Effects of Increasing Agricultural Productivity: A Computable General Equilibrium Analysis for Sri Lanka

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Abstract

This paper provides a quantitative assessment of the likely economy-wide impacts of agricultural productivity improvements in Sri Lanka. A static multi sector Computable General Equilibrium (CGE) model of the Sri Lankan economy using the input-output table for year 2000 is employed highlighting the agricultural sector and its interactions with other production sectors in the economy. The results indicate that increasing agricultural productivity leads to positive economic benefits. However, productivity improvements would lead to reduction in agricultural employment, which in turn may affect the real income of households in agricultural provinces in the short run.

Keywords

Multi sector CGE model, productivity

Introduction

Growth in agriculture and its productivity are regarded as crucial in accomplishing the goals of sustainable growth and substantial poverty reduction in developing countries. There has been a long consensus among development economists that agricultural productivity growth is vitally important if agricultural output is to increase at a prompt rate to meet growing demand for food for the growing non agricultural population (Mellor, 1976). Historically, agriculture sector has been a major source of employment in developing countries. As the structural transformation progresses, agriculture accounts for a diminishing share of employment and income, but the growth process is directed by the development of agricultural sector. This trend is evidenced by steadily declining share of the agriculture sector in world gross domestic product (GDP) in favour of manufacturing and services sectors over the past three decades and the falling contribution of agriculture to total employment.

However, the decline in agriculture's contribution to GDP is much faster than its decline as a source of employment. Therefore, trend away from agriculture has not necessarily been met by employment creation in non agricultural sectors.

There has been increasing attention given by development economists to the simulation of domestic markets in developing countries to gauge the effects of changes in external economic effects. Because of the importance of the agricultural sector in most developing economies, raising agricultural productivity appears as a plausible and appealing choice for policy makers to promote economic growth. The literature provides overwhelming theoretical and empirical evidence that agricultural growth is essential, especially in the developing countries. It identifies the diverse roles that agriculture plays in the process of growth and development. For example Johnson and Mellor (Johnston & Mellor, 1961) specify agriculture's contribution to economic development as food and raw materials, labour and capital, foreign exchange and markets for the outputs of other sectors. Agricultural productivity growth would generate increased demand not only for food but also for other industrial outputs and services via intermediate and final demand linkages (Adelman, 1984; Mellor, 1976). Bautista (Bautista, 1986) identifies increased agricultural production through productivity increase result in foreign exchange savings and reduction in food imports and increase the ability to export. Further, increased agricultural productivity may cause lower and more stable food prices making households better off (Adelman, 1975; de Janvry & Sadoulet, 2002).

It is important to distinguish the distinction between increases in output and productivity since these do not necessarily have similar impacts. In some cases, output and productivity increase together where as in other cases they can vary inversely with differential consequences for poverty. A new technology, for example can have a range of impacts with different effects on output, profit and employment. If the technology cuts down the inputs needed, production costs will decrease raising profits, but output may not be affected and employment could be reduced. If instead technology raises yields, output and probably employment will increase, but profits not inevitably increase. Alternatively, if the technology raises labour productivity, wage rates will increase but possibly at the expense of employment and with indeterminate output effects. A technology that allows expansion of cultivated area may raise the output, employment and profits but is likely to lower yield. A technology may also induce a change

in the composition of output towards more or less labour-intensive crops (Irz et al., 2001; Schneider & Gugerty, 2011).

The effects of agricultural growth are spread to the non-farm economy by different linkages; production, employment and income. Higher real incomes in the agricultural sector stimulate demands for the products of other sectors and labour within the sector while higher agricultural outputs stimulate the creation of non-farm rural and urban employment opportunities through backward and forward linkages to manufacturing and services sector activities (Hanmer & Naschold, 2000; Thirtle et al., 2001). Irz et al., (2001) summarise and review many possible arguments of effects of agricultural productivity growth on farm economy, rural economy as a whole and the national economy and the necessary conditions to achieve them.

