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Agricultural Demand Linkages and Growth Multiplier in Rural Indonesia

July 2006

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ABSTRACT

In a fast urbanizing Indonesia, the rural sector still plays an important role in the country's economy. Although declining, the majority of the population still live and find employment in rural areas. However, rural areas lag behind urban areas in many aspects. As a result, around 80% of all the poor in the country are found in rural areas. Resolving this problem requires a clear and effective strategy to jump-start and sustain economic growth in rural areas. This study finds that the growth of the agricultural sector strongly induces the growth of the non-agricultural sector in rural areas. Although it has been fluctuating over time, it is estimated that, on average, one percent growth in the agricultural sector will induce 1.2% growth in the non-agricultural sector in rural areas. This finding vindicates the view that rising incomes in the agricultural sector stimulate demand for locally produced goods and services in rural areas, in particular those produced by the non-tradable sector. Formulated appropriately, a rural development strategy that develops the agricultural sector could provide a major impetus for achieving a fast growing and vibrant rural sector in Indonesia.

I. BACKGROUND

Although declining, rural areas still make up an important part of the Indonesian economy. The majority of Indonesians still live in rural areas. According the data from Population Census 2000, around 58% of Indonesians are rural residents. Aside from providing food supplies for the whole economy, the rural areas also contribute importantly to foreign exchange earnings from export of commodities. However, rural areas lag behind urban areas, both in terms of physical infrastructure as well as socio-economic welfare. As a consequence, around 80% of all the poor in the country are found in rural areas.

This obviously calls for more focused attention and more rigorous efforts in rural development. This requires a clear and effective strategy to jump-start and sustain economic growth in rural areas. Since rural areas are closely identified with the agricultural sector, a more specific question is whether investments should be directed to improve productivity in the agricultural sector or whether it is more effective to invest in the development of the rural non-agricultural sector directly. Ultimately, the answer to this question and the formulation of the rural development strategy adopted should depend on the potential to push growth for the whole rural economy.

The agricultural and non-agricultural sectors in rural areas are closely linked. Hence, growth in one sector will induce growth in the other and *vice versa*. However, despite the fact that there is a relatively long history of studies focusing on the subject of rural sectoral linkages, there remains debate on whether the most effective route for rural development is through firstly developing the agricultural sector or through directly developing the non-agricultural sector.

Among one strand of literature, there is a consensus that agriculture has strong linkages and a large growth multiplier with other sectors in the rural economy and, because of that, it is essential to develop the agriculture sector first, in order to develop the whole rural area. Not all rural development thinkers and practitioners agree with the agriculture-first strategy, however. Some have argued for the opposite, that it is the non-agriculture sectors that have strong potential to push economic growth in the rural areas and pull the poor out of poverty. Others, meanwhile, have argued that both agricultural and non-agricultural sectors have strong potential to become the engine of growth in rural areas and, hence, call for a more balanced growth strategy.

In the context of Indonesia, unfortunately, there is no known or published study on sectoral demand and growth linkages in rural areas. This is unfortunate considering the importance of the rural areas for the Indonesian economy, in particular as the location where the majority of workers find employment. Furthermore, the vast majority of the poor in Indonesia live in rural areas and work in the agricultural sector.

This study tries to fill in the gap by examining the empirical evidence on the strength of agricultural demand linkages and estimating the agricultural growth multiplier in rural Indonesia. It is hoped that the results of this analysis will provide the foundation for formulating the most effective strategy for stimulating economic growth in rural Indonesia, which is crucial for improving the welfare of its residents as well as effectively resolving a large part of the poverty problem in Indonesia.

II. SECTORAL LINKAGES IN RURAL AREAS

There are several types of sectoral linkages in rural areas. The most well known linkages are production and distribution linkages. A production linkage occurs when a sector produces output which is then used as an intermediate input by another sector. An example of this is the linkage between a farm producing food commodities and a food-processing industry. From the point of view of a certain sector, there are two types of production linkages: backward and forward linkages. For example, from a farm's point of view, the linkages to fertilizer and seed producers are backward linkages. On the other hand, the linkages from the farm to food processing industries are forward linkages.

Meanwhile, distribution linkages act as an intermediary between two sectors. A farm may supply its output directly to a food-processing industry, but it may also sell its output to a trader who then re-sells it to the food-processing industry. In this case, the trader plays the role of a distribution linkage. In general, a distribution linkage provides two types of services. First, it provides location value added by transporting a good from one place to meet its demand in another place. Second, it provides time value added by storing a good to meet its demand in the future.

Another type of linkage which is less well known, but whose strength and impact is no less important, is consumption linkage. This linkage refers to the consumption demand from households for the output of a sector. This linkage works mainly through the second round effect of growth in the economy as a whole. This growth increases demand from households due to increasing income driven by growth in a particular sector. Hence, the consumption patterns of households play a crucial role in determining the importance of this linkage.

The following is an example how consumption linkage boosts the growth of an economy from an increase in output of the agricultural sector. Suppose an exogenous technological improvement is introduced to the agricultural sector, which then results in an increase in farm productivity. Households supplying factors of production to this sector experience increases in real incomes. Due to the increase in income, the households' demand for various goods and services increases. In particular, the increase in demand for the outputs of non-tradable sector will stimulate the local economy, hence increasing the total income of the local economy further.

The extent to which an increase in income in a particular sector induces an increase in income of the whole economy is referred to as the sectoral growth multiplier. Hence, the agricultural growth multiplier quantifies the impact of a certain increase in income in the agricultural sector on the growth of income in other sectors. Early on, it was thought that this multiplier was small because agriculture is considered a low-linkage sector. This conclusion was later proved wrong because it only looked at production linkages. Once consumption linkages were taken into account, the multiplier turned out to be quite large (Haggblade, Hazel, and Brown 1989).

