Master's Thesis

The Indirect Agricultural Input Elasticity and Spatial Analysis of Migration in Java, Indonesia

도농 이주에 대한 농업투입요소의 간접 탄력성과 공간 분석 : 인도네시아 자바섬을 중심으로

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The Indirect Agricultural Input Elasticity and Spatial Analysis of Migration in Java, Indonesia

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국 문 초 록

도농 이주에 대한 농업투입요소의 간접 탄력성과 공간 분석 : 인도네시아 자바섬을 중심으로

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본 연구는 인도네시아 자바섬 내 농촌-도시 이주에 대한 농업투입요소의 간접 탄력성을 측정하고 있다. 대부분의 농촌-도시 이주는 도농 임금격차에서 기인하는 연유로, 본 연구는 농업소득 증진이 탈농인구 감소의 수단임을 전제로 한다. 실증분석을 위하여 인도네시아 자바섬의 서부-중부-동부 도(Province) 단위 자료를 활용하고 있으며, 분석시기는 2010년으로 제한한다. 농업생산성은 OLS를 통해 추정하며, 이주 회귀식은 공간적 의존성을 반영한 공간계량모형(SAR, SEM, SAC)을 활용한다. 분석 결과, 비료사용, 농업노동력, 농지의 증대와 농촌인구의 교육수준 향상은 이주 감소에 긍정적인 영향을 미치는 것으로 확인된다. 또한 해당 분석결과에 기반한 정책 수립은 산업화 수준이 상대적으로 저조한 지역에 집중적으로 실시될 필요가 있다. 따라서 고도의 산업화가 진행 중인 Bekasi, Bogor, Bandung, Karawang, Sidoarjo를 제외한 여타 행정구역에 관련 정책이 적용되어야 할 것으로 보인다. 반면, 도농 임금격차는 자바섬 내 농촌-도시 이주에 미미한 영향을 미치는 것으로 나타나고 있다. 이러한 결과는 모형에서 통제된 변인들, 즉, 도시지역의 구직가능성 및 사회자본 형성 등 외생변수 대비 도농 임금격차의 비교적 낮은 인과효과에 근거한다.

주요어: 농업생산성, 농촌-도시 이주, 공간계량모형, 자바섬, 인도네시아

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Abstract

The Indirect Agricultural Input Elasticity and Spatial Analysis of Migration in Java, Indonesia

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This paper investigates indirect agricultural input elasticity of rural to urban migration in Java, Indonesia. Since rural to urban migration occurs due mainly to disparity between urban and agricultural wage, we assume that boosting agricultural income will reduce migration to urban areas. The data used in this study is the 2010 provincial statistics in West Java, Central Java, and East Java, Indonesia. The agricultural productivity was estimated by Ordinary Least Squares (OLS) and Spatial Regression model (SAR, SEM, SAC) was used to estimate migration equation so as to consider the spatial dependence problems.

The research findings may offer the suggestion to increase fertilizer, add agricultural labor, raise education of rural people, and utilize agricultural land resource, in order to reduce migration. The suggested policy should particularly be concentrated in the regions other than the heavy industrial areas in Bekasi, Bogor, Bandung, Karawang and Sidoarjo Regency. However, it turns out that wage ratio variable has the least influence to migration decision in Java, comparing to the other exogenous variables such as probability of getting urban job and human capital.

Keywords: Agricultural Productivity, Rural-Urban Migration, Spatial Regression, Java, Indonesia
Student ID.: 2012-22612

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CHAPTER I

INTRODUCTION

As a result of Indonesia's industrialization in the last few decades, there has been tremendous number of rural to urban migration in the country. The rapid growth of industrial economy has promoted migration flows from all parts of rural areas to larger urban centers, particularly during the 1970s and 1980s. During this period, Indonesia performed a number of economic reforms that successfully attracted foreign investment which went into labor-intensive industries. Together with domestic industries, this performance contributed to the growth of urban and industrial agglomerations in several major cities. As the consequences, the rural population movement to urban areas took place during these decades and keeps going on until presently.

Even though rural out-migration is considered a pathway out of rural poverty as the rural people will probably have better opportunities to earn higher income in urban areas, escaping to urban areas does not necessarily guarantee escaping poverty as well. Instead, rural migration also becomes a major contributor to the problem in the destination areas. In the case of Less-Developed Countries (LDC), rapid urbanization can give rise to problems in urban areas. Limited absorption capacity of both industry and urban social services raise unemployment and poverty, along with other problems such as a progressive overloaded houses and social services, increased crime, pollution, and congestion (Zhang and Song, 2003). According to Lu

(2010), in Indonesia, rural-urban migration improved economic status and living standards by earning twice as much as rural non-migrants, yet this came with a cost of the adverse health effects (physical and psychological disorder). Beyond solely that, the movement poses some problems in rural areas as well. According to Mini (2000), in most rural areas, the impact of rural to urban migration was a rapid deterioration of the rural economy and it leads to chronic poverty and food insecurity. These emerge mainly due to excessive drain of youth from rural populace thus leaving only the older and aged members to constitute the labor force of the rural area.

As the urbanization continued to increase along with the problems caused by the internal migration, many policies have been implemented to cope with rural to urban migration. Generally, government may have two policy options dealing with migration: one is open migration and the other is constricted migration. In the case of open migration, government should be pushed to create more jobs in urban industries and services, or in other words, promoting industrialization and urbanization, which is beyond the scope of this study. Creating more jobs in urban areas may help little to overcome the disappointed result of migration. However, the number of rural migrants will considerably increase together with draining rural capital. On the contrary, constricted migration is a powerful policy instrument to control the pace of migration and urbanization. This type of policy can be conducted by minimizing the rural-urban income gap since migrants respond significantly to the differential between rural and urban income. Controlling migration policy is mainly influenced by Harris-Todaro model of migration which assumed that migration is an economical decision where the individual or household decides to move in response to a higher expected income in the urban areas rather than the actual earnings.

In Indonesia, although the government places few restrictions regarding rural to urban migration, policy of controlling migration through enhancing rural development may worth reckoning. There are a number of facts of why the migration to urban areas should be controlled through rural development. The most notable point is that the rural to urban migration in Indonesia is a consequence of the country's rapid economic growth, not the other way around. Thus, the assumption that economic growth is a feedback of migration does not hold for Indonesia case. Hence, controlling migration is not supposed to divert the economic growth. Also, the fact that there has been limited absorption capacity of both industry and urban social services may lead to critical problems of unemployment and poverty in urban areas (Zhang and Song, 2003). Another fact to exhibit is as Indonesia entered World Trade Organization, there is a growing potential of rural-urban income differential in the near future. Policy issues in international trade such as agricultural subsidies in developed countries may harm the poor farmers since it can increase agricultural imports in the developing world and will affect rural income to be decreasing. On the other hand, the expanding labor intensive manufacturing exports may escalate urban income. The potentially decreased rural income and increased urban income are likely to widen the rural-urban inequality and may attract more rural populace to migrate to urban areas and deteriorate rural conditions.

Through the several facts mentioned above, it is necessary to focus on areas of greatest need. Here, rural area is economically disadvantaged compare to urban areas. Therefore, focusing the policy aimed at encouraging rural economy is preferred because it does not distort urban economy, but promoting industrialization will have adverse impact on rural economy (Goldsmith, 2004). In addition, in countries where the majority of population still lives in rural areas, the emphasis needs to be placed on rural development to discourage rural-urban migration (Epstein and Jezeph, 2001). According to Stiglitz (1969) and Todaro (1997), to manage rural-urban migration is to have policies in place that increase agricultural productivity through increased agricultural investment. By increasing agricultural production, it will theoretically increase farmers' incomes which then increase demand for goods and services produced by non-farming rural inhabitant (Mellor, 1999). In consort with agricultural output, employment in the rural and urban non-farm sectors is stimulated through both forward and backward linkages (Hanmer and Naschold, 2000). Sequentially, urban poverty will be decreased due to the slowing migration to urban areas and food price will be lowered (Mellor, 1999).

Nevertheless, although there are many studies dealt with migration and raised many interesting insights on the topic, most of them seem to overlook the problem of finding the best functional form for the migration model (Cushing and Poot, 2004). On the other hand, spatial dependence issue of migration flows has relatively received deficient attention. As a matter of fact, spatial dependence can create either inefficient or biased and inconsistent estimates (Anselin, 1988). Due to the spatial relationship among regions, each region can have different impact on each other depending on their relative location. Therefore, there is a need for additional set of information on how the relationship is distributed. Spatial analysis is increasingly important to obtain more accurate information regarding migration phenomenon by considering spatial autocorrelation problem.

The focus of this study is however not to restrict rural populace and discriminate them by keeping the rural people where they are. The policy to cope with the negative effects of migration must concentrate on removing the causes of the phenomenon which is believed to be the income differential. This paper investigates the relationship between agricultural output (GRDP) and rural-urban migration in Java, Indonesia, particularly in the regencies and small cities. It is hypothesized that the improvement of agricultural productivity will increase rural income, and will thereby decrease rural to urban migration. Therefore, the objective of this study is to explore the relationship between agricultural productivity and rural to urban migration without ignoring the spatial dependence effect. More precisely, the relationship will be presented in the form of indirect agricultural input elasticity of migration through recursive equations. Here, the research questions being raised are: (1) Is there any spatial relationship among regions in Java migration? and (2) How does agricultural productivity affect migration to urban areas in Java? By using the recursive equation system between traditional regression (OLS) for agricultural output and spatial regression (SAR, SEM, SAC) for migration, the study will identify which agricultural factors have a significant impact on rural to urban migration.

This paper is constructed as follows. It begins with an introduction which expresses the focus of this study. At the second part, it provides the supported theoretical background regarding the relation between agricultural productivity and rural-urban migration. In the next section, chapter three explains descriptively about the rural-urban migration and agricultural productivity in Indonesia. This study then presents a set of equations as a model of agricultural productivity and rural to urban migration in chapter four. Subsequently, the chapter five of this study proceeds to the empirical results and the indirect effect of agricultural output on rural-urban migration. Finally, the results of the model can be used to scheme a policy intended to reduce rural to urban migration in Java, Indonesia.

