings)*. Honolulu, USA, Published for the East-West Center by the University Press of Hawaii, Hololulu, 1979.
- Knudsen, O and Nash, J. with the contribution by Bovard, J, Gardner, B and Winter, L. A. Redefining The Role of Government in Agriculture for the 1990. *World Bank Discussion Paper No. 105*, 1990.
- Krueger, A. O. *Economic Policy Reform in Developing Countries: The Kuznets Memorial Lectures At The Economic Growth Center, Yale University*, B. Blackwell, Cambridge, USA, 1992.
- Lewis, A. Economic Development with Unlimited Supplies of Labor. Manchester School. May

1954; Reprinted in *The Economics of Underdevelopment*, ed. A. Argarwala and S. Singh. Oxford University Press, London, 1958.

Liang, EP.L Market Accessibility and Agricultural Development in Prewar China. *Economic Development and Cultural Change*, 1981, **30**(1): 77-105.

Lipton, M. and Longhurst, R. *New Seeds and Poor People*, Unwin Hyman, London, UK, 1989.

Lipton, M. *Why Poor People Stay Poor*, Harvard University Press, Cambridge, MA, 1967.

Mashaiyekhi, A. N. Development Projects Cost Dynamics. *Working Paper*, MIT, Cambridge, MA, 1996

Meier, G. M. *Leading Issues in Economic Development*, Oxford University Press, New York, Oxford, 1989.

Mellor, J. M. Toward a Theory of Agricultural Development. In *Agricultural Development and Economic Growth*, ed. H. M. Southworth and B. Johnson, Cornell University Press, Ithaca, New York, 1967.

Minami, R. *The Economic Development of Asia*, The Macmillan Press Ltd., London, 1994.

Munasinghe, M. *Rural Electricity for Development Policy Analysis and Application*, Westview Press, London, 1987.

Munnell, A. H. with the assistance of L. M. Cook. How Does Public Infrastructure Affect Regional Economic Performance? *New England Economic Review*, **1990**, (Sept./Oct.), 11-32.

Munnell, A. H. Policy Watch Infrastructure Investment and Economic Growth. *Journal of Economic Perspectives*, 1992, **4**(6), 189-198.

Muqtada, M. (1984) Special Employment Schemes in Rural Bangladesh. *Asian Employment Program Working Paper ILO, Geneva*, 1984.

Musgrave, R. A., and Musgrave, P.B. *Public Finance in Theory and Practice*, McGraw-Hill Book Company, London, 1976.

Myint, H. Organizational Dualism and Economic Development. *Asian Development Review*, 1995, **3**(1), 25-42.

Nadiri, M.I. and Mamuneas, T.P. The Effect of Public Infrastructure and R&D Capital on The Cost Structure and Performance of US Manufacturing Industries. *Review of Economics And Statistics*, 1994, **76** (1): 22-37.

Oshima, H. *Economic Growth in Monsoon Asia : a Comparative Survey*, University of Tokyo Press, Tokyo, 1987.

Parker, A. N. Decentralization: The Way Forward for Rural Development. This Is a Research under *The Project “ Decentralization, Fiscal Systems and Rural Development”*, RPO 679-68, 1995.

Pasinetti, L. L. Richardian Debt/Taxation Equivalence in The Kaldor Theory of Profits and Income Distribution. *Cambridge Journal of Economics*, 1989, **13**, 25-36.

Raj, M. Urbanization, Infrastructure and Besieged Growth Potential. *Third World Planning*

Review, 1993, **15**(2), 159-173.

Ravallion, M and Sen, B. Impact of Land Based Targeting on Rural Poverty. *World Development*, 1994, **22**(6), 823-38.

Rondinelli, D. Project Identification in Economic Development. In *Planning Development Projects*, edited by D. A. Rondinelli. Dowden, Hutchinson@Ross, Inc., Stroudsburg, Pennsylvania, 1977.