It is not clear that rural income will increase at all times with improvements in agricultural productivity as a result of possible deterioration of agricultural terms of trade arising from price and income inelasticity of agricultural products (Bautista, 1986). Arndt et al., (2000) suggest that price declines due to an increase in agricultural productivity would transmit most of the gains to urban households, to non-agricultural sectors and to non-agricultural factors of production. Rural households who mostly engage in agricultural activities gain from greater availability of food. Further, Thirtle et al., (2001) implies that productivity gains may not trigger poverty reduction if the decline in output prices outweighs the gain from increased productivity. These complex relationships between direct and indirect general equilibrium effects emphasize the linkages between agricultural productivity, growth and poverty reduction.

Past studies

There are implications for determining a suitable method to identify the relationship between agricultural productivity and economic growth and poverty alleviation. It should be considered in the context of broader economy and address both direct and indirect effects of rise in productivity growth. Many studies of productivity or technical change in developing country agriculture have been conducted in isolation from linkages to other sectors (Mellor, 1999; Self & Grabowski, 2007; Thirtle et al., 2003). However, in analysing the effects of agricultural productivity, it is important to consider the linkages of the agricultural sector with the rest of the economy in terms of both agriculture's demand for non-agricultural products

and rest of the economy's demand for agricultural goods. For example, Rangarajan (1982) estimated that a 1 per cent addition to agricultural growth rate in India stimulated a 0.5 per cent addition to the growth rate of industrial output and a 0.7 per cent addition to the growth rate of national income. Schuh (2000) suggest that agricultural research community has failed to take credit for a substantial decrease in poverty in general by disregarding general equilibrium effects of an introduction of new technologies in agriculture and by focusing significantly on poverty within the farm sector.

Social accounting matrices (SAM) and computable general equilibrium (CGE) models generally use data on the production structure of a given country to estimate how an economy would respond to a shock or a change in economy. There are several country level CGE models demonstrating the multiplier effects of agricultural growth in other sectors of the economy (Arndt, et al., 2000; Bautista, 1986; I. Coxhead & Warr, 1993, 1995; I. A. Coxhead & Warr, 1991; De Franco & Godoy, 1993; Dorosh et al., 2003).

Arndt et al., (2000) used a CGE model to analyse improvements in agricultural productivity and reductions in marketing costs in Mozambique. They found that increasing agricultural productivity is an important priority for Mozambique with large potential gains. However, increasing agricultural output with very high marketing costs leads to significant fall in prices transmitting most of the gains in factor income to non-agricultural sectors.

Bautista (1986) developed a CGE model to investigate the effects of productivity increases in Philippine agriculture. The study simulates the impacts of productivity increases in three agricultural sectors; food crops, export crops and livestock and fishing sectors and the food manufacturing sector on sectoral prices and outputs, rural and urban income, trade balance and national income. The simulations imply a ten per cent increase in total productivity separately in the four sectors and increased productivity in all sectors simultaneously. The cause of the productivity increase is assumed to be as a result of technological change and/or improved infrastructure. Increased productivity in the food crops sector results in a fall in food prices but promotes the food manufacturing sector. Productivity improvements in export crop sector results in a decline in sector prices while improving sector production. Increased productivity in the food manufacturing sector stimulates growth in production and in the food crop sector as well. Simultaneous productivity increases in all four sectors show moderate positive impacts on household income while there are significant impacts on macroeconomic

variables. Based on those results, the author argues that increasing agricultural productivity does not necessary result in reduced rural income but is more likely to benefit urban households.

