INSTITUTE OF DEVELOPING ECONOMIES

IDE Discussion Papers are preliminary materials circulated
to stimulate discussions and critical comments

IDE DISCUSSION PAPER No. 186

Is South Sulawesi a Center of Growth in Eastern Indonesia? : Japanese ODA Strategy Revisited

Kazushi TAKAHASHI*

March 2009

Abstract

Japanese ODA, especially that undertaken by JICA, has targeted South Sulawesi Province as a core area of development in eastern Indonesia, with hope that the economic growth of South Sulawesi will bring about spillover effects in other regions. This paper tests the validity of the strategy using a framework of Vector Autoregressive model. The results show that South Sulawesi's economy Granger causes other regions in eastern Indonesia, but not vice versa, implying that South Sulawesi drives the development of other regions in eastern Indonesia. Further analysis shows that the development of the agricultural sector in South Sulawesi potentially has the highest spillover effects than other sectors and that the magnitude of spillover effect from South Sulawesi on eastern Indonesia is higher than other economically important regions, such as Eastern Java and Kalimantan.

Keywords: Spillover Effect; Vector Autoregressive; Regional Disparity; Indonesia
JEL classification: O10; R11; R12

---

* Research Fellow, IDE

The Institute of Developing Economies (IDE) is a semigovernmental, nonpartisan, nonprofit research institute, founded in 1958. The Institute merged with the Japan External Trade Organization (JETRO) on July 1, 1998. The Institute conducts basic and comprehensive studies on economic and related affairs in all developing countries and regions, including Asia, the Middle East, Africa, Latin America, Oceania, and Eastern Europe.

INSTITUTE OF DEVELOPING ECONOMIES (IDE), JETRO
3-2-2, WAKABA, MIHAMA-KU, CHIBA-SHI
CHIBA 261-8545, JAPAN

1. Introduction

Prior to the Asian financial crisis in 1997, the Indonesian economy had achieved an impressive level of progress. The annual GDP growth rate was as high as 5% in the 1970s and accelerated to 6% to 8% from the late 1980s to the early 1990s. In parallel with the country's remarkable economic growth, the poverty ratio decreased substantially, from 40% to 11%, between 1977 and 1997. While this outstanding economic performance is worthy of the label "East Asian Miracle" at the national level, regional disparities remained during that period. In particular, eastern Indonesia, including Sulawesi, Maluku, Papua, and Nusa Tenggara, has long lagged behind western Indonesia, especially Java. Given such conditions, the President Suharto stressed the importance of development in eastern Indonesia in a speech in 1990. In 1993, acceleration of development in eastern Indonesia was explicitly included in the five-year national development plan. Since then, balanced growth between the eastern and western regions of the country has become one of the major policy concerns of the Indonesian government.

In line with Indonesia's development policy, more Japanese aid has been allocated to eastern Indonesia since the 1990s. After 1997, the Japanese general account budget for official development assistance (ODA) begun to decline, and in the allocation of aid budgets, a "selection and concentration" strategy became increasingly important. Accordingly, Japanese aid agencies, especially Japan International Cooperation Agency (JICA), placed heavier emphasis on eastern Indonesia than ever before. South Sulawesi Province (*Sulsel*) was selected as a core area for aid in eastern Indonesia, and many projects have been implemented there. According to JICA, the rationale behind targeting *Sulsel* is as follows: (1) *Sulsel* can reduce poverty and also catch up with western Indonesia, especially Java, through Japan's assistance; (2) given that *Sulsel* functions as a center of transportation and distribution network in eastern Indonesia, the positive impact of economic development in *Sulsel* can be expected to spill over to the surrounding regions, including other provinces in Sulawesi, and other regions in eastern Indonesia, including Maluku and Papua; and (3) a variety of sector-based aid projects have been implemented in *Sulsel*. Provided that these projects are properly linked with each other, a multiplier effect will emerge, which in turn will positively affect the economy of eastern Indonesia as a whole.