Aside from production and consumption linkages, there are other linkages across sectors in a rural economy. One such linkage is investment linkage. For example, part of increased income in the agricultural sector may be saved. These savings may constitute an

important source of funds for investments in non-agricultural sector. On the other hand, capital flows from other sectors also provide important sources of fund for investments in the agricultural sector.

Other than capital, there are also labor flows across sectors in the rural economy, in particular the labor flows between the agricultural sector and non-agricultural sector can be quite intensive. Because the nature of agricultural production is in general seasonal, the pattern of labor used in agriculture is also seasonal. Partly as an effort to smooth income during the low-season, agricultural labor will temporarily move to work in other sectors. Meanwhile, during the peak season, non-agricultural labor can also join force in the agricultural sector.

Another possible cross-sectoral linkage in a rural economy is a transfer linkage. This type of linkage occurs whenever a household transfers part of its income to another household for purposes other than production, consumption, or investment. This may take place in the forms of charity to help relatives or friends in need, which constitutes an important part of informal social safety nets in rural areas.

III. THE INDONESIAN RURAL ECONOMY

In developing countries, rural areas and the agricultural sector usually make up an important part of the economy, either in terms of output, employment, or both. For the case of Indonesia, Table 1 shows that since 1990 the contribution of agricultural sector to Gross Domestic Product (GDP) has been low compared to industry and services. Furthermore, the share has been continuously declining over time, falling from around 22% in 1990 to just 15% in 2003.

Table 1. Sectoral Contributions to GDP in Indonesia, 1990-2003 (%)

Sector	1990	1995	2000	2003
Agriculture	22	17	16	15
Industry	39	42	40	39
Services	39	41	45	46

Source: BPS, Statistik Indonesia, various years.

On the other hand, the contribution of the services sector has continued to increase during the period, from 39% in 1990 to 46% in 2003. For the industrial sector, meanwhile, after expanding before the economic crisis in 1997-98, its contribution to GDP declined again during the post-crisis period. After reaching 42% in 1995, the contribution of the industrial sector to GDP declined to 39% in 2003, similar to its level in 1990. This provides evidence that Indonesia has experienced a deindustrialization during the post-crisis period.

At a glance, the declining contribution of agriculture to GDP gives an indication that the role of agriculture in the national economy has become less and less important. However, the existence of forward and backward production linkages means that the importance of the agricultural sector cannot be simply implied just from the value of its direct output. In 2003, for example, the food, beverages and tobacco subsector alone contributed 28% to the total output of the manufacturing industry. Similarly, a significant part of the output of the services sector is also strongly related to agriculture.

Furthermore, until now rural areas and the agricultural sector still provide important sources of livelihoods for a large fraction of the Indonesian population. Table 2 shows the shares of rural and urban areas on providing employment opportunities for the working population. Meanwhile, Table 3 disaggregates the employment in rural areas by sector. These tables indicate that the importance of rural areas and the agricultural sector in terms of employment is higher than that is implied by output data.

Table 2 shows that, although continuously declining, the majority of workers in Indonesia still find employment in rural areas. In 1990, fully three quarters of the Indonesian workforce worked in rural areas. By 2003, although the proportion of rural workforce had declined substantially, around 60% of the working population still worked in rural areas.

Interestingly, the table shows that there is no evidence that the economic crisis has reversed the trend of urbanization in the country.

Table 2. Employment Share of Rural and Urban Areas in Indonesia, 1990-2003 (%)

Area	1990	1995	2000	2003
Rural	75	67	62	60
Urban	25	33	38	40

Source: Calculated from Sakernas data.

Within the rural areas, as shown in Table 3, the large majority of rural workers stated that their main occupations were in the agricultural sector. In 1990, around 70% of the rural workforce worked mainly in the agricultural sector. This proportion had declined substantially during the pre-crisis era, so that by 1995 the proportion of agricultural workforce had fallen to 60%. After the onset of the economic crisis in 1997-98, however, the role of the agricultural sector in providing employment opportunities in rural areas regained its importance. As a result, in 2003 the proportion of the rural workforce working in the agricultural sector increased again to 68%. On the other hand, after increasing during the pre-crisis period, the proportions of rural workforce who worked in the industrial and services sectors have both declined during the post-crisis period.

Table 3. Sectoral Employment Share in Rural Areas in Indonesia, 1990-2003 (%)

Sector	1990	1995	2000	2003
Agriculture	70	60	66	68
Industry	9	11	10	9
Services	22	29	24	24

Source: Calculated from Sakernas data.

Consistent with the employment data, a large fraction of Indonesian households, particularly in rural areas, derive their income from agriculture, either as a sole income source or in combination with other sources. Table 4 shows the household income sources in Indonesia in 1995 based on the Intercensal Population Survey (Supas) data. Nationally, slightly less than a half of all households derived their incomes wholly or partly from the agricultural sector. In rural areas, 72.6% of households derived at least part of their incomes from the agricultural sector. This shows the strong potential of the agricultural sector to stimulate growth of the whole rural economy. Growth of the agricultural sector, which translates to increases in income for more than 70% of the rural population, will provide a strong stimulus for a second round of growth in other sectors by increasing local demand.

Table 4. Household Income Sources in Indonesia, 1995 (%)

Income Source	Rural	Urban	Total
Agriculture	46.3	6.0	24.9
Non-agriculture	27.4	84.0	52.5
Mixed:	26.3	10.0	22.6
- Mainly agriculture	13.2	2.6	9.9
- Mainly non-agriculture	13.1	7.4	12.7

Source: Booth (2002).