Coxhead & Warr (1991) used a CGE model for Philippines to investigate the distributional effects of technical progress in Philippine agriculture. They show, in a small open economy, technical improvements in farming are likely to benefit poor, especially if the technical change is labour-using, land-saving. It produces a redistribution of income from landlords to labourers. A technical change which substitutes capital for labour with no increase in output in irrigated agricultural sector triggers a reduction in real wage in the same sector. Households owning only labour lose while real incomes of households that do not depend on labour show a slight increase. Coxhead and Warr (1995)used the same model to trace the effects of differential rates of technical progress in the irrigated and non-irrigated agricultural sectors on income distribution of factor owning household groups, poverty and economic welfare within a small open economy with open agricultural trade and agricultural trade under restrictions. The results clearly showed that reduced poverty from technical progress is substantially greater when agricultural trade is unrestricted at a constant world price.

Coxhead and Warr (1993) examined the distributional effects of technical change in Philippines' agriculture using a general equilibrium model. They show that technical change in Philippine agriculture raised incomes, reduced poverty and improved the income distribution. Further, they argue that income distributional aspects of technical change depend on differential changes in returns to primary factors of production, the distribution of returns between factors of production that are mobile across industries and the relationship between changes in the prices of final consumer goods and expenditure patterns of different income classes.

De Franco & Godoy (1993) developed a CGE model for Bolivia to show that improvements to crops generate all round benefits in the economy, stimulating growth and employment. Hoever, improvements to the major non-tradable, potatoes have greater effects than improvements to traded crops such as wheat or soybeans. When the price of potatoes fall, real income increases as a result of poor people spending larger proportion of their household budgets on food.

Dorosh et.al (2002; 2003) use a CGE model for Uganda with the objectives of quantifying the linkages between agriculture, other sectors in the economy and the macro-economy as agriculture is a dominant sector in the Ugandan economy and to assess the implications of various external shocks in the Ugandan economy. The model conducts simulations to analyse the impacts of changes in world coffee prices, agricultural productivity shocks, reductions in agricultural marketing costs and changes in foreign capital inflows. They found that Broader increases in agricultural productivity and reductions in marketing costs have more potential to raise rural incomes in Uganda with largest gains in regions where home consumption is lower.

This paper presents a quantitative assessment of potential macroeconomic, industry level and household level benefits from the increase in productivity of agricultural sectors. The cause of the productivity increase is assumed to be as a result increase in primary factor productivity. The analysis is based on a CGE model designed to capture important recent socio economic features of Sri Lankan economy

The agricultural sector continues to play a very important role in the Sri Lankan economy even though its relative position in the economy has been declining with the growth of other sectors, which reflects the normal pattern of structural change during economic development. Historically, Sri Lanka was an agricultural economy with agriculture accounting for more than 50 per cent of its GDP. Agriculture accounts for about one third of total employment and 23 per cent of total exports in 2008, contributing nearly 70 per cent of the growth of export earnings. The role of the agriculture sector remains important to poverty reduction. The low agricultural share in Gross Domestic Product (GDP) of around 12 per cent is notable implying the low income received by farmers. Nearly 80 per cent of the population resides in rural areas, the majority of which still depend directly or indirectly on agriculture for their livelihoods. Uva, Sabaragamuwa and Central provinces of Sri Lanka where agricultural activities are mostly carried out reports higher incidences of poverty (Department of Census and Statistics, 2008b). Therefore, development in agriculture has been considered by the successive governments as a path for poverty alleviation.

Agricultural growth rates in Sri Lanka have been poor in comparison to expectations. According to the Central Bank of Sri Lanka (2008), agricultural productivity growth was around 2 per cent for the past few decades. The most recent policy framework envisaged that

the agriculture sector would grow at a faster rate of around five per cent (Ministry of Finance and Planning, 2006). Current agriculture policy in Sri Lanka is directed towards improving productivity of many subsectors by making them more competitive. It aims to create exportable surpluses or import substitution to strengthen the balance of payment situation of the country while increasing the income levels of the people who engage in such cultivation.

Methods

The model developed for this study belongs to the Johansen class of general equilibrium models and is based on ORANI G (Dixon et al., 1982; Horridge, 2003). Therefore, the model is linear in percentage changes of variables. This model acts as the policy simulation laboratory in which external shocks in the policy environment can be assessed. A CGE model involves a number of assumptions. This model deploys the classic economic assumptions; perfectly competitive economy with constant returns to scale; cost minimisation for industries; utility maximisation for households; perfectly mobile labour across industries and fixed in supply; capital and land industry specific and fixed in supply and market clearance for all input and output markets.