While there is little doubt that Japanese aid can potentially contribute to poverty reduction in *Sulsel* as stated in (1), what is less obvious is whether the growth of *Sulsel* will have a positive impact on other regions as described in (2) and (3). It is possible that intensive assistance to *Sulsel* will not generate any spillover effect but will solely benefit *Sulsel*, resulting in the widening of regional gaps within eastern Indonesia. Obviously, such a result is undesirable and is to be avoided. In order to verify the validity of the Japanese aid strategy in Indonesia, therefore, a rigorous study on regional development is required.

A major objective of this study is to evaluate whether the current direction of Japanese aid is promising or not. Toward this goal, this study first explores whether there is actually a spillover effect from *Sulsel* to other regions in eastern Indonesia based on the Vector Autoregressive approach. Then, we compare possible spillover effects by sector origin, i.e., agriculture, industry, and service, in order to identify effective means for maximizing the growth of *Sulsel* and the spillover effects from *Sulsel*, if any. Finally, we investigate whether the magnitude of the spillover effects to eastern Indonesia as a whole is higher from *Sulsel* than from other regions, such as Surabaya and Kalimantan where economic linkages with eastern Indonesia are tight.

The remainder of this paper is organized as follows. Section 2 briefly explains the framework of the Vector Autoregressive approach and introduces the data sources. Section 3 discusses the results, and based on the findings, Section 4 presents the policy implications for Japanese ODA in Indonesia.

2. Model and Methodology

Literature

This study uses the Vector Autoregressive (hereinafter referred to as VAR) model to examine the impact of economic growth in *Sulsel* on other regions. A similar approach has been undertaken in the existing literature, including Cromwell (1992) and Groenewold *et al.* (2004). Cromwell (1992) applied the VAR model using employment data from 1947 to 1991 in the US. He found that the development of California significantly affected the development of neighboring regions and concluded that growth in California drives growth in the western US. Groenewold *et al.* (2004) used data on GRDPs in China from 1953 to 2003 to examine whether the growth of the coastal regions spilled over to other regions. Their results showed that the growth of the coastal region spilled over to both the central region and the western region, but the reverse was not the case. They also found that the spillover effects persisted for approximately four years and that the magnitude of impact from the coastal region was stronger in the central region than in the western region because of geographical proximity. In this way, VAR analyses allow us to identify the degree, direction, and length of spillover effects.

VAR Model

Following the existing literature, this paper uses the VAR model to examine the dynamic relationship between *Sulsel* and other provinces in eastern Indonesia. To represent the economy in each region, we employ the Gross Regional Domestic Product (GRDP) at the provincial level. In addition, for convenience's sake, eastern Indonesia is divided into the following three regions: (1) South Sulawesi Province (also referred to as "*Sulsel*" or "SS"), (2) Other provinces in Sulawesi (referred to as "OS"), and (3) Maluku and North Maluku provinces (referred to as "MLK").[1]

The VAR model employs a system of linear equations to capture the dynamic feedback relationships between two or more endogenous variables. Formally, let x_t be the GRDP of SS in year *t*, let y_t be the GRDP of OS in year *t*, and let z_t be the GRDP of MLK in year *t*. The VAR model can be expressed as:

$$x_t = \sum_k a_k x_{t-k} + \sum_k b_k y_{t-k} + \sum_z c_k z_{t-k} + u_{xt}, \qquad (1)$$

$$y_t = \sum_k d_k x_{t-k} + \sum_k e_k y_{t-k} + \sum_z f_k z_{t-k} + u_{xt}, \qquad (2)$$

$$z_t = \sum_k g_k x_{t-k} + \sum_k h_k y_{t-k} + \sum_z i_k z_{t-k} + u_{zt}, \qquad (3)$$

where *a* to *i* are parameters to be estimated and *u*'s are white noise series. As shown, only lagged values of the endogenous variables are used for the right-hand side of the equations. Therefore, simultaneity is not an issue and OLS gives consistent estimates.

The first step in VAR analysis is to determine the appropriate number of lags to be

---

[1] While eastern Indonesia covers not only Sulawesi and Maluku but also Kalimantan, Nusa Tenggara, and Papua, this study focuses only on Sulawesi and Maluku based on interviews with JICA staff. The results presented in this paper are robust when the definition of "eastern" is changed to include Kalimantan, Nusa Tenggara, and Papua.

included in the equations above. Following Akaike's Information Criteria (AIC), it was decided to include one time lag. Also, an Augmented Dicky-Fuller test was conducted to check if each variable is stationary, and it was found that the log GRDPs of SS, OS, and MLK are not stationary. Therefore, the first difference of each variable is used in the analyses below.