However, there are some constraints that may affect the potential of agricultural sector as the driving factor of growth in rural economy. Table 1 indicates that the Indonesian economy has undergone massive structural transformation from an economy where agricultural sector played a dominant role in the country's output production to an economy where agriculture's contribution has become much less important. This is more evident in the long term, where the contribution of agriculture in GDP has declined from around 45% in 1971 to just 15% in 2003. Meanwhile, the pace of structural transformation in the labor market has been much slower. Over the same period, the proportion of agricultural workforce has declined from around 67% in 1971 to 46% in 2003.

Since agriculture's share of output fell faster than its share of employment, output per agricultural worker fell in relative terms compared to output per worker in other sectors. This implies that over time agricultural workers have become relatively poorer than non-agricultural workers. Unsurprisingly, therefore, the agriculture sector has the highest poverty incidence and contains the largest proportion of the poor in the country. Table 5 shows the distribution of the poor population in Indonesia across sector. In 2002, more than two thirds of the poor had a livelihood in the agricultural sector. This is similar to the level reached in 1996. Meanwhile, due to the economic crisis, which hit the modern sectors harder, in 1999 the proportion of the poor who made a living in the agricultural sector fell to below 60%.

Table 5. Distribution of the Poor in Indonesia by Sector, 1996-2002 (%)

Sector	1996	1999	2002
Agriculture	68.5	58.4	67.4
Industry	6.7	8.7	10.3
Services	24.7	32.9	22.4

Source: Calculated from Susenas data.

Because most of the poor have a livelihood in the agricultural sector, this implies that most of the poor live in rural areas. In fact, Table 6 shows that in 2002 almost 80% of Indonesia's poor population resided in rural areas. This proportion has declined from the 1996 level which reached 85%. Again due to the economic crisis, this proportion reached its lowest level in 1999 with 76%.

Table 6. Distribution of the Poor in Indonesia by Rural-Urban Areas, 1996-2002 (%)

Area	1996	1999	2002
Rural	85.0	76.2	79.7
Urban	15.0	23.8	20.3

Source: Calculated from Susenas data.

There are at least three interrelated reasons why people who make a living in agriculture tend to be much poorer than those who are not in agriculture. First, the quality of human resources in agriculture is very low compared to those in non-agriculture. Second, in general, they have low access to capital. Third, their land holding size is small. Table 7 shows the distribution of agricultural households by size of cultivated land holding. The table shows that in 2003 around 75% of Indonesian farmers cultivated land of sizes less than one hectare. This proportion has increased from around 70% in 1984 and 1993. More worrying is the proportion of farmers who cultivate land with sizes less than 0.1 hectare, which has increased substantially from 7% in 1993 to 17% in 2003.

Table 7. Distribution of Agricultural Households by Cultivated Land Holding Size (%)

Size of Cultivated Land Holding (ha)	1984	1993	2003
< 0.1	8.5	7.0	17.2
0.1 – 0.49	37.7	40.7	39.2
0.50 – 0.99	24.1	22.4	18.4
• 1.0	29.7	29.9	25.2

Source: Calculated from Agricultural Census data.

In terms of demand linkages and growth multiplier to the non-agricultural sector in the rural economy, the fact that the large majority of farmers are poor and small constitute a constraint for two reasons. First, it means that farm households have relatively low purchasing power to boost the rural economy through consumption demand on locally produced goods and services. Second, there is evidence from other countries that poor and small farm households spend a smaller proportion of their expenditures on locally made goods and local services than large farm households (Hazell and Röell 1983).

IV. METHODS FOR ESTIMATING LINKAGES: LITERATURE REVIEW

The literature on sectoral linkages in rural areas has largely focused on attempts to estimate the agricultural growth multiplier in the rural economy. Most of the studies have been spirited by Mellor's tradition to prove that agriculture has a potent power to boost rural economic growth (Mellor 1976). These empirical studies are mostly confined to African countries and parts of Asia, where the majority of workers are still employed in the agriculture or agriculture-related sectors. In analyzing the linkages, these studies have invariably focused on production and consumption linkages.

In terms of the methods used to estimate the sectoral growth multiplier, these studies can be broadly grouped into three types: (i) studies which use micro-econometric approach, (ii) studies which employ macro-econometric approach, and (iii) studies which utilize an input-output table (IOT), social accounting matrix (SAM), or computable general equilibrium (CGE) modeling. Each of these approaches has its advantages and disadvantages. Each approach requires different type of data. Data availability often determines the approach used in a particular study.

4.1. Studies Using Micro-econometric Approach

Studies that can be included in this type, among others, are Foster and Rosenzweig (2004 and 2005), Haggblade and Hazell (1989), Haggblade, Hazell, and Brown (1989), Hazell and Röell (1983), and Simphiwe (2001). The studies of this type are usually based on household survey data that records detailed household expenditures. The method is set to examine household consumption pattern so as to know the proportion of household budget spent on locally produced goods and services, i.e. the non-tradable, and that spent on goods imported from outside regions.[1] Based on the results of estimation of an Engel function or a Working-Leser model,[2] evaluated at the mean values, the marginal budget share, i.e. the change in household budget share from an increase in income, can be calculated for each commodity. These marginal budget shares are then used to calculate the agricultural growth multiplier. Higher marginal budget shares for non-tradable goods and services will lead to a higher multiplier.

One of the classics of this type of studies is Hazell and Röell (1983). This study utilized data from two areas where World Bank's agriculture development projects were implemented. The first area is Muda in northwest Malaysia, where an irrigation project was implemented. The other area is Gussau in northern Nigeria, where an agriculture development project was put in place. Through these projects, household data was collected weekly for about one year. The household expenditures were annualized to overcome the problems of seasonality and lumpiness of expenditure patterns.