The economy of Sri Lanka is divided into 40 production sectors, among which there are 16 primary agricultural sectors and six agricultural processing sectors. The model assumes that there is one to one relation between industries and commodities. The production structure for all the industries is a nested three level, constant returns to scale production function. At the top level, the production function is characterised by a Leontief production function. That is intermediate inputs and an aggregate of primary factors are combined in fixed proportions to create each unit of output. At the second level, the aggregation between domestic and imported intermediate inputs and the aggregation of primary factors are described by a Constant Elasticity of Substitution (CES) production function which result in composite commodities and composite primary factors of production. The composite commodities are used as inputs in the production sectors, are consumed as final goods by households and government and are exported. The primary factors include labour, capital and land. At the third level, the substitution possibilities among eight labour categories are described by a CES production function. No substitution takes place between intermediate inputs and primary factors or between intermediate inputs of different input-output classes. Imported goods are

modelled as imperfect substitutes for domestically produced commodities both in intermediate and final usage following the Armington assumption. Similarly, imperfect transformability between exported commodities and goods produced for local market is assumed using a Constant Elasticity of Transformation (CET) function.

A small country assumption is used in specifying all sectors' exports and imports except for tea processing sector. Tea processing sector exports are modelled with an assumption that Sri Lankan has some market power in the international tea market.

The present model differentiates among nine household groups representing geographical provinces/regions in the country that consumes commodities and supplies primary factors of production. Consumption demands by households are determined by a two level nested Linear Expenditure System (LES). The LES function at the top level allows the households to adjust their combination of consumption in response to income changes. The CES function at the bottom level reflects the flexible choice between imported and domestic goods in consumption. The household income is created by primary factor rewards.

The economy is further divided into nine regions representing nine provinces in order to analyse regional impacts of the simulation shocks. The production sectors are divided as national and local industries. While national commodities are traded extensively across borders, local commodities are traded scarcely among regions. Demand for local commodities in each region is satisfied mainly from the production in that region. It was decided to treat three service commodities in the data base as local commodities (construction, owner dwelling and other personal services) while other industries considered as national commodities.

The model is based on the most recent input-output (I-O) table constructed for Sri Lanka which is for the year 2000 (Amarasinghe & Bandara, 2005) on the basis of national accounts compiled by the Department of Census and Statistics, Sri Lanka. Further, national accounts data for 2000 published by the department of Census and Statistics (Department of Census and Statistics, 2002c), Consumer Finance and Socioeconomic Survey 1996/97 and 2003/04 by the Central Bank of Sri Lanka (Central Bank of Sri Lanka, 1999, 2005) and other publications from the Department of Census and Statistics such as labourforce survey reports, poverty, household income andexpenditure survery reports and industry survery reports

(Department of Census and Statistics, 2002a, 2002b, 2002d, 2008a, 2008b) were used to construct the database. The values for behavioural parameters are adopted from drawing heavily on the literature. Previous CGE studies (Bandara, 1989; Centre for International Economics, 1991; Naranpanawa, 2005; Somaratne, 1998) conducted for Sri Lanka is the main references for those parameters.

Model closure and simulation design

Model closure creates the economic environment to reflect the way economic agents behave and any economy-wide constraints. The model simulations are conducted in both short run and long run environments. For the short run closure capital stock at aggregate and industry levels and real wages are exogenised in order to determine aggregate employment and gross sectoral rates of return on capital. Since capital stock is fixed there are no changes in investment. Further, aggregate private consumption, aggregate government consumption and the trade balance is assumed to be endogenous. For long run closure, aggregate employment and the gross sectoral rate of return on capital are exogenised. As a result, capital stock at aggregate and industry levels is allowed to adjust so a fixed rate of return on capital is maintained and the real wage adjusts to reflect changes in demand for the fixed aggregate labour. All expenditure side aggregates- aggregate real consumption, investment, government and inventory demands adjust to produce real GDP from expenditure side while and trade balance remain fixed.