The next step in VAR analysis is to conduct a Granger causality test, impulse response functions (IRF), and variance decompositions (FVD). Granger causality statistics examine whether the lagged values of independent variables help to predict the dependent variable. In equation (1), for instance, if the coefficient of b is statistically significant, we say that the OS Granger causes SS. In this case, since the economy of OS has predictive power over the economy of SS, it can be interpreted that the economic development of OS causes the economic development of SS, or that there is a spillover effect from OS to SS. Hence, the granger causality test is especially useful for determining the direction of spillover effects among the three indentified geographical regions above.

In addition, the impulse response function (IRF) is used to show the percentage of change in the output when there is a one percent (or one standard deviation) error shock in the output at own and other regions. The IRF can also show when spillover effects first arise as well as how long they persist. To simulate this, equations (1) to (3) are converted into a vector moving average representation, and furthermore, shocks are transformed into an orthogonal form using Choleski decomposition which allows us to derive the orthogonalized impulse response functions (for details, see Sims, 1980).

A similar transformation process is conducted for Vector decompositions (FVD), which enable us to identify the relative percent contributions of forecast errors attributed to shocks in own and other regions.

Data Source

The analyses in this paper rely on GRDP at the provincial level from 1977 to 2003. The data are derived from the Statistical Yearbook of Indonesia, published annually by Indonesia's Central Statistical Office.

Let us first overview the economy of each region. Figure 1 illustrates the natural log of real GRDP for SS, OS, and MLK. It is shown that the real GRDP of SS completely dominates those of the other two regions in terms of size. With respect to the growth rate, the three regions show a similar trend. More specifically, they achieved high growth beginning in the early 1980s, then stagnated for nearly four years in the late 1990s due to the effect of the Asian financial crisis, and subsequently rebounded starting in the early 2000s.

3. Results

Granger Causality Test

Table 1 presents the result of the Granger causality test on SS, OS, and MLK. The number in each cell indicates chi-squared statistics under the null hypothesis that the row region does not Granger cause the column region. It is clear from the test statistics that the GRDP of SS has a statistical Granger causality on the GRDP of OS at the 10% significance level and on the GRDP of MLK at the 1% significance level, indicating that there is a high possibility that SS has a spillover effect on these two regions. Importantly, the reverse is not true. It can be found that neither the GRDP of OS nor the GRDP of

MLK Granger causes the GRDP of SS. Besides, the GRDP of OS has a statistically significant explanatory power for the GRDP of MLK at the 5% level. These findings suggest that the economic development of SS will not only directly cause the economic development of OS and MLK, but will also indirectly cause that of MLK through the effect of OS. Thus, it seems reasonable to say that SS drives eastern Indonesia and that assistance to SS will benefit the other two regions as well.

IRF and FVD

The next questions to be addressed are the timing and the degree of the spillover effects from SS to the other two regions, which are illustrated in Figure 2.

The horizontal axis measures the timing (year) at which spillover effects appear, whereas the vertical axis measures the percent changes in the GRDPs of SS, OS, and MLK, respectively, when there is a one percent error shock in the GRDP of SS.

It is evident that a positive shock to the GRDP of SS has the largest effect on SS itself in the very short run; a 1% shock in the GRDP of SS increases the GRDP of SS in the next year by almost 1%. However, its effect gradually decreases over time. On the other hand, a 1% shock in the GRDP of SS causes growth at a rate of 0.7% in the next year and 1.2% two years later in MLK. The corresponding figures for OS are 0.4% in the next year and 0.5% two years later. Interestingly, the effects of a positive shock to the GRDP of SS bring about a larger benefit to the other two regions than own region from three years later. Also, it is noteworthy that such positive spillover effects persist for almost ten years and converge to zero afterwards.