[1]The information on the area of origin of goods consumed by households is usually not available in a regular household survey. Therefore, this type of studies usually requires special data collection effort.

[2]An Engel function maps the relationship between household expenditure on food with total household expenditure. A Working-Leser model is a version of Engel function defined in terms of expenditure share.

They find that the linkages from agricultural sector to local non-farm economy are much stronger in Muda. In this region, households on average spent 18% of their total budget on locally produced non-food goods and services. Furthermore, they allocated 37% to these items of any incremental increase in their total expenditures. In Gussau, meanwhile, the average and marginal budget shares on the same items of locally produced goods and services were only 8 and 11% respectively.

Furthermore, based on the analysis of budget shares across income levels and farm sizes, they found that richer and larger farms in both regions had the most desired expenditure patterns for stimulating secondary round of growth in the local economy than smaller farms. Hence, they concluded that larger farm households are the most suitable targets for technology or public investments to increase agricultural output in order to stimulate the growth of the whole rural economy.

Two studies by Foster and Rosenzweig in 2004 and 2005 utilized the same data source from India. This is a continuing survey of rural households residing in approximately 250 villages located in the 17 major states of India that began in 1968. The survey has been carried out by the National Council of Applied Economic Research (NCAER). The two studies, however, analyzed the survey data of two different interval periods.

Foster and Rosenzweig (2004) used a panel data of the villages for the period 1971-1999 to review the impact of the Green Revolution, which has increased agricultural productivity in the non-farm sector in rural areas. They found that the growth of the non-farm sector is not determined by increases in agricultural productivity. In fact, areas that have the highest non-farm sector growth are areas that have benefited relatively less from agricultural productivity growth. They concluded that focus and resources should be shared to equally promote non-farm and farm growth in India, because non-farm growth can also play a direct and important role in rural growth.

Meanwhile, Foster and Rosenzweig (2005) used the village and household panel data for the period of 1982-1999 to empirically assess the contributions of agricultural productivity improvements and rural factory expansion to rural income growth, poverty reduction, and rural income inequality. In this study, they developed and tested a simple general equilibrium model of farm and non-farm sectors in a rural economy. The key prediction of their model is that while both agricultural development and capital mobility and openness increase rural incomes, the growth of a rural export-oriented manufacturing sector reduces both local and spatial income inequality relative to agriculture-led growth.

Empirically they found that the non-tradable non-farm sector is driven by local demand conditions and, hence, is positively influenced by growth in agricultural productivity. On the other hand, the tradable non-farm sector, which consists of relatively small-scale factories, enters areas with relatively low wages and, hence, is negatively influenced by growth in agricultural productivity. Both agricultural technical change and factory employment growth increase rural incomes and wages, and hence reduce poverty. Consistent with the model prediction, they found that factory investment in a locality reduced both spatial wage inequality and local household income inequality, while agricultural technology improvements increased inequality.

Similarly, Eapen (2003) argued that an excessive concentration on agricultural linkages has resulted in an underestimation of rural non-farm linkages. She states that since agriculture linkages to the non-agricultural sector in a rural economy mostly stems from consumption linkages, there is still much benefit that could be realized by expanding non-agricultural sectors, especially since those sectors provide considerable scope to stimulate growth in the rural economy through production linkages.

However, Kimenyi (2002) argued that many studies in developing countries have found that agricultural growth contributed the most to poverty reduction, especially in countries whose labor force were largely engaged in agriculture.[3] There are two channels where agricultural growth can spur large poverty reduction. The first is the direct linkage between agriculture and its input and output industry, which includes urban industries, where growth in the agricultural sector would create, among other things, more jobs and higher income both within the sector itself and in other sectors. The second channel is through an increase in non-agricultural sector growth in rural areas that result from the increase in income of agriculture households. This positive effect on poverty reduction constitutes an advantage of agriculture-led growth in rural areas.

4.2. Studies Using Macro-econometric Approach

Studies that can be included in this type, among others, are Block (1999), Ravallion and Datt (1996), Datt and Ravallion (1998), Fan, Hazell, and Thorat (1999), and Rock (2002). The main difference between this type of macro-econometric studies and the micro-econometric studies is on the data used. Rather than using household survey data, these studies analyzed aggregate data at the national, state, provincial, or regional level. Hence, this type of study requires the availability of relatively long time series or panel data for the analysis to be statistically meaningful. The data is used to analyze a macroeconomic model, which could be either a well-specified model or a reduced form model.

Block (1999) developed a four-sector numerical simulation model of economic growth in Ethiopia. He defined the four sectors as agriculture, services, traditional industry, and modern industry. In order to calculate the macroeconomic growth multipliers resulting from exogenous income shocks in each sector, the model specifies a set of intersectoral linkages through which the output of one sector can contribute, either through forward and backward linkages or indirectly through effects on prices and investment, to output in other sectors.

The sectoral growth multipliers resulted from the simulated income shocks are 1.80 for services sector, 1.54 for agriculture, 1.34 for modern industry, and 1.22 for traditional industry. These results suggest that intersectoral linkages in the economy operate unevenly. Linkages operate robustly between agriculture and services, and to some extent from agriculture to traditional industry. Services provide important stimulus to modern industry. However, the industrial sectors have limited impact on services and agriculture. Even though the services sector has the highest multiplier, he argued that since most of

[3]Mellor (1999) has compiled a thorough review on the relationship between agriculture growth and poverty reduction.

the poor are confined in the agriculture sector, focusing on developing that sector would yield the most benefit in the efforts to reduce poverty in the country.