CHAPTER II

RURAL-URBAN MIGRATION AND AGRICULTURAL PRODUCTIVITTY

Two important concepts utilized in this study are agricultural productivity and rural-urban migration (urbanization). There are many researches measuring the impact of urbanization on agricultural development. Nonetheless, studies about the inverse relationship between the two are still limited. As a matter of fact, agricultural development should be taken into account for the regional policy if the internal migration to urban areas is expected to be reduced. This study views agricultural development as the growth of agricultural productivity.

Among many factors that can trigger migration, such as agricultural mechanization, land conversion, poor living condition in rural areas, natural disaster, etc., economical decision appears to be the most dominant factor to migrate to urban areas in many developing countries. The most influential model of rural-urban migration was suggested by Todaro (1969) which assumed that migration proceeds in response to rural-urban differences in expected income rather than actual earnings. Migrants consider the various labor market opportunities available to them in the rural and urban sectors and choose one that maximizes their expected gains from migration. Rural inhabitants live mainly by farming which is considered low paid. Thus, if there are better options in urban areas which may be financially more rewarding than farming, rural people are very likely to take in the alteration. The model predicts that migration rates in excess of urban job opportunity growth rates are not only possible but also rational and even likely in the face of wide rural-urban expected income differential.

As the urbanization continued to increase along with the problems caused by the internal migration, many policies have been implemented to reduce the number of rural-urban migration and control rural inhabitant to migrate to urban areas. Although in Indonesia itself the migration is not considered as a crucial problem and the government does not make any particular policy regarding the issue, the idea of controlling rural to urban migration may have opportunity to be taken into consideration. The policy to manage migration flows to urban areas has been implemented in several developing countries and is worth to be paid attention to. In this case, promoting rural development plays significant role to forestall excessive migration to urban areas.

In Senegal case, through recursive equation system, Goldsmith *et al* (2004) pointed out that agricultural investment targeted in key areas can reduce migration. The policy is preferred not only because it reduces the differences in marginal productivities, but also it does not distort the urban economy. Similarly, the study by Asfaha and Jooste (2006) for South Africa case also indicates the same thing. By using time series data, the result showed that developing agricultural land and infrastructure and increasing fertilizer use can boost agricultural income, reduce rural-urban migration, and these are consistent with policies aimed at curbing urban unemployment. Nonetheless, it should be noted that this response depends on the successful transmission of effects from investment, through production, to the wage differential (Goldsmith *et al*, 2004).

In responding the disappointing results of migration, it would be probably too rigid to restrict rural populace to gain the benefits from urban areas by migrating. Some countries that implement this type of policy are China with the Hukou system of residence permits and also a parallel to that which prevails in Vietnam, Russia in the 1980s, South Africa, etc. By adding to discrimination against the rural poor laws to keep them where they are, is neither sensible nor just (Lipton, 1980). However, providing more urban jobs also only helps a little since more than proportionately increasing number of villagers will flow, increasing the drain of rural leadership and skills without improving the urban situation. Therefore, it is believed that rationalization of migrant flows requires more rational policies towards agriculture improvement (Lipton, 1980).

According to Eipstein and Jezeph (2001), to declare that such rural development policy is preferred and more cost-effective rather than urban biased policy involved a number of rational reasons. The first one is because infrastructure improvements are highly labor intensive works and wages are lower in rural areas. Secondly, rural inhabitants can be motivated to offer some of their assets and/or labor free as long as they are assured the venture in which they get involved will benefit their own society. Lastly, a wealthier rural sector will create increased demand for industrial products and thus help to ensure an increasing GNP growth rate. Therefore, the benefit of rural-urban integrated approach will by far outweigh the costs.

The successful of rural improvement in forestalling villagers to move out from their village can be encountered in South Asia and Southeast Asia case (Eipstein and Jezeph, 2001). In their study, they found how economic growth in rural areas can make people village-introverted, so much so that they do not want to migrate to cities. They enthusiastically explained how canal and piped irrigation, in the case of Wangala Sawankhalok, could triggered off an overall improvement in economic conditions. The impact of agricultural improvement on the village economy is clearly defined in Wangala village, South India. The onset of irrigation and increasing scale of growing cash crops combined with subsequent Green Revolution with high yielding varieties (HYV) of seeds and beginning of mechanization of agricultural activities has improved Wangala's agricultural base. This strong economic base made Wangala people village-introverted and caused very few villagers have worked outside Wangala and even fewer have moved out. Eipstein and Jezeph (2001) stated that due to the improvement, Wangala now benefits most of the urban amenities such as electricity, piped water, a primary health center, a large educational complex, telephone, radio, TV connections, banking and postal offices, etc., without the disadvantages of urban life such as pollution.

In Southeast Asia, the role of rural development in improving the living level of rural populace can be demonstrated through Sukhothai Groundwater Development Project during 1980-1990 in North Central Thailand. Due to the development of irrigation system and introduction of cash crop cultivation, this region became a soybean seed production center for the whole province. This improvement then enacts the small village encircled by modern banks, schools, traders and an extensive service industry, first-class hospitals and an air of prosperity within the community associated with villages in more developed countries (Eipstein and Jezeph, 2001).

As reported by World Bank (2008), rural development is accountable for 80% of the decline in rural poverty and generates better conditions rather than out-migration of the poor. Increase in agricultural productivity is seen as a pathway out of rural poverty as it is able to create higher income for rural people or those who mainly work in agricultural sector. There is strong linkage between increases in agricultural productivity and poverty reduction. Many evidences suggest that increase in agricultural productivity can reduce poverty in multiple pathways, such as real income changes, employment generation, rural non-farm multiplier effects, and food prices effects (Schneider and Gugerty, 2011). Ravallion and Datt (1996) demonstrated through CGE (Computable General Equilibrium) model, that growth in agricultural sector is a key determinant of poverty eradication in India. Their model showed that rural growth contributes to urban poverty alleviation, yet urban growth appears to have no effect on rural poverty.

Stiglitz (1969) and Byerlee (1974) argued that the best manner to control rural-urban migration in LDC is to have policies which aim to increase agricultural productivity through increased agricultural investment. According to Mellor (2001), theoretically, increasing agricultural production (output) increases incomes for poor farmers who then increase demand for the goods and services produced by the non-farming rural poor. Hence, higher agricultural output stimulates employment in the rural and urban non-farming sectors through both forward and backward linkages (Hanmer and Naschold, 2000). In turn, when rural growth is achieved, it will slow migration to urban areas and lower food prices which will lead to decrease in urban poverty. Agricultural growth, therefore, benefits poor farmers and landless laborers by increasing both production and employment, benefitting both the urban and rural poor through growth in the rural non-farm economy (Thirtle et al., 2003). By focusing policy on rural growth, it will alleviate both urban and rural poverty. In addition, policies that do not provide rural inhabitants with viable economic alternatives will likely lead to migration, creating problems of over urbanization in the urban areas. Accordingly, rural development policies should receive greater attention so that those policies can focus on creating more employment and income in rural areas. It can be a positive factor in a country that is heavily dependent on inputs from rural areas.

Some studies showed that growth in agricultural productivity can increase real wage rates. Datt and Ravallion (1998) found that real rural wage increased with higher average farm productivity, presumably through increase labor demand resulting from multiple cropping. However, increased productivity could remain unchanged or even lower farm wages (Estudillo and Otsuka 1999 and Thakur et al. 1997). In their studies, it occurred due to the new technologies and modern varieties which decrease the factor share of labor and hence defeat wages. Notwithstanding, others argue that some factors such as population growth and slow adjustment in the wage market are also responsible for the wage decrease in that case. Mellor (1999) suggest that if there is underemployment in rural areas, agricultural growth would unlikely to increase real wages because increased output will result in declining real prices unless effective demand for the good in question also increases. In the conclusion, he stated that real wages rise consistently with agricultural growth. He also suggested that agricultural growth has employment multiplier. Nevertheless, much of this effect is likely to come from non-farm sector since increase in real wages creates an automatic incentive to increase labor productivity.

It is strongly believed that in an agricultural country like Indonesia, the solution to the fate of urban areas is closely linked with the fate of rural areas (Wood, 1986). In Java, the majority of farms are less than half a hectare, a size which permits little more than a subsistence income at best. It indicates that push factor obviously plays an important role in Indonesian's rural to urban migration. During the 1970s and 1980s, the government subsidized rice production by means of price subsidies on fertilizers, pesticides, and high yielding varieties of seeds through the establishment of agricultural extension services. It resulted in increase in rice production, yet the benefits to rural inhabitants have been mixed, with some of the wealthier farmers increasing their landholdings at the expense of poorer neighbors (White, 1978). Schiller (1980) showed that with the changes in rice production methods, particularly the replacement of farm labor from local farmers with small tractors and professional harvesters, has deprived many landless rural farmers of their livelihood and has forced many of them to migrate to urban areas. It has also increased rural income disparities between the owners of land and landless farmers due to the high cost of rice on the government-regulated market. However, according to Wood (1986), one must be careful of the improvement in rural development does not necessarily guarantee a decrease in migration number to urban areas. As a matter of fact, rural development can result in the opposite as improved communication and transport linkages between urban and rural areas increase interest in urban-biased economic and decrease the cost of rural to urban migration. Thus, it is inevitably important to keep the track of transmission of agricultural investment to boost local farmers’ income and withstand rural people to move to urban areas, not vice versa.

CHAPTER III

OVERVIEW OF INDONESIA

Figure 3.1 Map of Indonesia

Urbanization in Indonesia has been greatly increased from time to time as the government placed few restrictions on rural-urban migration. Internal migration in Indonesia represents an open movement rather than constrained migration that are hampered by restrictive migration policies and associated legal and social barriers (Lu, 2010). At any time in the 1980s or 1990s, migration flows from all parts of rural areas to larger urban centers were common within Java, Sumatra and Bali and could be casually observed. The extent of these migration flows was such that it did not happen unintentionally. Many factors contributed such as improved education levels in rural areas, substantial population density, reasonable infrastructure development across much of the non-mountainous parts of the country, and the absence of regulations prohibiting this migration (Barichello, 2004). Rural-urban migration in Indonesia slowed down after the economic crisis in 1998, but continued triggering urban population growth (Hugo, 2000). Most of the migration movements consisted of the rural poor moving into the informal sector and urban slums. Even though more than half of the population in the country still depends on agriculture, urban sector is becoming more attractive for many people.