Two simulations were conducted with this Sri Lankan CGE model based on the ten year development plan. The development plan identifies improving productivity in the agricultural sector as an important strategy for the development of the country. It targets increases in extent of cultivation and improvement in productivity of different sub-sectors over a ten year period (Ministry of Finance and Planning, 2006). Table 1 describes the targeted productivity increases in the ten year development plan. Simulation scenarios were developed by taking into consideration the targeted productivity increases.

Two simulation scenarios are simultaneous productivity increases in the short run and in the long run: 4 per cent productivity increase in tea growing sector, 1 per cent productivity increase in rubber growing sector, 4 per cent productivity increase in coconut growing sector, 2 per cent productivity increase in paddy sector, 5 per cent productivity increase in highland crops sector, 5 per cent productivity increase in vegetables sector, 5 per cent productivity

increase in fruits sector, 6 per cent productivity increase in minor export crops sector and 1 per cent productivity increase in the livestock and fish sector.

Table 1: Targeted long term productivity increases

Sub sector	Productivity increase (%)
Tea	20
Rubber	5
Coconut	20
Paddy	10
Field crops, vegetables, fruits and other	25
Export agricultural crops	30
Livestock	5

Source: Ministry of Finance and Planning (2006)

The model is implemented using the GEMPACK software package (Codsi & Pearson, 1988). The outcomes of agricultural productivity increases as quantified in the above simulations are analysed and interpreted as percentage change deviations from the base period.

Results

The impacts of simultaneous productivity improvements are analysed within above mentioned two different settings. The results can be grouped into macroeconomic, sectoral and income effects. Specially, the effects on macroeconomic variables such as GDP and employment and the effects on domestic production, prices, sectoral employment and household incomes are investigated.

Macroeconomic results

The projections for the macroeconomic effects of increased agricultural productivity are presented in Table 2. Accordingly, the productivity increase is likely to lead to a positive real GDP in both the short run and the long run. However, GDP in the long run (0.73 per cent) is higher than that of the short run (0.56 per cent). Since, we assume real wage is fixed in the

short run and aggregate employment is fixed in the long run, increased productivity in the agricultural subsectors increase the level of aggregate employment in the economy in the short run (by 0.04 per cent), increase the real wage in the long run (by 1.12per cent). Further, improved productivity reduces the aggregate price level and thus improve aggregate real household consumption. Increase in real household consumption can be considered as an indicator of the welfare improvement by the rise in productivity. Moreover, productivity improvements enhance the balance of trade and promote trade leading to more exports and imports. The increase in net exports is from lower export prices and a real depreciation of the exchange rate in both scenarios. Exports decrease more than imports in the long run. A slight depreciation of the exchange rate in the long run (0.47 per cent) compared to short run (1.08 per cent) restores the equilibrium in the trade balance. The rise in sectoral production, both agricultural and non-agricultural, and the increase in real household consumption could lead to increased demand for imports. The reduction in consumer price index in both the scenarios reflects declines in prices of most agricultural and non-agricultural products.

Table 2: The projections of the macroeconomic effects of increased productivity (percentage changes)

Variable description	Productivity increase	
	Short run (simulation I)	Long run (simulation II)
Real GDP from the income side	0.56	0.73
Aggregate employment	0.04	Exogenous
Average real wage	Exogenous	1.12
Real devaluation	1.08	0.47
Consumer price index	-1.21	-0.69
Export volume index	0.91	0.36
Export price index	-0.22	-0.21
Import volume index, C.I.F. weights	0.38	0.172
Real household consumption	0.43	0.74
(change in Nominal balance of trade)/(change in nominal GDP)	0.000	Exogenous
Real trade balance (Rs. Mn)	2110.38	Exogenous