The natural extension of the literature on agriculture growth multiplier is to relate it to poverty reduction. This is quite straightforward since economic growth has been proved in many studies to be one of the most effective ways to reduce poverty. One of the pioneering studies in this area is Ravallion & Datt (1996), which analyzed data from India. They estimated the impact of urban and rural growth on urban, rural, and national poverty using the Indian national time-series data spanning from 1951 to 1991. They concluded that rural growth benefits both urban and rural poor, while urban growth has an adverse distributional impact on urban poor, which undermines the gains the urban poor receive, and no impact on rural poor.

Furthermore, when investigating the probable reasons why some Indian states managed to reduce rural poverty better than others, Datt & Ravallion (1998) analyzed panel state-level data from 1957 to 1991. They found that agriculture technology growth, measured by output per acre, and initial agriculture infrastructure and human resource conditions, measured by initial irrigation rate, female literacy rate, and infant mortality rate, are the main determinants of success in reducing rural poverty.

Meanwhile, Rock (2002) investigated the impact of agriculture growth and government intervention in the agricultural sector, such as rice stabilization policies, in Indonesia, Malaysia, and Thailand. He argued that studies such as this are important because most industrial analysts believe that developing country economies are bifurcated between the traditional agriculture sector and the modern sector, and the two sectors have little connection. He stated that growth in agriculture, particularly agricultural exports, can facilitate the growth of manufacturers by providing foreign exchange to import capital goods, semi-processed goods, and spare parts to the manufacturing sector. He used panel data from the three countries and found agricultural growth and rice stabilization policies to have significant and positive impact on growth in the manufacturing sector.

In contrast to putting the agriculture sector in the spotlight and measuring its multiplier on other sectors, there are also studies that focused on other sectors and measured their multipliers on agricultural growth. An example of such studies is Fan, Hazell, and Thorat (1999). They estimated a simultaneous equation model to trace the effects of government expenditure items on productivity growth and poverty alleviation, including their trade-offs and complementarities. They found that investments in rural roads, rural infrastructure, and agricultural research and development have the greatest impact on reducing rural poverty and agricultural productivity growth, while expenditure on direct poverty reduction programs, for example employment programs, only has modest effects.

In addition, they also estimated the marginal returns to agricultural productivity growth and poverty reduction from additional government expenditure and found that investments on roads have the highest marginal return in both areas, while other types of spending benefit one more than the other. The important contribution of this study is the finding that government spending on rural infrastructure and agricultural research and development has a higher impact on reducing poverty both directly and indirectly through increased agricultural productivity. This implies the government would be wise

to direct its spending on these aspects rather than concentrating on direct poverty reduction programs.

4.3. Studies Using IOT, SAM, and CGE Modeling

A study that can be included in this type, among others, are Byerlee (1973), Byerlee et al. (1977), Rangarajan (1984), Adelman (1984), and Bautista and Thomas (1998). The advantage of using a general equilibrium modeling approach is that it can measure the full direct impact of rural agricultural growth in the national economy. The precision of the measured impact, however, depends on how good the model is and how accurate the database is in representing the economy.

Byerlee (1973), who applied a general equilibrium model to Nigeria, and Byerlee et al. (1977), who applied a similar model to Sierra Leone, are the pioneering studies in this subject which utilize general equilibrium modeling. Studies using general equilibrium modeling approach in the context of Asia came later, pioneered among others by Rangarajaran (1982) for India and Adelman (1984) for South Korea. Confirming findings from studies using other methods, the results of these general equilibrium modeling studies also suggest that linkage effects from agricultural growth to non-agricultural growth are stronger in Asia than in Africa.

More recently, Bautista and Thomas (1998) calculate national-level agricultural growth multiplier using a macro-modeling based on SAM in Zambia. In their model, they divide the agriculture sector into five sub-sectors: (i) agriculture, which consists of all crop and livestock commodities; (ii) smallholder agriculture, which includes all smallholder activity; (iii) food crops, consisting of maize and other grain commodities; (iv) traditional export crops, which include tobacco and cotton; and (v) non-traditional export crops that consist of horticultural commodities.

They found that agriculture growth linkages are high with smallholder agriculture being the largest GDP multiplier at 1.92. Based on these results, and since a large portion of the poor are in rural areas engaged in the agriculture sector, they concluded that investments in this sector would yield the optimum advantage to overall growth and poverty reduction. Hence, they advocate that countries switch their focus from solely concentrating on the industrial sector and mainly urban investments to also include investments in the agriculture and rural sector.

V. THE MODEL

As described in the introduction section, the aim of this study is to examine empirically the strength of agricultural demand linkages and estimate the agricultural growth multiplier in rural Indonesia. In particular, the research question that will be addressed in this study is how growth in the agricultural sector in rural areas affects the growth of non-agricultural sector in rural areas. Following the macro-econometric approach discussed in the literature review, the analysis will be based on a simplified model of the inter-relationships of growth across sectors in the whole economy.