Many studies have examined that rural-urban migration plays an important role in the process of urbanization. United Nation (UN) reported that 65% of the increasing number of urban population is due to migration and reclassification from rural to urban areas and 35% is caused by natural growth. Chen, et al. (1996) reported that internal migration accounted for 40.3%, 44.1% and 54.3% of urban population growth in the developing world during the 1960's, 1970's and 1980's, respectively. In particular, migration of the labor force from rural to urban markets has been a major source of the growth in urbanization.

Table III.1 Urbanization in Indonesia, 1971-2010

Year	Total Population	Urban Population	Urbanization Level (%)	Natural Growth (%)	In-Migration	Out-Migration	Net Migration
1971	116,996,006	204,97,934.24	17.5202	2.53	5,843,173	5,703,037	140,136
1980	145,494,452	32,160,093.67	22.104	2.32	10,230,798	9,971,785	259,013
1985	162,458,871	42,383,894.86	26.089	2.09	11,536,170	11,457,446	78,724
1990	178,633,239	54,633,189.82	30.584	1.79	14,743,056	14,643,333	99,723
1995	194,112,556	69,014,778.16	35.554	1.57	17,876,743	17,824,772	51,971
2000	208,938,698	87,758,431.93	42.002	1.44	20,456,483	20,357,011	99,472
2005	224,480,901	103,119,791.5	45.937	1.43	21,276,929	20,919,062	357,867
2010	240,676,485	120,155,328.4	49.924	1.33	27,975,612	27,736,130	239,482

Table III.1 estimated that the urbanization process in Indonesia is majorly caused by rural-urban migration rather than the natural growth of population. Figure 3.2 shows that over the years, the trend of urbanization in Indonesia keeps decreasing. In fact, the term urbanization itself often defines as rural to urban migration in the country. This presumption is based on the declining natural growth of urban population (see Figure 3.3), the slow alteration (re-classification) of rural areas in becoming urban, and the vigorous economy and development policies which enlarge pull factor to urban areas for rural inhabitants. Figure 3.4 exhibits that In line with the rapid urbanization in Indonesia, the number of in migration also tends to increase over the past decade.

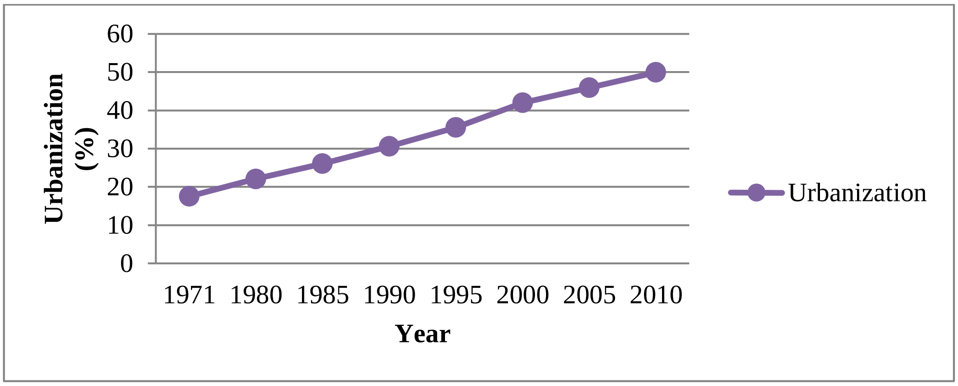

Figure 3.2 Urbanization in Indonesia in 1971-2010

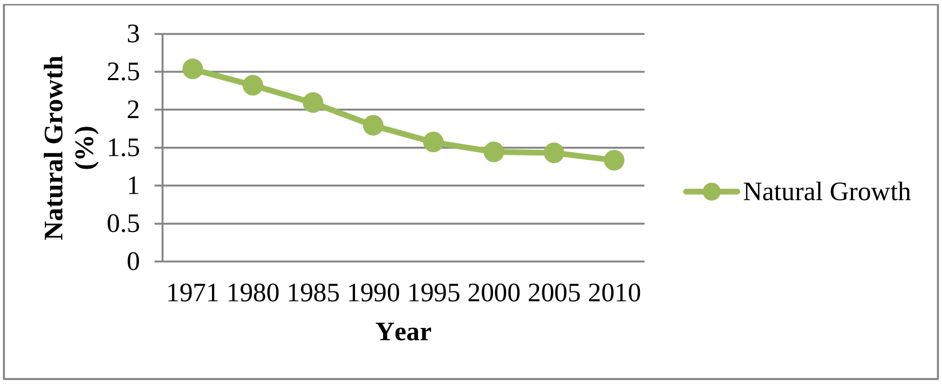

Figure 3.3 Natural Growth of Population in Indonesia in 1971-2010

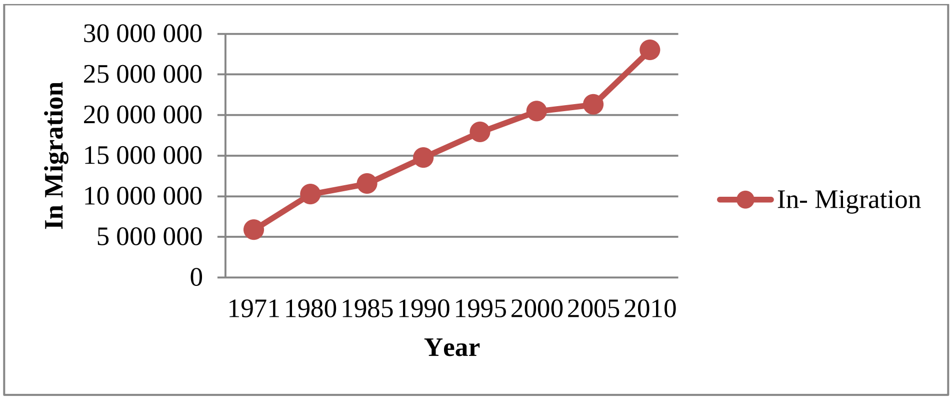

Figure 3.4 Trend of In-Migration in Indonesia in 1971-2010

The high percentage of migration rate, particularly in Java as the main island, is caused by the concentrated, both economic and social, growth centers in this main island, particularly in urban areas. The concentration of growth centers becomes the pull factor towards the movement to urban areas. It also indicates that the development of new growth centers in small and medium cities has not been optimized. According to Baiquni (2004), the urbanization phenomenon in developing countries mainly occurs due to the rapidly growing economy and considerable job opportunities regarding industry and services in urban areas. Thereunto, education services and other urban amenities are also taking major part of this phenomenon. On the other hand, the agricultural involution and alteration due to modernization serve principal push factor in Indonesian urbanization and cut down job opportunities in rural areas. Therefore, urbanization in Indonesia is not merely a matter of demographic problem but a phenomenon of capital drain or brain drain which will impendence development in rural areas.

Unsurprisingly, the rapid growth of urbanization is not followed by the growth of agricultural sector. Even though the agricultural output (GDP) in Indonesia had increased during the period 2005-2010, the growth rate has been relatively slow. According to the data from Statistics Indonesia, it is recorded that agricultural GDP growth is the second lowest (after mining and quarrying output growth). During the period 2005-2010, the average growth of agricultural GDP is 3.5% and this is nearly less than a half of the total GDP average growth in Indonesia, which is 5.73%. Figure 3.5 exhibits the agricultural growth in Indonesia form 2005 to 2010.

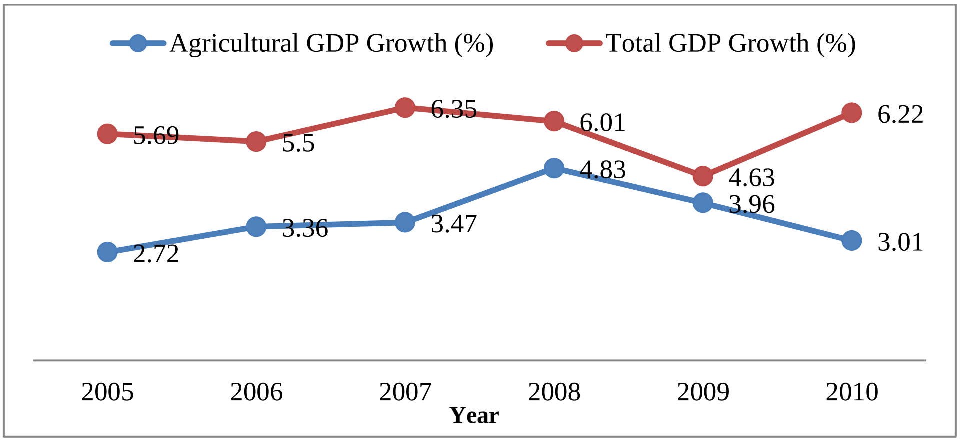

Figure 3.5 Agricultural GDP Growth in Indonesia, 2005-2010

In addition to the relatively slow growth of agricultural output, farmers' real income in Indonesia has also been decreasing from time to time during 2009-2012 (see Figure 3.6). Within those years, the previous year lies above the latter, indicating that the real income keeps exsiccating from year to year. Moreover, their real income only ranges from 2.5 to 3 USD more or less. This income range is not sufficient to make a decent living.