Source: Model outputs

Sectoral effects

Projections of effects of increased productivity on production, prices and employment are listed in Table 3. Simultaneous productivity increases in several agricultural subsectors lead to a significant positive response in the majority of sectoral outputs both agricultural and non-agricultural. Minor export crops, tea growing, vegetables and highland crops are the highest growing agricultural sectors in the short run. Apart from those sectors, coconut growing sector also shows a boost in production in the long run. Another important feature is that increases in productivity in agriculture also expand the agriculture related processing sectors such as tea processing, rubber processing, rice milling, coconut processing and food, beverages and tobacco processing sectors owing to ample supply of raw materials for lower prices from the primary agricultural sectors in both short run and long run. Increased production in non-agricultural sectors could be due to increased demand for non-agricultural products required as intermediate inputs for agricultural sectors. This increase in supply leads to a decline in market prices. This could have a negative effect on agricultural production, offsetting the expansionary effect of increasing productivity if there is no intervention by the government to prevent this price decline.

The expansion of agricultural sectors leads to a decline in demand for labour as a result of improved primary factor productivity. For example rubber growing, coconut growing, paddy, vegetables, fruits, highland crops and livestock and fisheries sectors demonstrate larger decline in labour demand. However, it is apparent that export oriented agricultural industries and agriculture related processing industries (minor export crops, tea processing, rubber processing and coconut processing industries) absorb more of labour with their increase in production. Expansion of other non-agricultural sectors also increases their demand for labour. Textile, footwear and leather, wood and wood products, chemicals and fertiliser, petroleum, plastic and rubber products, electricity, gas and water and post and communications sectors show higher increases in demand for labour in the short run. Contraction of export oriented garment industry and other manufacturing sector cause a decline in labour demand in the long run. This may be due to the attraction of agriculture related export oriented manufacturing industries over them.

Table 3: Effects of increased productivity on production, prices and employment

Sectors	Short run			Long run		
	Output	Price	Employment	Output	Price	Employment
Tea growing	4.02	-4.54	-0.27	4.40	-2.88	0.31
Rubber growing	0.70	-3.58	-1.70	0.85	-0.85	-0.45
Coconut growing	0.96	-7.77	-5.36	2.71	-3.91	-2.04
Paddy	0.56	-4.73	-2.73	0.67	-2.21	-1.90
Vegetables	1.69	-11.91	-8.36	1.39	-7.59	-6.39
Fruits	0.61	-13.78	-9.29	0.81	-8.55	-6.77
Highland crops	1.23	-13.85	-8.24	1.14	-8.90	-6.34
Potatoes	0.29	-0.32	0.63	0.48	0.75	0.76
Minor export crops	9.24	-0.48	6.27	10.57	-0.54	6.65
Tobacco	0.42	-0.05	0.95	0.38	0.27	0.59
Betel	0.33	-0.38	0.74	0.46	0.89	0.72
Miscellaneous agriculture	0.49	-0.12	1.10	0.65	1.01	1.04
Plantation development	0.15	-0.63	0.32	0.59	0.76	0.91
Firewood	0.22	-0.68	0.48	0.43	0.33	0.40
Forestry	0.30	-0.45	0.67	0.52	0.36	0.49
Livestock and fish	0.57	-2.71	-1.39	0.59	-0.69	-0.64
Tea processing	4.02	-1.79	10.84	4.40	-1.93	4.33
Rubber processing	0.75	-0.09	11.61	0.82	-0.19	0.70
Coconut processing	0.21	-0.01	2.23	16.70	-0.80	16.57
Rice milling	0.60	-2.77	7.88	0.75	-1.88	0.63
Flour milling	0.11	0.32	1.42	0.51	0.07	0.40
Food beverages and tobacco	0.15	0.40	1.57	0.60	-0.19	0.49
Textile footwear and leather	0.63	0.91	2.30	1.15	0.14	1.06
Garment	0.24	-0.01	0.85	-1.69	0.08	-1.78
Wood and wood products	1.29	0.98	3.29	1.93	0.11	1.85
Paper and paper product	0.46	-0.07	0.90	0.81	0.10	0.75
Chemicals and fertiliser	0.42	0.69	2.33	1.21	0.08	1.11
Petroleum	0.23	0.25	2.65	0.49	0.07	0.37
Plastic and rubber products	0.56	1.56	2.79	0.97	0.08	0.87
Other manufacturing	0.29	-0.01	0.84	-0.47	0.10	-0.55
Electricity gas and water	0.48	2.31	2.43	1.08	0.20	0.98
Construction	0.27	-0.57	0.42	0.49	0.25	0.44
Hotels and restaurants	0.83	-2.59	1.28	0.94	-1.31	0.90
Tourist and travel	0.36	-0.07	0.75	0.74	0.20	0.67
Trade and transport	0.31	-0.01	0.91	0.47	0.23	0.39
Post and communication	0.00	4.29	7.61	0.75	0.22	0.63
Banking	0.42	-0.75	0.55	0.65	0.33	0.62
Owner dwelling	0.49	-1.09	0.49	0.50	0.39	0.50
Public administration	0.41	-0.81	0.41	0.70	0.31	0.70
Other personal services	0.53	-0.68	0.67	0.82	0.31	0.80