Let us define the whole economy as having three sectors: (i) rural agricultural sector, (ii) rural non-agricultural sector, and (iii) urban sector. Therefore, the economy's total Gross Domestic Product (GDP) can be defined as the sum of GDP of the three sectors:

$$Y = Y_R^A + Y_R^N + Y_U \tag{1}$$

where Y is the real GDP, the subscripts R and U refer to rural and urban areas, and the superscripts A and N refer to the agricultural and non-agricultural sectors respectively. Differentiating equation (1) and then dividing by Y result in:

$$\frac{dY}{Y} = \frac{dY_R^A + dY_R^N + dY_U}{Y} \tag{2}$$

$$\dot{y} = \frac{Y_R^A}{Y}\frac{dY_R^A}{Y_R^A} + \frac{Y_R^N}{Y}\frac{dY_R^N}{Y_R^N} + \frac{Y_U}{Y}\frac{dY_U}{Y_U} = H_R^A\,\dot{y}_R^A + H_R^N\,\dot{y}_R^N + H_U\,\dot{y}_U \tag{3}$$

where $\dot{y} = \frac{dY}{Y}$ refers to real GDP growth. Equation (3) says that the total GDP growth is the sum of its sectoral GDP growth components weighted by each sector's share (H) in the total GDP.

Now let's assume that the total economic growth is a function of a vector of exogenous variables X:

$$\dot{y} = \dot{y}(X) \tag{4}$$

Since the total GDP growth is a function of X, then implicitly all of its components are also a function of X. This means that:

$$\dot{y}(X) = H_R^A\,\dot{y}_R^A(X) + H_R^N\,\dot{y}_R^N(X) + H_U\,\dot{y}_U(X) \tag{5}$$

Rearranging equation (5):

$$H_R^N\,\dot{y}_R^N(X) = \dot{y}(X) - H_R^A\,\dot{y}_R^A(X) - H_U\,\dot{y}_U(X) \tag{6}$$

$$\dot{y}_R^N(X) = \frac{1}{H_R^N}\dot{y}(X) - \frac{H_R^A}{H_R^N}\dot{y}_R^A(X) - \frac{H_U}{H_R^N}\dot{y}_U(X) \quad (7)$$

Equation (7) is an identity, defining the GDP growth of rural non-agricultural sector. Behaviorally, it implies that the GDP growth of rural non-agricultural sector can be defined as a function of the GDP growth of the other two sectors in the economy, each weighted by the ratio of its GDP share to the GDP share of rural non-agricultural sector, conditional on X:

$$\dot{y}_R^N = f\left(\dot{y}_R^{A*}, \dot{y}_U^*; X\right) \quad (8)$$

where $\dot{y}_R^{A*} = \frac{H_R^A}{H_R^N}\dot{y}_R^A$ and $\dot{y}_U^* = \frac{H_U}{H_R^N}\dot{y}_U$. Imposing a linear functional form, the estimable model of rural non-agricultural sector growth is:

$$\dot{y}_R^N = \alpha + \beta_1 \dot{y}_R^{A*} + \beta_2 \dot{y}_U^* + \gamma X + \varepsilon \quad (9)$$

If rural non-agricultural sector growth does not affect rural agricultural sector growth and urban sector growth, then equation (9) can be estimated using the Ordinary Least Squares (OLS) procedure. This is quite likely to be true for the case of urban sector growth. However, it is more likely that this condition is not true for the case of rural agricultural sector growth. In this case the estimates obtained from OLS will be inconsistent, so the model has to be estimated using the Instrumental Variable (IV) procedure.

The coefficient of interest in this study is β_1. This coefficient shows the percent growth of rural non-agricultural sector due to the growth in rural agricultural sector by one percent times the inverse of the ratio of rural agricultural sector GDP share to rural non-agricultural sector GDP share. For example, if the ratio of rural agricultural sector GDP share to rural non-agricultural sector GDP share is 50%, then β_1 is the percent growth of rural non-agricultural sector due to 2% growth in rural agricultural sector. Note that 50% times 2% is 1%.

VI. EMPIRICAL ESTIMATION

6.1. The Data

The database that is used to estimate the model is a panel data of sectoral GDP growth with province as the unit of observation. The source of the data is the province level Regional Gross Domestic Product (RGDP) publication from BPS. The RGDP data for each province is already disaggregated by sectors, but it is not divided into rural and urban areas. Therefore, to split the sectoral RGDP data by rural-urban areas in each province, the proportions of aggregated sectoral rural and urban household expenditures in each province calculated from the Susenas Consumption Module data are applied to the RGDP data. The time period covered in the panel data is from 1984 to 2002 with a three-year interval in accordance with the Susenas Consumption Module survey.

The resulting sectoral and rural-urban disaggregation of GDP at the national level is presented in Table A1 in Appendix 1. The disaggregation results make sense and confirm some common knowledge about the rural and urban economies in Indonesia. First, the order of sectoral importance in urban areas is services, industry, and agriculture in the last position. Second, the order of sectoral importance in rural areas is agriculture, services, and industry. Third, the agriculture sector makes up only a very small part of the urban economy. Fourth, in the long run the importance of the urban economy has been increasing, while the importance of the rural economy has been decreasing. This shows that the method used to disaggregate the sectoral GDP by rural-urban areas is justified and, hence, provides confidence for using the data in the estimations.

However, Table A1 also shows a flaw in the rural-urban GDP disaggregation method that needs to be taken into account when using the resulting data. This has to do with the fact that the Susenas sampling frame is always updated following a population census, which is conducted every ten years. This update in the sampling frame takes into account the changes in population, administrative boundaries, as well as urban-rural status of villages across regions. The data used in this study consistsof three different sampling frames. The 1984, 1987, and 1990 surveys used a sampling frame based on the results of the 1980 Population Census. The 1993, 1996, and 1999 surveys used a sampling frame based on the results of the 1990 Population Census. Meanwhile, the 2002 survey used a sampling frame based on the results of the 2000 Population Census.