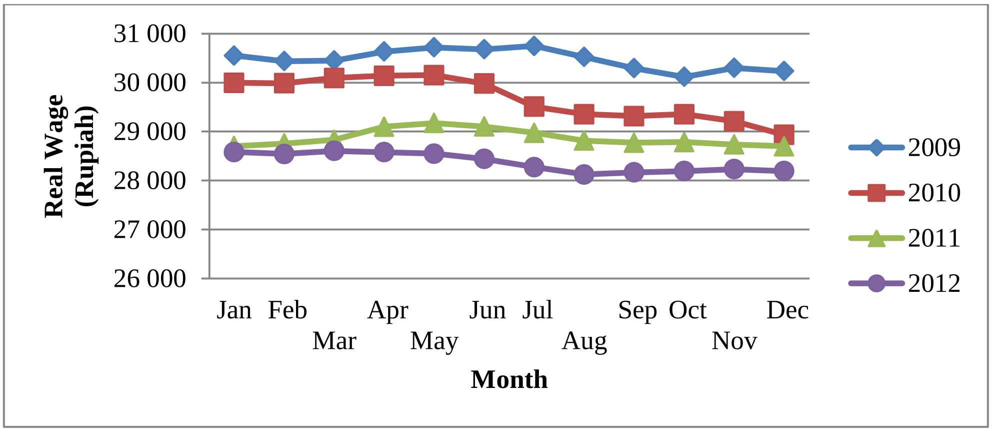

Figure 3.6 Daily Real Wage of Farmers Labor in Indonesia, 2009-2012

There are many difficulties in estimating the farmers' income since total costs of production are unknown and many farmers have additional incomes (Soemarwoto et al, 1975). For instance, during the low season, farmers do home gardens and manual labor. Nevertheless, doubling or tripling the above figures to give generous allowance for additional income does not make any big difference because farmers still stand very low. It is then highly argued that the stagnancy of agricultural growth and decreased farmers' real income are some of the main factors that speeds rural-urban migration and urbanization, with more people concentrated on urban sector economy.

In this research, the estimated rural-urban migration is limited only to urban population who lives in Regency and some small cities that still have rural population within. This study excludes cities which do not have rural population. Furthermore, while most of the policy discussion concerning urbanization has focused on the growth of megacities and big cities, there has been a little attention to the growing of small cities. While megacities and other cities are facing the huge challenge of coping with the chaos, congestion, pollution and social problems, the newer, smaller urban centers that exhibit all the same problems yet smaller scale has to be dealt with as well. In fact, these small cities often experience worse problems as they are growing disorderly and the required urban amenities are absence (Gosh, 2012). Since the population is increasingly gravitating towards urban areas, the shift has already taken place in many small cities, not only in big cities or megacities. Thus, it is necessary to place more alert on small cities in the coming years as they are growing rapidly.

CHAPTER IV

METHODOLOGY

4.1 The Model

In this study, the author utilizes two equations: migration and agricultural output. These two models will then be connected by using recursive equations.

4.1.1 Migration Model

In explaining migration through macro sense, Harris-Todaro model is often used to capture the urban-rural wage differentials and the probability of getting urban job. Urbanization rate is also included as the independent variable since it is assumed that the higher the number of urbanization is, the greater number of rural people coming in to the urban area. Moreover, urbanization can also affect the number of contacts in urban areas. It is argued that the number of rural inhabitants of the state who would have contacts in urban areas could influence the cost of rural to urban migration. Referring to Bhattacharya (2002), the more urbanized the state is, the greater the number of contacts in urban areas, and such contacts would facilitate migration. Thus, as the state gets more urbanized, it would lower the cost of migration and eventually increase the rural to urban migration rate.

4.1.1.1 Traditional Regression Model (OLS)

For the migration model, the dependent variable is migration (M). The independent variables are explained by agricultural wage (Wa), urban wage (Wu), education in urban areas (Eu), urbanization (U), probability of getting urban job (Pr), industrial workers (Iw), and share of industrial GRDP (Sh). Here, the proxy to measure agricultural wage is calculated by dividing agricultural output (Ya) per rural population (Pu), and urban wage is implicitly expressed by urban (non-agricultural) output (Yu) per urban population (Pu).

The traditional regression (OLS) of migration equation can be written as follows:

$$\ln M = \alpha_0 + \alpha_1 \ln Wa + \alpha_2 \ln Wu + \alpha_3 \ln Eu + \alpha_4 \ln U + \alpha_5 \ln Pr + \alpha_6 \ln Iw + \alpha_7 \ln Sh + e_t \quad (1)$$

To simplify the model, the wage ratio (WR) is obtained by dividing urban wage (Wu) to agricultural wage (Wa), forming the equation below:

$$\ln M = \alpha_0 + \alpha_1 \ln WR + \alpha_2 \ln Eu + \alpha_3 \ln U + \alpha_4 \ln Pr + \alpha_5 \ln Iw + \alpha_6 \ln Sh + e_t \quad (2)$$

4.1.1.2 Spatial Regression Model (SAR, SEM, SAC)

In migration phenomenon, the existence of spatial dependence which incorporated into the lag variable or the error structure often arises. Since the conventional regression model above does not consider spatial features of migration, it is necessary to apply another model that allows this distinction. The term spatial here refers to geographical location relative to neighboring regions. This means that there could be a possibility that there exists interdependency between neighboring districts in the form of spillover or interaction. Spatial regression models can be utilized to consider spatial autocorrelation effect of such phenomenon. It indicates that the migration number in district A is influenced by the performance in other districts surrounding A. Each region can have a different impact on each other depending on their relative location. Therefore, to get deeper analysis of migration and to see how the relationship is distributed, spatial econometrics model becomes important to comprehend the phenomenon.

Anselin (1998) defined spatial econometrics as the collection of techniques that deal with the peculiarities caused by space in the statistical analysis of regional science models. Spatial econometrics is different from traditional econometrics. When sample data has a locational component, there could be spatial dependence or spatial heterogeneity problems in which conventional econometrics largely ignored (Le Sage, 1998). Overlooking these problems could violate Gauss-Markov assumptions used in regression modeling. Spatial dependence contravenes the classical assumption that the explanatory variables are fixed in repeated sampling, resulted in biased and inconsistent estimates. Similarly, spatial heterogeneity violates the assumption that a single linear relationship exists across the sample data observations. If the relationship varies as we move across the spatial data sample, it is necessary to utilize alternative estimation rather than standard regression equations to avoid wrong conclusions.

Traditional regression commonly used to analyze cross-section and panel data assume that observations/regions are independent of one another whereas it is not invariably like that. Ignoring the spatial dependence problems in migration can affect some key variables to be insignificance and other unnecessary variables to be significant. Also, it will have impact on the sensitivity of the magnitudes of the parameter estimate. Thus, in this study, the migration function will be conducted by taking spatial dependence issue into account.

Before applying this spatial regression model, Moran’s I-test is conducted to detect the presence of spatial dependence in OLS residuals. If the null hypothesis of Moran’s I-test is rejected, then spatial regression model will be utilized to estimate the migration model. The calculation of this test is executed by using Matlab. The Moran’s I is defined as:

$$\boxed{I_t = \frac{n}{s_{ij}} \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}(y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^{N}\sum_{j=1}^{N}(y_i - \bar{y})(y_j - \bar{y})}}$$

where

n : number of regions

s_{ij} : sum of all the elements of the spatial weight matrix

w_{ij} : the element of the spatial weight matrix between i and j

y_i : logarithm of migration of region i

Moran's I value ranges between -1 and 1. Negative values indicate negative spatial autocorrelation while positive values mean positive spatial autocorrelation. Zero value exhibits the absence of spatial dependence. The null hypothesis is there is no spatial dependence in the model. If the null hypothesis is rejected, there is a sign of spatial pattern and thus it requires further investigation using spatial regression model.

The spatial regression model is employed by using GIS and Matlab. The spatial weight matrix W is obtained through GIS and then it is processed under Matlab program for spatial regression. The null hypothesis for the test of significances of spatial parameters is $\rho = 0$ for spatial lag (SAR) model and $\lambda = 0$ for spatial error (SEM) model. The significances of spatial parameters confirm the existence of spatial dependence and spatial heterogeneity in the migration model.

In applying spatial econometrics model, the geographical location information can be set in the form of spatial weight matrix. A spatial weight matrix is a square matrix with the number of rows and columns represent the number of regions or individuals in the observation. The weight matrix is symmetric and has always zeros on the main diagonal. There are multitude of weighting possibilities including inverse distance, fixed distance, K nearest neighbors, contiguity and spatial interaction. The weight matrix W used in this spatial regression model is inverse-distance matrix which later be standardized by the sum of each row. This type of matrix is one of the most commonly used interpolation techniques of scatter points. The general of idea inverse-distance weighted (IDW) is based on the assumption that the attribute value of an unsampled point is the weighted average of known values within the neighborhood, and the weights are inversely related to the distances between the prediction location and the sampled locations. The interpolating surface should be influenced mostly by the nearby points and less by the more distant points. In other words, the influence decreases with increasing the distance from particular points.

The simplest weighting function is inverse power:

$$W(d) = \frac{1}{d^p}$$

with $p > 0$. The value of p is specified by the user, and the most common choice is $p = 2$. Thus, the inverse distance matrices can be written as follows:

$$\mathbf{W} = \begin{bmatrix} 0 & \frac{1}{(d_{1,2})^2} & \frac{1}{(d_{1,3})^2} & \frac{1}{(d_{1,4})^2} \\ \frac{1}{(d_{2,1})^2} & 0 & \frac{1}{(d_{2,3})^2} & \frac{1}{(d_{2,4})^2} \\ \frac{1}{(d_{3,1})^2} & \frac{1}{(d_{3,2})^2} & 0 & \frac{1}{(d_{3,4})^2} \\ \frac{1}{(d_{4,1})^2} & \frac{1}{(d_{4,2})^2} & \frac{1}{(d_{4,3})^2} & 0 \end{bmatrix}$$

In order to control the spatial dependence problems, the migration function is tested by using spatial autoregressive model (SAR), spatial error model (SEM), and the mixed of both models or also called general spatial model (SAC). The former is also termed a mixed regressive – spatial autoregressive model because it combines the standard regression model with spatially lagged dependent variable, similar to lagged dependent variable model from time-series analysis (LeSage, 1998). The SAR model is appropriate to assess the existence and strength of spatial interaction. Modifying the OLS regression of migration into spatial regression SAR model in which the explanatory and dependent variables are the same, with Wy is the spatial weight matrix and ρ is the coefficient of spatial lagged dependent variable, α is the parameter of the explanatory variable, and e_t is the error term, the regression model now takes the form:

$$\ln M = \rho Wy + \alpha_0 + \alpha_1 \ln WR + \alpha_2 \ln Eu + \alpha_3 \ln U + \alpha_4 \ln Pr + \alpha_5 \ln Iw + \alpha_6 \ln Sh + e_t \quad (3)$$

When the spatial dependence is incorporated in error structure, the spatial regression SEM takes the form. The SEM model is suitable to correct the potential bias of spatial autocorrelation due to the use of spatial data that varied with location and are not homogenous throughout the data set. This heterogeneity is assumed to exist as every location has uniqueness relative to other location. The structure of the SEM model of the migration in this study is the following:

$$\ln M = \alpha_0 + \alpha_1 \ln WR + \alpha_2 \ln Eu + \alpha_3 \ln U + \alpha_4 \ln Pr + \alpha_5 \ln Iw + \alpha_6 \ln Sh + e_t + \lambda Wu + e_t \quad (4)$$

where λ is spatial error coefficient analogous to the serial correlation problem in time series model, and Wu is the spatial weight matrix, and other variables are identical with previous model.