Table 2 shows the result of FVD for OS and MLK. It is shown that the GRDP of OS accounts for about 87% of its own forecast error variance in the first year. However, the relative importance of own economy significantly decreases to 74% two years later and further to 69.5% eight years later. In place of own GRDP, the relative importance of SS steadily increases from 12.6% in the first year to 27.6% seven years later. Similar trends hold true for MLK. In this case, the GRDP of SS accounts for about 25% of the forecast error variance of MLK in the first year, and it jumps to 46% two years later.

In sum, we found (a) that the flow of spillovers is from SS to OS and MLK and from OS to MLK with the little reverse effect, (b) that a 1% shock in the GRDP of SS will lead to 0.5% growth in OS and 1.2% growth in MLK in two years, and (c) that positive spillover effects from SS to the other two regions will persist for almost ten years. These results suggest that *Sulsel* actually plays a leading role in the development of eastern Indonesia.

Extension of Analysis

From the analyses discussed so far, we found that the development of *Sulsel* highly likely benefits eastern Indonesia. In this sub-section, we explore (1) which sector of development has highest potential in terms of spillover effects, and (2) whether the spillover effects from *Sulsel* are greater than those from East Java and Kalimantan. For the sake of brevity, this sub-section specifically focuses on the Granger causality test and IRF.

Sectoral Linkages

In order to compare spillover effects by industrial sectors, we divide the GRDP of SS into the three components of a) agriculture, b) industry, and c) service sectors.

Table 3 reports the result of a Granger causality test. According to the table, the agricultural sector of SS has statistically significant granger causality on both OS and MLK. In contrast, the industrial sector has no impact on OS, but has a significant impact on MLK. Finally, the service sector has no significant impact on OS or MLK. Therefore, it can be said that assistance for the agricultural sector or the agri-based industry in SS will produce the greatest effects from the perspective of spillover effects.

In Figures 3 and 4, we present the impulse response of OS and MLK to a 1% shock to the GRDP of each sector in SS. We only present the impulse response of sectors which have statistically significant granger causalities.

Figure 3 reveals that a one percent shock in the GRDP of the agricultural sector in SS brings about the largest peak effects to OS two years later and results in approximately 0.4% higher growth in OS, while Figure 4 shows that a one percent shock in the GRDP of the agricultural sector has a larger impact on the economy of MLK compared with the same shock in the industrial sector in SS. The latter result seems plausible because the agricultural sector plays a more important role in SS than the industrial sector. The magnitude is also impressive. If the GRDP of agriculture in SS increases by 1%, the GRDP of MLK will increase by 0.8% two years later. Moreover, it is shown in Figures 3 and 4 that the inter-regional spillover effects do not dampen to zero for ten years.

Judging from these analyses, it seems to be quite effective for Japanese ODA to support agricultural development in SS.

Comparison of spillover effects across regions

Before concluding this study, we compare the magnitudes of the spillover effects among SS, East Jawa (EJ) and Kalimantan (KAL). A major motivation behind this analysis is to check whether the largest spillover effects on eastern Indonesia are from SS. To put it differently, we are concerned that if economic linkages between eastern Indonesia and other regions, such as EJ and KAL, are stronger than those between eastern Indonesia and SS, Japanese ODA would be more effective for promoting development in eastern Indonesia as a whole if it were channeled to EJ or KAL. As a comparison group, we selected EJ and KAL because of their geographical proximity to eastern Indonesia, including SS, OS, and MLK.

The results of a Granger causality test and impulse response functions are presented in Table 4 and Figures 5 and 6. Table 4 clearly shows that both EJ and KAL have Granger causal effects on OS and MLK, and all the statistical significance levels are as high as 1%, implying that there is a quite high probability of growth spillovers from EJ and KAL.

The interpretation of the magnitudes illustrated in Figures 5 and 6 is somewhat cumbersome mainly because there seems to be no clear trend. For example, the GRDP of SS has the largest impact on the GRDP of OS in the short period, but its position is replaced by the GRDP of EJ from two to four years later, and further replaced by the GRDP of KAL in the medium period. In the long period, the GRDP of EJ again has the largest impact on the GRDP of OS. A similar story applies to MLK. Different spillover effects are observed across regions at different periods.

To obtain a more concrete idea, therefore, we sum up the magnitudes of the response in each period to yield an accumulated response, which is reported in Figures 7 and 8.