The consequence of the changes in sampling frame is reflected in the urban-rural share of GDP shown in Table A1. For example, between 1984 and 1990 the urban share of GDP tended to decline. However, as a result of reclassification of successfully developed rural areas to become urban areas, the urban share of GDP in 1993 jumped up very significantly. Likewise, between 1993 and 1999 the urban share of GDP tended to decline, but it increased again very significantly in 2002. This means that the original rural areas tend to grow faster that the original urban areas, but since successfully developed rural areas are reclassified as urban areas, over the long run the GDP share of urban areas increases while that of rural areas decreases.[4]

[4]For discussion on rural-urban reclassification of villages, see Firman (1992).

6.2. Estimation Results

Within a region, growth of various sectors may or may not be highly correlated with one another. It depends on whether the sectors in question are integrated or not. In a dualistic economy, for example, the modern sector could be booming with little effect on the traditional sector since they are practically insulated from each other. In an integrated economy, on the other hand, each sector is strongly interrelated with the other sectors in the economy, making growth in one sector affecting growth in the other sectors significantly.

Table 8 shows the results of estimating equation (9) using both ordinary least squares (OLS) and instrumental variable (IV) procedures. In both estimations, the dependent variable is rural non-agricultural sector growth and the independent variables are rural agricultural sector growth and urban sector growth.[5] The control variables are rural population growth, initial rural poverty rate, initial rural Gini ratio as a measure of inequality in income distribution, initial proportion of rural population with junior secondary education and above as a measure of human resources quality, and log of total real expenditures of village governments within a province. In addition, to take into account the effects of changes in Susenas sampling frame following a population census, two dummy variables in the 1990 and 2000 sampling frames are also included as control variables.

[5]An attempt to estimate the model in levels instead of growth was dropped due to multicollinearity problem. Sectoral GDP levels are highly correlated with each other.

Table 8. Results of Estimation of Growth Linkages Model
(Dependent variable: Rural non-agricultural sector growth)

Independent Variable	OLS	IV
Rural agricultural sector growth	0.5805**	1.8504*
	(3.33)	(2.44)
Urban sector growth	-0.2539**	-0.3113**
	(-7.40)	(-5.91)
Rural population growth	-0.0247	-0.0189
	(-0.95)	(-0.61)
Initial rural poverty rate	0.1871	-0.0042
	(1.21)	(-0.02)
Initial rural Gini ratio	-0.6237	-0.1636
	(-0.74)	(-0.16)
Initial proportion of rural population with junior secondary education and above	0.3468	0.5586
	(0.92)	(1.19)
Log of total real expenditures of village governments	0.0058	0.0705
	(0.19)	(1.35)
1990 Susenas sampling frame	-0.2677**	-0.2056*
	(-3.84)	(-2.26)
2000 Susenas sampling frame	-0.1738	-0.0333
	(1.91)	(0.25)
Constant	0.4351	-0.2607
	(1.53)	(-0.50)
Number of observations	132	132
F-value (9, 122)	11.26**	7.65**
R-squared	0.4538	0.2166

Notes: Numbers in parentheses are t-values.
** Is significant at 1% level.
* Is significant at 5% level.
Rural agricultural sector growth is treated as an endogenous variable and instrumented by rainfall and number of trucks.

In the IV estimation, the rural agricultural sector growth is treated as an endogenous variable and instrumented by rainfall and number of trucks. The reason for using rainfall as an instrument for rural agricultural sector growth is obvious. Meanwhile, number of trucks is also used as an instrument for rural agricultural sector growth because both agricultural inputs and outputs are bulky, so the number of trucks available in a province provides a good indication of the intensity of economic activities in the agricultural sector in that province. On the other hand, urban sector growth is treated as an exogenous variable as there is no strong reason to believe that there is a significant feedback effect from rural non-agricultural sector growth to urban sector growth. The results of the first stage regression of the IV estimation are presented in Table A2 in Appendix 2.

In both the OLS and IV estimation results, the coefficients of both rural agricultural sector growth and urban sector growth are statistically significant. However, the magnitudes of the coefficients obtained from the IV estimation are larger than those obtained from the OLS estimation. Except for change in the Susenas sampling frame, none of the control variables in both estimations have statistically significant coefficients, although the signs of the coefficients are, in general, as expected. Since it is more likely

that the endogeneity problem does exist in the data, the following discussion on the estimation results is based on the IV estimation results.

The coefficient of rural agricultural sector growth is positive. This indicates that indeed the growth of the agricultural sector positively induces growth of the non-agricultural sector in rural areas. This vindicates the view that rising incomes in the agricultural sector in rural areas stimulates demand for local goods and services, in particular those produced by the non-tradable sector. This positive effect combines both the production and consumption linkages, so it cannot be ascertained which one is more dominant.

On the other hand, the coefficient of urban sector growth is negative. This indicates that urban development is not directly complementary to the development of the non-agricultural sector in rural areas. Rather, urban sector growth suppresses rural non-agricultural sector growth, perhaps because both sectors produce similar goods and services that compete with each other. Indirectly, however, Table A2 in Appendix 2 shows that urban sector growth has a positive and statistically significant effect on rural agricultural sector growth. Since rural agricultural sector growth positively affects rural non-agricultural sector growth, this means that the net effect of urban growth on rural non-agricultural growth depends on the balance of these two opposing effects.

In interpreting the magnitude of the coefficient of the rural agricultural sector growth variable as the agricultural growth multiplier to non-agricultural sector growth in rural areas, it is important to keep in mind that in the estimation this variable is weighted by the ratio of the rural agricultural sector GDP share to rural non-agricultural sector GDP share in total GDP. Hence, as discussed in the previous section, the coefficient represents the percent growth of the rural non-agricultural sector due to the growth in the rural agricultural sector by one percent times the inverse of ratio of rural agricultural sector GDP share to rural non-agricultural sector GDP share.