Furthermore, if there were evidence that spatial dependence existed in the error structure from a spatial autoregressive (SAR) model, the general spatial model (SAC) is an appropriate approach to modeling this type of dependence in the errors (LeSage, 1998). SAC model includes both the spatial lagged term and a spatially correlated error structure as shown below:

$$\ln M = \rho W_1 + \alpha_0 + \alpha_1 \ln WR + \alpha_2 \ln Eu + \alpha_3 \ln U + \alpha_4 \ln Pr + \alpha_5 \ln Iw + \alpha_6 \ln Sh + e_t + \lambda W_2 + e_t \quad (5)$$

Here, W_1 is an inverse distance matrix and W_2 is constructed based on $W_2 = W' W$.

4.1.2 Agricultural Productivity Model

Cobb-Douglas production function is often used to measure the relationship between inputs and outputs, marginal products, and production elasticity (Dillon and Hardaker, 1993). The log linear form of this function enables quantifying the marginal contribution of each variable of inputs to aggregate production and mitigates the multicolinearity problems (Hayami and Ruttan, 1970, Yamada and Ruttan, 1980, Mundlak and Butzer, 1997). In Cobb-Douglas production function, agricultural output becomes the dependent variable, while the explanatory variables represent the agricultural inputs. Labor, capital, technology, and human capital are included for the independent variables. Capital accumulation is captured by using land and livestock. Fertilizer and tractor are used to measure technical aspect in production. As a proxy for human capital, the level of education is being used.

For agricultural output model, it is conducted by using conventional regression OLS model. The dependent variable for this model is agricultural output (Ya), while the independent variables are agricultural land (L), agricultural labor (La), livestock (Li), fertilizer (F), tractor (T), and education in rural areas (Er). The formula for agricultural productivity equation is expressed as follows:

$$\ln Ya = \beta_0 + \beta_1 \ln L + \beta_2 \ln La + \beta_3 \ln Li + \beta_4 \ln F + \beta_5 \ln T + \beta_6 \ln Er + et \qquad (6)$$

4.2 Definitions of Variables and Data Source

This study formulates two equations simultaneously, the traditional regression of agricultural output and the spatial regression of migration. These two equations are the recursive model linked by the agricultural output (Ya) variable. In the former equation, agricultural output is the dependent variable, while in the latter, agricultural output is a component of agricultural wage and used for wage ratio (WR) to explain migration (M). The recursive equations can be written as:

a. Equation [6] and equation [3] for SAR model:

$$\begin{cases} \ln M = \rho W_1 \alpha_0 + \alpha_1 \ln WR + \alpha_2 \ln Eu + \alpha_3 \ln U + \alpha_4 \ln \Pr + \alpha_5 \ln Iw + \alpha_6 \ln Sh + e_t \\ \ln Ya = \beta_0 + \beta_1 \ln L + \beta_2 \ln La + \beta_3 \ln Li + \beta_4 \ln F + \beta_5 \ln T + \beta_6 \ln Er + e_t \end{cases} \quad (7)$$

or

b. Equation [6] and equation [4] for SEM model:

$$\begin{cases} \ln M = \alpha_0 + \alpha 1 \ln WR + \alpha_2 \ln Eu + \alpha_3 \ln U + \alpha_4 \ln \Pr + \alpha_5 \ln Iw + \alpha_6 \ln Sh + \lambda Wu + e_t \\ \ln Ya = \beta_0 + \beta_1 \ln L + \beta_2 \ln La + \beta_3 \ln Li + \beta_4 \ln F + \beta_5 \ln T + \beta_6 \ln Er + e_t \end{cases} \quad (8)$$

or

c. Equation [6] and equation [5] for SAC model:

$$\begin{cases} \ln M = \rho W_1 + \alpha_0 + \alpha 1 \ln WR + \alpha_2 \ln Eu + \alpha_3 \ln U + \alpha_4 \ln \Pr + \alpha_5 \ln Iw + \alpha_6 \ln Sh + \lambda W_2 + e_t \\ \ln Ya = \beta_0 + \beta_1 \ln L + \beta_2 \ln La + \beta_3 \ln Li + \beta_4 \ln F + \beta_5 \ln T + \beta_6 \ln Er + e_t \end{cases} \quad (9)$$

For such equations above, it is suggested to use estimation procedures such as two-stage or three stages least squares rather than Ordinary Least Square to avoid biased estimates of the parameters. However, the equations above are sequential (one-way) rather than simultaneous (two-way), meaning that Ya affects M but M does not affect Ya either directly or indirectly. Since the equation is a recursive system, using OLS is an appropriate estimator for each single equation and will not result in bias estimation. Yet, since the spatial autocorrelation should be considered in migration function, using spatial regression, whether it is SAR, SEM or SAC, would be the most appropriate to estimate migration.

The data and variables are slightly similar with the empirical research conducted by Goldsmith *et al* (2004) for Senegal case, and Asfaha and Jooste (2006) for South Africa case. All data used in this research cover the year 2010 and the study areas are West Java, Central Java and East Java.

Agricultural output (Ya) - agricultural GRDP of each regency/city at constant price as sourced from BPS (National Statistics) of each province. Agricultural output is measured as the total of crop, livestock, fishery, and forestry production in real terms, expressed in Indonesian Rupiah (IDR).

Labor (La) - the number of agricultural employees in each regency/city as sourced from BPS of each province.

Fertilizer (F) - the number of subsidized fertilizer distribution in agricultural sector in each regency/city as sourced from ministry of agriculture. Fertilizer is measured as the quantity of nitrogen, potassium and phosphorus as well as organic.

Tractor (T) - the number of availability of agricultural equipment and machinery (2 wheels tractor) in each regency/city as sourced from ministry of agriculture.

Livestock (Li) - the number of animal units (cattle, buffalo, horses, goats, sheep, chickens, ducks, and pigs) available for agricultural production in each regency/city as sourced from BPS of each province.

Land (L) - the number of wet and dry agricultural land (expressed in hectare) in each regency/city as sourced from BPS of each province.

Human capital rural (Er) - the number of university graduates in rural areas in each regency/city as sourced from BPS.

Migration (M) - the number of recent in-migration in urban areas (based on residential five years ago) in each regency/city as sourced from BPS of each province.

Rural population (Pa) - the number of rural population in each regency/city as sourced from BPS.

Urban population (Pu) - the number of urban population in each regency/city as sourced from BPS.

Implicit agricultural wage (Wa) - the ratio of agricultural GRDP to rural population in each regency/city as sourced from BPS of each regency. Agricultural wage is approximated by the average productivity of the family labor force. Family labor is usually the most important cost item for small farms. Traditional agriculture is characterized by work sharing with quasi-unemployment and farm income sharing (Ghatak and Ingerscent [8]). Thus, according to FAO (1999), the implicit agricultural wage can be defined as the ratio of agricultural output to the total agricultural population. Due to the unavailability of farmers' income data by regency in the country, implicit agricultural wage was used to capture the variable. It can be calculated as:

$$Wa=\frac{Ya}{Pa}$$

Implicit urban wage (Wu) - urban wage is defined as non-agricultural output per capita: the ratio of non-agricultural output (GRDP minus agricultural GRDP) to urban population in each regency/city as sourced from BPS of each regency. Here, urban output is equal to the sum of industrial and service production. The implicit urban wage hence is measured as:

$$Wu=\frac{Yu}{Pu}$$

Wage ratio (WR) - the ratio of urban wage to agricultural wage.

$$WR=\frac{Yu/Pu}{Ya/Pa}=\frac{Wu}{Wa}$$

Human capital urban (Eu) - the number of university graduates in urban areas in each regency/city as sourced from BPS.

Urbanization (U) - the proportion of urban population to total population as sourced from BPS. According to UN, urbanization can be measured by the percentage of urban population or the rate of growth of urban population minus that of the total population.

Probability of getting an urban job (P) - the number of employment rate (the proportion of urban employment to labor force) in urban areas in each regency/city as sourced from BPS.

Industrial workers (Iw) - the number of workers whose job is in industrial sector in each regency/city as sourced from BPS.

Share of industrial GRDP (Sh) - the proportion of industrial (manufacturing) GRDP to total GRDP in each regency/city as sourced from BPS.

CHAPTER V
DATA ANALYSIS

5.1 Empirical Results and Interpretation of the Model

There are set of assumptions that need to be met in order to use linear regression. The data has been tested through normality, heteroscedasticity, multicolinearty, and autocorrelation assumption in advance. All variables in agricultural function are normally distributed (significant at 1% level), no heteroscedasticity and no multicolinearity as well. However, from the test result, autocorrelation problem is founded in migration model. Thus, it needs to be further investigated to avoid biased estimates.

All the variables were converted to natural logarithms in order to interpret the parameters as elasticity. The total number of observations is 79. Cities that do not have rural population are excluded from the data. Since all the variables are converted into logarithm form, it can be interpreted as elasticity. The agricultural output is estimated by OLS model whereas spatial regression SAR is used to estimate the migration function.