Household level effects

The present model captures the changes that take place among demand for occupational labour categories through the different impacts observed at industry level and associated derived demand for occupational labour categories. Figure 1 presents the projection of changes employment among different occupational categories. The effects on employment suggest an increase in employment in all occupations except in agriculture as a result of increase in production of both agricultural and non-agricultural sectors. The decline in agricultural labour despite of expanding agricultural output may be due to the improvement of their labour productivity as a result of the shock. Contraction of agricultural employment in the long run (2.1 per cent) is much smaller compared to that of short run (3.3 per cent).

Further, short run results revealed an increase in production and related transport equipment operators and labourers (1 per cent), administrative and managerial workers (0.7 per cent) and sales and service related workers (0.6 per cent) as a result of expansion of manufacturing industries and trading related industries

The long run results show that the demand for skilled and semi skilled labour categories such as professional, technical and related workers (0.6 per cent), administrative and managerial workers (0.5 per cent)and clerical and related workers(0.5 per cent) are highly influenced than unskilled labour groups.
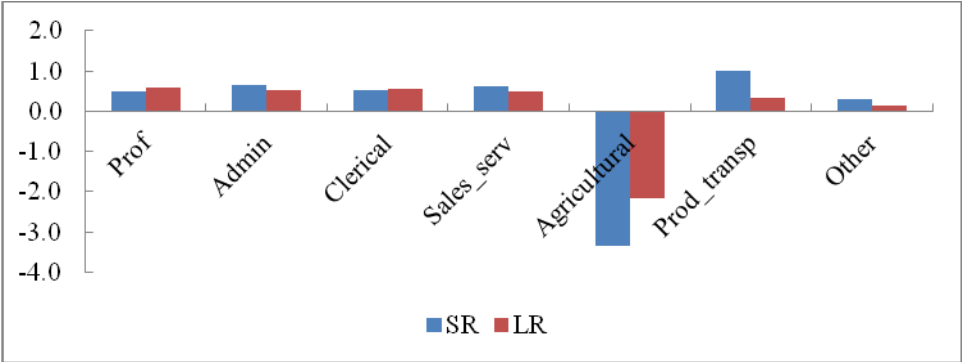

Figure1: Employment effects in the short run (percentage changes)