Reynolds, L.G. Agriculture in Development Theory: an Overview. In *Agriculture in Development Theory*, ed. L.G. Reynolds, Yale University Press, New Haven and London, 1975

Richards, P. J. The Economic Context of Rural Roads. In *Basic Needs And Employment: Rural Roads and Poverty Alleviation: An Introduction and Four Country Studies*, P.J. Richards, M. A. EL-Hawary, T. Y. EL-reedy, J. D. Howe, and J. H. Johns, *Working Paper No. Wep 2-32/Wp-41*, International Labor Organization, Geneva, 1982

Saeed, K. A Re-Evaluation of the Effort to Alleviate Poverty and Hunger. *Socio-Economic Planning Sciences*, 1987, **21**(5): 291-304.

Saeed, K and Prankprakma, P. Technological Development in a Dual Economy: Alternative Policy Levers for Economic Development. *World Development*, 1997, **25**(5), 695-712.

Saeed, K. *Development Planning and Policy Design a System Dynamics Approach*, Ashgate, Avebury, England, 1994.

Saeed, K. Trade Relations in Dual Global Economy. *System Dynamics Review*, Special Edition on Sustainable Development, 1998, **14**(2): 107-128

Saeed, K. and Brooke, K. Contract Design for Profitability in Macro-Engineering Projects. *System Dynamics Review*, 1996, **12**(3): 235-246.

Saeed, K. *Rural Development and Income Distribution: The Case of Pakistan*, Ph.D. Dissertation, MIT, Cambridge, MA, 1980.

Saeed, K. Wage Determination, Income Distribution and the Design of Change. *Behavioral Science*, 1988, **3**(33): 161-186.

Samuel, P. Accountability in Public Services: Exit, Voice And Capture. *World Bank Discussion Paper No. 614*, 1991.

Samuelson, P.A and Nordhaus, W. D. *Economics*, Macgraw-Hill, New York, 1985.

Schiff, M and Valdes, A The Plundering of Agriculture in The Developing Countries. *World Bank, Development Brief Number 3*, 1992.

Sen, A. K. Peasants and Dualism With or Without Surplus Labor. *Journal of Political Economy*, 1966, **74**(5), 425-450.

Shah, A. Dynamics of Public Infrastructure, Industrial Productivity and Profitability. *The Review of Economics And Statistics*, 1992, **LXXIV**(1), 28-36.

Simon, J. L. The Positive Effect Of Population Growth On Regional Savings In Irrigation Systems. *Review Of Economics And Statistic*, 1975, **57**, 71-79.

Sraffa, P. *Production of Commodities By Means of Commodities*, Cambridge University Press,

Cambridge, England, 1960.

Stephanedes, Y. Distributional Effects Of State Highway Investment On Local And Regional Development. *Transportation Research Record* 1274, 1974.

Todaro, M. P. *Economic Development*. 5th edition, Longman New York, 1994.

UNPAD (United Nations Public Administration Division) Development Planning as a Framework for Project Administration. In *Planning Development Projects*, ed. D. A. Rondinelli, Dowden, Hutchinson@Ross, Inc., Stroudsburg, Pennsylvania, 1977.

Van de Walle, D and Nead, K. *Public Spending and the Poor: Theory and Evidence*. Baltimore and London, The Johns Hopkins University Press for the World Bank, 1995.

Winters, P; Janvry, A; Sadoulet, E and Stamoulis, K. The Role of Agriculture in Economic Development: Visible and Invisible Surplus Transfers. *Working Paper No.814. California,1996. Agricultural Experiments Station*. Giannini Foundation of Agricultural Economics.

World Bank *The East Asian Miracle Economic Growth and Public Policy A World Bank Policy Research Report*, Oxford University Press, New York, 1993.

World Bank Sustainable Transport: Priorities for Policy Sector Reform. *World Bank Working Paper* 13598, 1996.

World Bank *World Development Report Infrastructure for Development*, Oxford University Press, New York, 1994.

Worldwatch Institute. *State of the World*. Washington D.C., World watch Institute, 1990.