5.1.1 Agricultural Productivity Model

The descriptive statistics for agricultural output equation is shown in the table 4 below:

Table V.1 Summary Statistics of Agricultural Productivity Model

Variable	Mean	Std. Deviation	N
Agricultural GRDP	27.8840	.7125	79
Labor	12.1379	.8174	79
Fertilizer	9.8562	1.2402	79
Tractor	5.9489	1.1567	79
Livestock	15.2011	1.0166	79
Land	11.3913	.7277	79
Education rural	8.4979	.7537	79

Table V.2 Pearson Correlation in Agricultural Productivity Model

Variable	Correlation to Agricultural GRDP
Agricultural GRDP	1
Labor	0.828**
Fertilizer	0.530**
Tractor	0.527**
Livestock	0.591**
Land	0.793*
Education rural	0.787**

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table V.3 Agricultural Productivity Model by OLS

Variable	Coefficient	t-statistic	t-probability	VIF
Intercept	16.9550	27.0829***	0.0000	
Labor	0.1884	2.1260**	0.0369	5.055
Fertilizer	0.1993	7.0383***	0.0000	1.187
Tractor	-0.0439	-1.1042	0.2732	2.041
Livestock	0.0719	1.7750*	0.0801	1.635
Land	0.3453	3.8423***	0.0003	4.117
Education rural	0.2250	2.3781**	0.0201	4.898
R-squared	0.8527			
Rbar-squared	0.8404			
Sigma^2	0.0810			
Durbin-Watson	1.8576			
Observations	79			

* $p<0.1$, ** $p<0.05$, *** $p<0.01$

a) Dependent variable: Agricultural GRDP

In agricultural productivity equation, the result shows that the labor force coefficient is significant at 5% level. Thus, it indicates that in Java, additional workers will increase agricultural regional output. A 1% increase in number of agricultural worker would increase the output by 0.18%. This result is reasonable since the agriculture in Java is more labor intensive rather than capital intensive as the agricultural system is still adopting less technology in the country. Also, the trend of agricultural labor has been decreasing in the past few years. This decline is associated with the increase in land conversion in productive areas (Statistics Indonesia), causing less agricultural land supply. Furthermore, many agricultural workers switch to non-agricultural sector because the prior sector is considered to have no or little adding value and weak competitiveness.

Fertilizer is also statistically significant with agricultural output at 1% level. A 1% increase in fertilizer use would increase agricultural output by 0.19%. This result was expected since increased use of fertilizer is associated with the adoption of modern capital and is one of the conditions for increasing productivity. This finding is in line with the study by Kasiyati (2010) who pointed out that subsidized fertilizer in Central Java would increase the production output. In addition, by doing simulation, she also performed that subsidized fertilizer would increase farmers household income by 0.6%. According to World Bank (2009), subsidized fertilizer can increase capital availability for farmers. By subsidizing the price of fertilizer, it can facilitate farmers to allocate their money for other inputs. Subsidized fertilizer contributes about 9-22% of total cost, depending on the dose and technology used. By using subsidized fertilizer, it allows farmers to increase fertilizer dose into the optimal level and it will eventually increase the agricultural productivity.

The tractor coefficient is not significantly different than zero. It is common in developing country, that agricultural mechanization has not been very successfully implemented because agricultural machinery was imported carelessly without any adaptation to the farm condition and characteristics. According to Bachrein *et al* (2009), in West Java case, generally, farmers use Japanese two wheel tractor which is less suitable for the land condition and characteristics.

Livestock also contributes significantly to agricultural output in Java at 10% level. The result shows that a 1% increase of livestock would increase agricultural output by 0.1%. It indicates that livestock contributes significantly to agricultural output in the regions. Livestock makes the second major contribution to agricultural GRDP after farm food crops in Java. Currently, livestock development has been concentrated in Java, particularly in West Java, Central Java and East Java.

The agricultural land coefficient is significant at 1% level. A 1% increase in agricultural land would increase 0.39% agricultural output. It indicates increase in agricultural land plays an important role in agricultural productivity in Java. This is reasonable since agricultural land in Java is facing an alarming fact on the conversion of agricultural land to non-agro uses. According to Ministry of Agriculture (2005), the conversion rate of the agricultural land in Java Island has reached approximately 100,000 ha per annum. Land conversion has recently been uncontrollable, particularly on irrigated land as well as on agricultural land around cities in Java Island (Adimihardja, 2006). Therefore, developing agricultural land will contribute significantly to boost agricultural productivity considering the output in the present is relatively low due to lack of sufficient land.

The result of education is also significant at 5% level. A 1% increase in educational attainment of rural people would increase the agricultural output by 0.2%. Human capital plays an important role in developing agricultural growth in a region. Thus, promoting rural inhabitants' education would result in higher agricultural output.

5.1.2 Migration Model

5.1.2.1 Detection of Spatial Autocorrelation

In order to apply spatial econometrics to the function, it is necessary to first detect the presence of spatial autocorrelation in the residuals from a least squares model. The test for the existence of spatial dependence in OLS residual can be conducted through the Moran's I statistics:

Table V.4 Moran's I-Test for Spatial Dependence in Migration Regression Model

Moran I-test for Spatial Correlation in Residuals	
Moran's I	0.1240
Moran I-statistic	3.7011
Marginal Probability (p-value)	0.0002
Mean	-0.0247
Standard Deviation	0.0401

The result of Moran's I-test is statistically significant at 1% level. In consonance with this result, there is positive spatial autocorrelation in migration flows in Java which indicates the geographic relationship among regions exists yet the correlation is not immensely high. The Moran's I will be higher (close to 1) if regions with a closer geographic relationship have a higher correlation. Therefore, since there is a sign of spatial pattern, it is necessary to investigate further using spatial regression instead of traditional regression otherwise the estimates could be biased and inconsistent.

Figure 1 Anselin Local Moran's I in West Java, Central Java, and East Java Migration

The local moran's I above exhibits a spatial relationship among each region in Java migration, particularly in the three provinces: West Java, Central Java, and East Java. In figure 1, it is evident that regions with notable manufacturing industries have high spatial autocorrelation effect to its neighboring regions. The spatial autocorrelation can be vividly seen in the regions which part of metropolitan area. In West Java, there is high-high correlation concentrated in Karawang, Bekasi and Bogor Regency which are part of Greater Jakarta, called Jabodetabek (Jakarta, Bogor, Depok, Tangerang, and Bekasi), and the biggest metropolitan area in the country. Moreover, the three regions are the main part of the biggest industrial areas in Southeast Asia, called Jababeka (Jakarta, Bandung, Bekasi, Karawang). In these areas, there located major manufacturing industries, and thus it plays an important role as the pull factor for migrants to become factory worker or labor in these urban areas. For instance, in Bogor Regency, manufacturing industry has the biggest share to its GRDP, counted 61%. Meanwhile, in Karawang and Bekasi Regency, the shares of manufacturing industry to the regions' GRDP are 49% and 43% respectively in 2010. Moreover, Bogor, Karawang and Bekasi Regency are the major contributors in the term of GRDP of West Java Provinces.

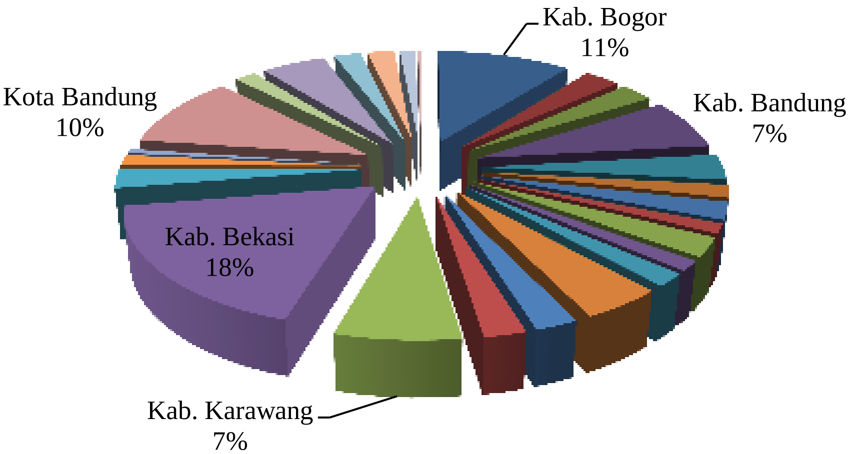

Figure 1 Share of GRDP per Region to Total GRDP in West Java Province, 2010

Another high-high correlation can be found in another West Java area, Bandung Regency which is part of Bandung Metropolitan Area, namely Bandung Raya (Bandung, Cimahi, and West Bandung). This metropolitan area ranked second largest metropolitan area in Indonesia. Bandung Regency is the second biggest contributor in GRDP to this metropolitan area, while the first comes from Bandung City (see Figure 3).Manufacturing industry contributes approximately 60% to its GRDP.

High-Low correlation is experienced in East Java area, specifically in Sidoarjo Regency. Sidoarjo Regency is the main buffer zone for Surabaya Cityand part of Surabaya Metropolitan Area or also named Gerbangkertosusila, the third largest metropolitan area in Indonesia. Gerbangkertosuila is an official acronym for Gresik, Bangkalan, Mojokerto, Surabaya, Sidoarjo, and Lamongan. Even though Sidoarjo is the smallest region in East Java Province, due to its location close to Surabaya, Indonesia's second largest city, as well as Tanjung Perak Port and Juanda Airport, the industrial sector in this region is growing rapidly. The growing industrial sector is in line with the number of in-migration to this district. Through the development of manufacturing industry in this region, Sidoarjo contributes the second largest to total GRDP in East Java Province. Therefore, the regency plays a significant role to the province's economy after Surabaya.

Nevertheless, there is no indication of spatial autocorrelation in Central Java migration. This may due to the scale of metropolitan area in this province which is not as big as Jabodetabek, Bandung Raya, and Gerbangkertosusila. Hence, the economic activities in the primary regions in Central Java are not as considerably large as in West Java and East Java to influence its neighboring regions to migrate to the urban areas. According to the local moran's I result, the migration pattern in Java is more likely to occur due to the economic role of the region and the contribution to the primary city in the sense of GRDP share. Figure

2 below shows that GRDP of Central Java has the least contribution compare to the other provinces. Therefore, this could be one of the reasons why there is no evident of the spatial autocorrelation of migration in Central Java.