There are several interesting findings. First, while the impact from SS is monotonically increasing for both OS and MLK for up to ten years, the impact from EJ is more cyclic and peaks in around 4 to 5 years. With respect to KAL, there is no such clear trend. Second, OS is affected most by SS on a 15-year average, but if the number of observation years is limited to the short to medium term (4 to 6 years), OS is affected most by EJ. On the other hand, KAL received a similar impact from EJ and SS in the short term (1 to 2 years), but after that it is affected most by SS throughout. In total, SS has a longer lead in its spillover effects on KAL than the other two regions have.

These results show that SS does not always deliver the maximum spillover benefits to OS and MLK. In particular, development of EJ would be more economically efficient in the short to medium terms for causing spillovers. However, more importantly, we should concentrate on the fact that the average spillovers over the long run are the largest from SS to both OS and MLK. In addition, considering that the development of SS is highly likely to trigger the development of MLK, which is the poorest region in eastern Indonesia, it seems most relevant to focus on assistance to SS rather than to EJ or KAL in order to facilitate the development of eastern Indonesia.

A remaining question is whether concentration of assistance on SS is more efficient than region-wide assistance that includes EJ and KAL. A Granger causality test among SS, EJ, and KAL in Table 5 gives some insight. It shows that SS, EJ, and KAL are all interdependent with each other at the 1% statistical significance level. This indicates that economic growth of SS facilitates the growth of EJ and KAL, which in turn facilitate the growth of SS. This result may imply that strengthening inter-regional trade linkages among SS, EJ, and KAL, by such means as construction of infrastructure, will further benefit eastern Indonesia.

4. Conclusion

By dividing eastern Indonesia into SS, OS, and MLK, this paper investigates (1) to what extent, if any, the growth of *Sulsel* affects the economy of eastern Indonesia, (2) which sector of development offers the highest potentials in terms of spillover effects, and (3) whether the spillover effects of *Sulsel* are greater than those of East Java and Kalimantan. In the analyses, we employ a framework of the VAR model with emphases placed on the Granger causality test and the impulse response function.

Our major findings are as follows. First, we found a significant Granger causality from SS to OS and MLK, which suggest that SS drives the economy of eastern Indonesia. Second, positive spillovers from SS to the other two regions will remain for about 10 years. Third, the agricultural development of SS displays the highest potential in terms of spillovers. Last, but not least, the average spillover effects of SS are greatest among SS, EJ, and KAL, but if we focus on the short to medium terms, the spillover effects of EJ are the highest.

Contemporary Japanese ODA projects are intensified in SS with the expectation that the development of SS leads to the development of eastern Indonesia. The findings of this study support this aid strategy. That is, if the economic growth of SS is facilitated by Japanese ODA, the benefits will accrue not only to SS itself, but also to OS and MLK. To maximize such spillover effects, strengthening inter-regional linkages across SS, EJ, and KAL will be very effective.

Acknowledgements

This paper is a revised version of the research report submitted to the Japan International Cooperation Agency (JICA), entitled "Program Evaluation Study for Development of Eastern Indonesia (Economic Analysis)." I would like to thank Mr. Nobuhiko Hanazato (Deputy Resident Representative, JICA Indonesia Office) and Mr.

Hideharu Tachibana (Senior Program Advisor, JICA Makassar Field Office) for their invaluable comments on the earlier version of this paper. I cordially acknowledge the data collection and various types of support in the field survey provided by Ms. Ida Gosal. The views expressed herein do not represent those of JICA or JETRO-IDE, and any errors are solely the responsibility of the author.

Reference

Cromwell, A.B. (1992). "Does California Drive the West? An Econometric Investigation of Regional Spillovers", Federal Reserve Bank of San Francisco *Economic Review*, 2, pp.15-25.

Groenewold, N., Lee, G., and Chen.A.（2004）. "Regional Output Spillovers in China: Estimates from a VAR Model." mimeo.

Sims, C. (1980). "Macroeconomics and Reality," *Econometrica*, 48(1): pp1-48.