Therefore, to obtain the multiplier of one percent growth of agricultural sector to non-agricultural sector growth, the coefficient needs to be multiplied by the ratio of rural agricultural sector GDP share to rural non-agricultural sector GDP share. Based on the sectoral and locational share of GDP in Table A1 in Appendix 1, this ratio has declined during the pre-crisis period from 0.75 in 1984 to 0.55 in 1996, reflecting the declining role of the agricultural sector in the total output produced, even in rural areas. After the crisis, however, the ratio has tended to increase again, reaching 0.73 in 2002. The mean of the ratio over time is 0.6.

The coefficient obtained from the IV estimation of 1.8504 implies that in 1984 one percent growth of the agricultural sector was able to induce 1.4% growth of the non-agricultural sector in rural areas. During the high economic growth pre-crisis period, this multiplier declined to just 1.0 by 1996. After the crisis, however, the multiplier has increased again, returning to 1.3 by 2002. The mean of the multiplier over time is 1.2.

This estimated agricultural growth multiplier is considered large, by any standard. Measured in a different way, Haggblade, Hazell, and Brown (1989) estimated that the agricultural growth multiplier in Asia is around 1.8, which in their study means that a certain increase in income of the agricultural sector will stimulate an increase in income

of non-agricultural sectors by 80%. At the same time, they estimated that the agricultural growth multiplier in Africa is around 1.5.

This finding implies that, although declining, the agricultural sector still has a large potential to become the driving force in the Indonesian rural economy. Formulated appropriately, a rural development strategy through developing the agricultural sector could provide an impetus for achieving a fast growing and vibrant rural sector in Indonesia.

VII. CONCLUSIONS

In a fast urbanizing Indonesia, the rural sector still plays an important role in the country's economy. The majority of the population, and hence the workforce, still live and find employment in rural areas. Rural areas also provide crucial services to the whole economy, in particular by providing food supplies for all of the population. In addition, rural areas also contribute importantly to foreign exchange earnings from export of commodities.

On the other hand, rural areas lag behind urban areas, both in terms of physical infrastructure as well as socio-economic welfare of its inhabitants. Strong evidence of this is that around 80% of all the poor in the country are found in rural areas. Although, in the long run, Indonesia will be more urbanized, and the rural areas can be expected to diminish, this still calls for a more focused attention and more rigorous effort in rural development.

This requires a clear and effective strategy to jump-start and sustain economic growth in rural areas. Specifically, since rural areas are closely identified with the agricultural sector, the question is: in order to push growth for the whole rural economy is it more effective to improve productivity in the agricultural sector first or is it better to invest in the rural non-agricultural sector directly?

This study examines the empirical evidence on the strength of agricultural linkages and estimates the agricultural growth multiplier in rural Indonesia. It finds, that indeed, the growth of the agricultural sector strongly induces growth of the non-agricultural sector in rural areas. Although it has been fluctuating over time, it is estimated that on average one percent growth of the agricultural sector will induce 1.2% growth of the non-agricultural sector in rural areas. This finding vindicates the view that rising incomes in the agricultural sector stimulates demand for locally produced goods and services in rural areas, in particular those produced by the non-tradable sector. Formulated appropriately, a rural development strategy through developing the agricultural sector could provide a major impetus for achieving a fast growing and vibrant rural sector in Indonesia.

On the other hand, this study also finds that urban development is not directly complementary to the development of the rural non-agricultural sector. Rather, urban sector growth suppresses the growth of the rural non-agricultural sector, perhaps because both sectors produced goods and services which compete with each other. Indirectly, however, urban sector growth has a positive effect on rural agricultural sector growth. Since rural agricultural sector growth positively affects rural non-agricultural sector growth, this means that the net effect of urban growth on rural non-agricultural growth depends on the balance of these two opposing effects.

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APPENDIX 1

Table A1. Contribution to GDP by Sector and Location (%), 1984 – 2002

Year	Urban				Rural			
	Agriculture	Industry	Services	Total	Agriculture	Industry	Services	Total
1984	1.53	17.94	35.57	55.03	18.56	10.50	14.22	43.28
1987	1.32	17.90	33.75	52.70	18.30	11.36	16.24	45.90
1990	1.29	18.55	30.36	50.20	17.37	11.56	20.19	49.12
1993	2.08	21.52	37.97	61.57	15.26	9.51	13.67	38.44
1996	1.79	21.87	37.39	61.05	13.77	10.30	14.89	38.96
1999	2.12	21.40	35.76	59.28	15.02	11.06	14.65	40.73
2002	2.75	25.53	40.08	68.36	13.34	6.91	11.38	31.63
Mean	1.95	21.32	36.35	59.62	15.40	9.93	14.71	40.04

APPENDIX 2

Table A2. Results of First-Stage Regression of Growth Linkages Model (Dependent variable: Rural agricultural sector growth)

Independent Variable	IV
Urban sector growth	0.0480** (2.84)
Rural population growth	-0.0039 (-0.30)
Initial rural poverty rate	0.2163** (2.73)
Initial rural Gini ratio	-0.6104 (-1.42)
Initial proportion of rural population with junior secondary education and above	-0.1893 (-1.00)
Log of total real expenditures of village governments	-0.0097 (-0.49)
Rainfall	-0.0000 (-0.66)
Number of trucks	-0.0000** (-3.10)
1990 Susenas sampling frame	-0.0594 (-1.68)
2000 Susenas sampling frame	-0.0959* (-2.14)
Constant	0.3432* (2.28)
Number of observations	132
F-value (7, 124)	3.61**
R-squared	0.2298

Notes: Numbers in parentheses are t-values.
** Is significant at 1% level.
* Is significant at 5% level.