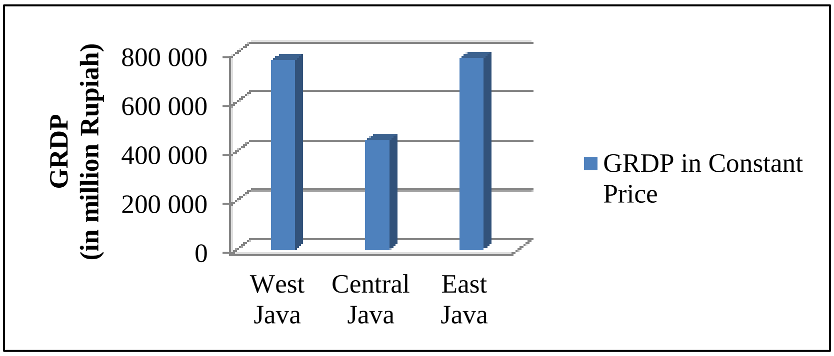

Figure 2 GRDP in Constant Price in Java, 2010

Through the spatial pattern of migration results, in can be concluded that so as to reduce the migration number to the urban areas concentrated in the industrial areas, it is necessary to encourage more balanced development other than Bekasi, Bogor, Bandung, Karawang, and Sidoarjo Regency, specifically by utilizing their local properties.

5.1.2.2 Spatial Econometrics Model of Migration

The descriptive statistics for migration equation is shown in the table 7 below:

Table V.5 Summary Statistics of Migration Model

Variable	Mean	Std. Deviation	N
Migration	9.3031	1.01391	79
Wage ratio	1.2909	.66054	79
Education urban	9.5279	.70156	79
Urbanization	2.3358	1.32460	79
Probability of getting urban job	4.4861	.03242	79
Industrial workers	10.0279	1.28869	79
Share of Industrial GRDP	2.5486	0.9790	79

Table V.6 Pearson Correlation in Migration Model

Variable	Correlation to Migration
Migration	1
Wage ratio	-0. 115
Education urban	0.883**
Urbanization	0.739**
Probability of getting urban job	-0.074
Industrial workers	0.848**
Share of Industrial GRDP	0.669**

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The Pearson correlation above provides the strength of linear relationship between each independent variable to the dependent variable (migration). It can be seen that from the result that variables which have strong correlation to migration respectively are education in urban, urbanization, industrial workers, and manufacturing GRDP. This exhibits that industry is strongly correlated with migration.

Table V.7 Migration Model by LS, SAR, SEM, SAC

Variable	OLS	SAR	SEM	SAC	VIF
Intercept	0.6927	-18.0177	-25.4485	-28.2222	
	(0.1100)	(-3.1801)***	(-3.5429)***	(-4.2216)***	
Wage ratio	0.2808	0.1911	0.1605	0.1827	2.476
	(2.7212)***	(2.2546)**	(1.9568)**	(2.3004)**	
Education urban	0.7717	0.8183	0.9143	0.8946	2.816
	(7.2470)***	(9.4674)***	(10.5200)***	(10.5285)***	
Urbanization	0.6852	0.5765	0.5537	0.5755	5.161
	(3.2602)***	(3.3649)***	(3.4096)***	(3.5421)***	
Probability of getting	-0.7896	2.5554	5.2285	4.7965	1.104
urban job	(-0.5717)	(2.1370)**	(3.2665)***	(3.2469)***	
Industrial workers	0.2166	0.1195	0.0379	0.0754	5.848
	(2.5928)***	(1.7499)*	(0.5601)	(1.1313)	
Share of Industrial	-0.0975	-0.0502	-0.0379	-0.0705	4.137
GRDP	(-1.0687)	(-0.6743)	(-0.5337)	(-0.9771)	
Rho		0.4949		0.4748	
		(5.9746)***		(5.9024)***	
Lambda			0.8250	0.6689	
			(10.4444)***	(9.3471)***	
R-squared	0.8613	0.8815	0.9037	0.9174	
Rbar-squared	0.8497	0.8716	0.8957	0.9105	
Log-likelihood		4.5229	2.6545	9.4000	
Sigma^2	0.1545	0.1015	0.0978	0.0839	
Durbin-Watson	1.1387				
Observations	79	79	79		79

* p<0.1, ** p<0.05, *** p<0.01

a) Dependent variable: Migration

According to the spatial regression result, it is vivid that in there is spatial autocorrelation in migration function. It can be seen from *rho* coefficient in spatial lag (SAR) model and *lambda* coefficient in spatial error (SEM) model. The spatial dependence test is significant in both models. Both parameters are significant at 1% level and the result confirms that the neighbor influence as well as locational factors is important. The result suggests that there exists spatial dependence between the migration numbers in neighboring districts. Thus, using OLS model would be biased and inconsistent. The OLS model ignores the spatial contiguity information whereas the spatial regression model would allow for this type of variation in the model. Moreover, taking the spatial variation into consideration improves the fit for the model, raising the Rbar-squared statistic for the SAR, SEM and SAC model. In OLS, the model only fits 85% while SAR fits roughly 87%, SEM fits 89%, and SAC fits 91%. This indicates that around 2% of the variation in the migration incidents is explained by spatial dependence and spatial heterogeneity explains 4% of the variation, while the mix of spatial dependence and heterogeneity is able to explain 6% of the variation.

In order to determine which spatial regression fits best to our migration model, it is necessary to investigate the existence of spatial correlation in the residuals of the SAR model. Lagrange Multiplier SAR (LMSAR) test based on the residuals from the SAR model can be used to examine whether inclusion of the spatial lag term eliminates spatial dependence in the residual form of the model (LeSage, 1998). The test result is as follows:

Table V.8 Lagrange Multiplier Test in SAR Model

LM Error Tests for Spatial Correlation in SAR Model Residuals	
LM Value	65.0945
Marginal Probability	0.0000
Chi (1) .01 Value	6.6350

Since the evidence of residual spatial autocorrelation was found, it suggests that the SAC model might be the most appropriate to further analyze the migration model. In addition, note that the log-likelihood function value is highest for the SAC model (9.4), so this would be evidence against the SAR (4.5) and SEM (2.6). Therefore, from hereafter, the migration analysis will be based on SAC model.

According to Anselin and Griffth (1998), neglecting the information regarding the spatial configuration of the data observation will produce different inferences that may lead to inappropriate model specification. In OLS model, industrial worker is statistically significant and probability of getting urban job is not. However, when spatial dependence problem is taking into account, the result shows otherwise. Furthermore, in OLS model, the migration number is more sensitive to wage ratio and urbanization, while the magnitude of education is less sensitive to the dependent variable.

The significance of spatial dependence and heterogeneity coefficient indicate that the neighborhood influence is significant. The migration incidence is significantly associated with the migration incidence in neighboring regencies given the spatial relationship. For instance, the wage ratio in Cianjur Regency affects the number of in migration to urban areas in Bogor Regency. It means that the explanatory variables in region *i* do have an impact on its neighboring region, say *j*, as they are spatially dependent.

The SAC estimation shows that the wage ratio is a positive function of migration and is significantly correlated at 1% level with the dependent variable. A 1% increase in wage differential between urban and rural areas would give rise to migration by 0.18%. This result is consistent with the hypothesis; migration is an economical decision when there is a higher expected income in urban areas. Thus, in order to withstand the migration flow to urban areas, one of the alternative ways is to increase agricultural output which will simultaneously increase agricultural wage. However, astonishingly, wage ratio appears to have the least elasticity effect towards migration compare to other independent variables such as human capital (education), urbanization, industrial workers, and probability of getting urban job. Therefore, even though wage discrepancy becomes one of important elements that determine migrant decision, this does not necessarily mean that wage is the only one that matters.

For human capital, a 1% increase in educational attainment in urban areas will increase migration number by 0.89%. Educational attainment of urban people plays an important role in migration decision. As urban people achieved higher education, it becomes a pull factor for rural people to migrate to urban areas. Pursuing higher educational attainment attract rural inhabitant because they want to get better and more promising jobs.

From the model, it reveals that human capital heavily influences migration flows to urban areas more than wage ratio. It indicates that skilled migration or human capital flight to urban areas becomes the one of the major concerns among migration pattern in Java. It may result in negative consequences of the loss of skilled human development in rural areas. The so-called 'brain drain' would enable rich (urban) area to freely attract skilled professionals from poorer (rural) areas that most need them. By draining the skilled human capital from rural areas, it can endanger development and create unfair or enlarge the disparity between both areas.

Urbanization is positively and significantly correlated at the 1% level with migration to urban areas. A 1% increase in urbanization will lower the cost of rural to urban migration, and the number of migration will increase 0.57%. It indicates that as the more urbanized a region, the more inhabitants will be attracted to the urban areas. As region becomes more urbanized and more people reside in urban areas, the number of contacts who live there will also increase. Therefore, urbanization can lower the cost of migration due to the fact that many rural people have contacts living in urban areas, and such contacts would facilitate migration. Moreover, since the cost of migration is lowered, the rural-urban migration rate could increase.

The probability of getting urban job is the most influential factor in migration decision in Java. This variable is statistically significant at 1% level. A 1% replenishment of the probability will escalate migration number by 4.8%. This is consistent with the assumption of migration phenomenon that migrant is more likely to move out to seek for a probability of urban job so as to increase their living level.

Astonishingly, the other variables related to industrial activity are not significant in spatial regression model. It indicates that migration decision in Java does not pretty much affected by the industrial factors such as the number of industrial workers and the share of industrial GRDP. Therefore, it can be concluded that wage differential and probability of getting job are more influential for migrant to decide whether or not they want to migrate. As long as urban areas can provide higher wage and wider job opportunities compare to in the rural areas, it will drive rural populace to escape to the more advantaged areas.

5.2 Reducing Migration: Indirect Agricultural Input Elasticity of Migration

In equation [6], the model estimates agricultural output elasticity to a set of various agricultural inputs. Meanwhile, equation [5] estimates agricultural per capita or income elasticity of rural-urban migration. Therefore, the indirect elasticity of rural-urban migration with respect to agricultural input can be computed through the recursive model [9] in the sense of SAC model of migration.

$$\begin{cases} \ln M = \rho W_1 + \alpha_0 + \alpha 1 \ln WR + \alpha_2 \ln Eu + \alpha_3 \ln U + \alpha_4 \ln \Pr + \alpha_5 \ln Iw + \alpha_6 \ln Sh + \lambda W_2 + e_t \\ \ln Ya = \beta_0 + \beta_1 \ln L + \beta_2 \ln La + \beta_3 \ln Li + \beta_4 \ln F + \beta_5 \ln T + \beta_6 \ln Er + e_t \end{cases} \qquad (9)$$

In order to see the impact of agricultural productivity on rural-urban migration, Goldsmith *et al* (2004) estimated the indirect agricultural input elasticity of migration ($E_{M,Xi}$). So as to calculate the indirect impact, they multiplied agricultural output of migration ($E_{M,WR}$) by the elasticity of agricultural output in response to agricultural input ($E_{Ya,Xi}$).