The impacts of rising productivity on household consumption and income levels are illustrated in Table 3. Real household consumption increases across all household groups in

both short run and long run. This is mainly due to reduction of food prices as a result of increased food production and increased returns of factor incomes. There is a positive impact on real income in all the provinces. Representative households of Uva (0.03 per cent), North Central (0.12 per cent), Sabaragamuwa (0.17 per cent) and Central provinces (0.34 per cent) reported only marginal increases in their real income compared to households in the other provinces. These provinces can be considered as primarily agricultural provinces with higher proportion of labour force employed in agricultural activities. Therefore, this effect may result from changes in employment levels in different occupational categories in different provinces. The effects on employment in the short run suggest an increase in employment in all occupations except in agriculture (Figure 1). Further, a sharp decline in market prices for agricultural products may lead to drop in farmer incomes. Western Province, which is considered as most urbanised and the richest region in Sri Lanka, shows the largest increase in real income in both scenarios.

Table 3: The projections of the impact of increased productivity on household income and consumption (percentage changes)

Household group	Real consumption		Real income	
	Short run	Long run	Short run	Long run
Western	0.40	0.61	0.83	0.97
Central	0.30	0.72	0.34	0.80
Southern	0.39	0.74	0.36	0.82
Sabaragamuwa	0.33	0.74	0.17	0.71
North western	0.56	0.80	0.61	0.91
Uva	0.26	0.67	0.03	0.57
North Central	0.40	0.71	0.12	0.64
Northern	0.74	1.03	0.49	0.96
Eastern	0.43	0.72	0.36	0.81

Regional results

It is important see how productivity improvement in agricultural sector affects different regions of the country. Table 4 represents change in regional GDP and employment due to increased productivity. It is clear that all the regions record positive regional GDP. Sabaragamuwa province experiences the highest growth in GDP followed by Central Province, Uva Province and Southern Province in both situations. This is mainly because the agricultural sectors where productivity improvement took place and related processing

industries located mainly in those provinces. Regarding employment performance, there is an employment contraction in many provinces where Uva Province records the highest contraction (by 1.49 per cent) followed by North Central Province (by 1.09 per cent). This employment contraction could also be due to the reduction of agriculture related labour category. Western province reports the highest growth in regional employment as a result of expansion of manufacturing and trade industries. Sabaragamuwa province also shows a slight positive growth in employment.

Table 4: The projections of the impact of increased productivity on regional GDP and employment (percentage changes)

Region	Regional GDP		Regional employment	
	SR	LR	SR	LR
Western	0.38	0.39	0.73	0.27
Central	1.01	1.40	-0.72	-0.40
Southern	0.79	1.26	-0.12	0.11
Sabaragamuwa	1.03	1.78	0.12	0.29
North western	0.54	0.88	-0.77	-0.36
Uva	0.84	1.21	-1.49	-0.90
North Central	0.44	0.67	-1.09	-0.67
Northern	0.43	0.75	0.00	0.33
Eastern	0.45	0.67	-1.03	-0.57

Discussion

This paper evaluated the impacts of simultaneous productivity increases of different sizes on agricultural sub-sectors in Sri Lanka using a general equilibrium framework. Two policy experiments were conducted reflecting short run and long run environments to examine impacts of targeted productivity increases in the ten year development framework.

It is clear from the above findings that macroeconomic impacts of increasing agricultural productivity are not marginal. The results showed that increasing agricultural productivity would generate positive economic benefits to the country as targeted in the development framework. Increase in agricultural productivity stimulate the growth of not only agriculture sector but also manufacturing and services sectors. However, it cause decline in agriculture related employment. Moreover, all the provinces record positive regional GDP from increased agricultural productivity while agricultural provinces record the highest.

Findings of the study also indicate that agricultural productivity improvements are likely to benefit rural agricultural provinces less than urban non-agricultural provinces. This could be due to deterioration in the agricultural terms of trade. However, increased output, decline in market prices and increase in overall aggregate employment would make households better off across provinces. Therefore, there is a need for some market intervention practices by the government such as agricultural price support as suggested by Bautista (Bautista, 1986) or establishing processing industries in the agricultural regions to ensure not only gains at national level but also greater share of gains for households from agricultural provinces from increased productivity.

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