By referring to their study, the derivation of indirect elasticity ($E_{M,Xi}$) of migration (M) with respect to agricultural input (Xi) can be conducted as follows:

Given that migration is a function of wage ratio: M = f (WR), and wage ratio is a function of agricultural output: WR = g (Ya), and agricultural output is a function of agricultural input: Ya = h (Xi), then:

$$
\begin{aligned}
E_{M,Xi} &= \left\{\frac{dM}{dWR}\frac{dWR}{dYa}\frac{dYa}{dXi}\right\}\frac{Xi}{M} \\
&= \left\{\left(\frac{dM}{dWR}\frac{WR}{M}\right)\frac{M}{WR}\left(\frac{dWR}{dYa}\frac{Ya}{WR}\right)\frac{WR}{Ya}\left(\frac{dYa}{dXi}\frac{Xi}{Ya}\right)\frac{Ya}{Xi}\right\}\frac{Xi}{M} \\
&= \left\{\left(E_{M,WR}\frac{M}{WR}\right)E_{WR,Ya}\left(\frac{WR}{Ya}\right)\left(E_{Ya,Xi}\frac{Ya}{Xi}\right)\right\}\frac{Xi}{M} \\
&= (E_{M,WR})(E_{WR,Ya})(E_{Ya,Xi})\left(\frac{M}{WR}\frac{WR}{Ya}\frac{Ya}{Xi}\frac{Xi}{M}\right) \\
&= (E_{M,WR})(E_{WR,Ya})(E_{Ya,Xi})
\end{aligned}
$$

$$
WR = \left(\frac{Yu/Pu}{Ya/Pa}\right) = \left(\frac{Yu}{Ya}\frac{Pa}{Pu}\right)
$$

By assumption,

$$
E_{WR,Ya} = \left(\frac{dWR}{dYa}\frac{Ya}{WR}\right) = \left(\frac{d\left(\frac{Yu}{Ya}\frac{Pa}{Pu}\right)}{dYa}\right)\left(\frac{Ya}{\frac{Yu}{Ya}\frac{Pa}{Pu}}\right) = -1
$$

substituting -1 in equation $(E_{M,WR})(E_{WR,Ya})(E_{Ya,Xi})$, it follows that:

$E_{M,Xi}=(E_{M,WR})(-1)(E_{Ya,Xi})$

And thus,

$$E_{M,Xi}=-(E_{M,WR})(E_{Ya,Xi}) \qquad (10)$$

From the previous estimation, it is estimated that labor, fertilizer, livestock and land contribute significantly to agricultural output in the study area. By enhancing those agricultural inputs, it is expected to increase the output as well. Thus, these four variables are utilized to calculate the indirect input elasticity of migration.

Table V.9 Indirect Agricultural Input Elasticity of Migration

Agricultural Inputs	$(E_{Ya,Xi})$	$(E_{M,WR})$	$(E_{M,Xi})$
Labor	0.1884	0.1827	0.0344
Fertilizer	0.1993	0.1827	0.0364
Livestock	0.0719	0.1827	0.0131
Land	0.3453	0.1827	0.0631
Education rural	0.2250	0.1827	0.0411

By using the equation [10], the result shows that the indirect elasticity of rural-urban migration subject to labor is -0.034. This indicates that a 1% increase in agricultural labor would result in 0.034% decrease in migration to urban areas, keeping all other factors including population constant. So as to increase agricultural labor, creating adequate agricultural related job opportunity is important. In addition, there should be an incentive for rural people so that they are willing to tie up with agricultural sector, and it has to be higher than agricultural wage. By increasing the agricultural wage, it will increase the number of agricultural labor, boost agricultural output and eventually reduce migration to urban areas.

The indirect elasticity of rural-urban migration with respect to subsidized fertilizer is -0.036. It implies that a 1% increase in subsidizing fertilizer in the region would affect migration to decrease by 0. 036%. According to World Bank (2009), subsidized fertilizer can increase farmers' capital or asset, suppress distribution price, increase farmers' productivity and enhance farmers' income. However, subsidized fertilizer should be accurately and evenly distributed among each farmer and region. There are several cases where wealthy farmers with larger agricultural land receive more subsidized fertilizer than poor and less spacious farmers because farmers with larger land use more fertilizer.

Livestock variable appears to have the slightest indirect elasticity to migration. A 1% increase in livestock will have impact on declining migration by 0.01%. Aside from having considerably small numbers in reducing migration, livestock also has the least contribution to increase agricultural output compare to other variables. Thus, increasing or adding the number of domestic animals so as to reduce migration number to urban areas seems does not have significant effect.

As for agricultural land, it has the biggest impact to reduce migration to urban areas. A 1% increase in agricultural land would result in 0.06% decrease in rural-urban migration. However, because agricultural land in Java is limited and supply of land is fixed, reducing rural-urban migration through land extensification in the long-term may not be possible. Thus, land intensification is more preferred in this area. In this sense, improving the utilization of existing agricultural land and enhancing its productivity becomes crucial to reduce migration to urban areas in the regions. However, one should be discreet and more concern for the smallholders in utilizing agricultural land. White (1978) stated that in Javanese agriculture, instead of reducing migration, agricultural modernization has been found to stimulate migration to urban areas, particularly for smallholder farmers. It occurs because green revolution is only benefiting farmers who have extensive land in receiving technology (capital intensive). Thus, it gives rise to social polarization in rural inhabitants causing many rural people leave rural areas due to the limited agricultural job opportunity.

For the impact of education in rural areas, a 1% increase in rural people education will reduce the migration to urban areas by 0.04%. Nevertheless, pursuing higher education is kind of problematic for rural people. At one side, better educated rural inhabitant will have a chance to increase agricultural output. On the other side, education can also be a potential factor to enter urban areas. Thus, for keeping rural people to develop agricultural productivity in rural areas, it has to be the case in which there is sufficient agricultural related job opportunity. By doing so, rural people are willing to attach to agricultural sector and promote it. If there is lack of agricultural related job opportunity in the rural areas, for instance due to limited agricultural land, rural people will choose to enter urban areas. Therefore, utilizing agricultural land, upgrading rural services and facilities, and creating sufficient and promising jobs in rural areas are inevitably necessary to withstand migration flow to urban areas.

CHAPTER VI

CONCLUSION

The focus of this paper is to estimate the indirect agricultural input elasticity of migration to urban areas by bearing spatial dependence in mind. Although the presence of spatial dependence is ubiquitous, it has been largely overlooked in migration analysis. In this study, the existence of spatial autocorrelation does matter in the analysis of migration in 79 districts in Java, Indonesia for 2010. By taking spatial dependence into account, it affects the significance of independent variables, the goodness of fit and the sensitivity of the magnitude of the parameter. It concludes that the migration number to urban areas in one region is affected by the performance of wage ratio, urbanization rate, human capital, and probability of getting urban job in its neighboring areas. Thus, reducing the wage ratio or minimizing the gap in one region can influence the migration flow in the neighboring regions. Even though the hypothesis that migration is a function of wage differential is proven, this variable has the least influence to migration decision in Java compare to the other exogenous variables.

Probability of getting urban job is the most influential variable in migration decision in Java. Seeing this, migrant is more likely to move to urban areas as they see the opportunity of getting urban job will raise their living level because agricultural job in rural areas is not a promising one. Therefore, government can have two policy options: creating more urban job or ameliorate agricultural related job in rural areas to ease the migration to urban areas as well as diminish the negative impacts caused by the phenomenon.

Migration propensity in Java is heavily influenced by human capital factor which amplifies the brain drain phenomenon of migration in the country rather than demographic problem. Responding to this, policy makers should be encouraged to put more concern on initiatives intended on preventing human capital flight in the more backward regions. Here, improving agricultural productivity targeted in key areas can make a good contribution to reduce the human capital flight due to rural-urban migration and confine the expansion of urbanization. By means of improving agricultural productivity, it is expected that the urban-rural income differentials can be minimized, and thus the number of migration can be reduced eventually. Respectively, the estimation suggests that utilizing 1% agricultural land and enhancing its productivity would expect to reduce rural-urban migration by 0.06%, increasing 1% educational attainment of rural populace will reduce 0.04% migration, and increasing 1% fertilizer use and agricultural labor will restrain migration by 0.036% and 0.034% severally. By way of increasing these agricultural inputs, it would expect to increase agricultural output, boost rural income, and hence narrow the wage differential between urban and rural area. However, to lessen the bias of benefiter of such agricultural development policy, it should be implemented and distributed evenly to all types of farmers, particularly to the smallholders. To support the policies, upgrading rural services and facilities, and creating sufficient and promising jobs in rural areas are inevitably important to withstand migration flow to urban areas.

Due to the spatial dependence effect, reducing the wage ratio or minimizing the gap in one region can influence the migration flow in the other regions. Therefore, the policy to promote agricultural productivity should be concentrated in the regions other than the heavy industrial areas in Bekasi, Bogor, Bandung, Karawang and Sidoarjo Regency. Through focusing the rural development in the more disadvantaged economy regions, it would expect to raise their rural income, and thus lessen their motivation to migrate to urban areas. By minimizing the income disparities between urban and rural labor, it could reduce the migration flow to urban areas. Reducing the rural-urban income differential may be a strong policy instrument to control the pace of urbanization caused by rural-urban migration (Zhang and Song, 2003). Since migrants respond significantly to rural-urban income disparity, minimizing the imbalances between rural and urban economic opportunities is fundamentally substantial. Nevertheless, one should be aware that this response depends on how successful the effects of agricultural investment can boost the production and hence reduce the wage differential. Also, the investment has to be taken into account conscientiously in order to increase the agricultural output. If the investment fails to boost production, the effect could be the case that the increase in agricultural investment does not necessarily result in increase in agricultural output due to many shortcomings.

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