Table 1. Granger Causality

	SS	OS	MLK
SS	-	3.56*	11.8***
OS	0.25	-	4.43**
MLK	1.15	0.37	-

(Note) ***, **, * are significant at 1%, 5%, and 10% level, respectively.

Table 2. Variance Decomposition of OS and MLK Output

Year	OS			MLK		
	% of Forecast Error due to Innovations in					
	SS	OS	MLK	SS	OS	MLK
1	12.6	87.4	0.0	24.7	11.8	63.6
2	24.3	74.1	1.6	46.4	11.0	42.5
3	26.1	71.6	2.3	49.4	10.0	40.6
4	27.1	70.3	2.6	50.8	9.5	39.6
5	27.4	69.8	2.8	51.3	9.4	39.3
6	27.5	69.6	2.8	51.5	9.3	39.2
7	27.6	69.6	2.8	51.6	9.3	39.1
8	27.6	69.5	2.8	51.6	9.3	39.1
9	27.6	69.5	2.8	51.6	9.3	39.1
10	27.6	69.5	2.8	51.7	9.3	39.1
15	27.6	69.5	2.8	51.7	9.3	39.1

Table 3. Granger Causality Test by Economic Sector in SS

	OS	MLK
SS_AGRI	3.75*	5.54**
SS_IND	0.00	3.11*
SS_SER	0.45	1.09

(Note) ***, **, * are significant at 1%, 5%, and 10% level, respectively.

Table 4. Granger Causality Test by Regions

	OS	MLK
EJ	87.12***	17.21***
KAL	198.34***	55.40***

(Note) ***, **, * are significant at 1%, 5%, and 10% level, respectively.

Table 5. Granger Causality

	SS	EJ	KAL
SS	-	83.2***	254.9***
EJ	41.0***	-	313.8***
KAL	48.6***	85.5***	-

(Note) ***, **, * are significant at 1%, 5%, and 10% level, respectively.

Figure 1. Natural Log of Real GRDP, 1979-2003

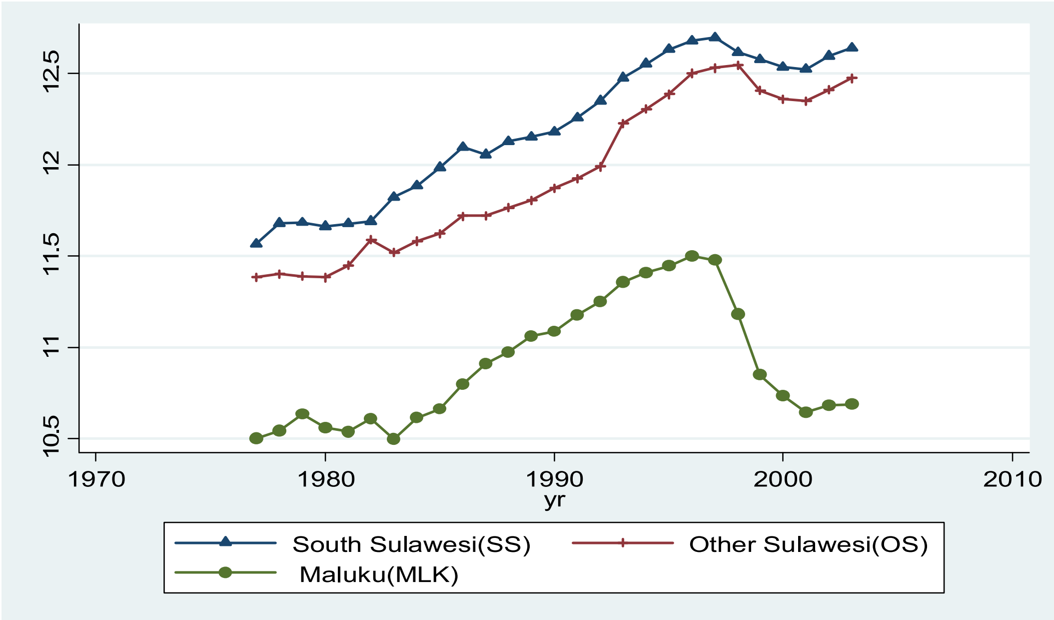

Figure 2. Response of SS, OS, and MLK to 1%. Shock of SS

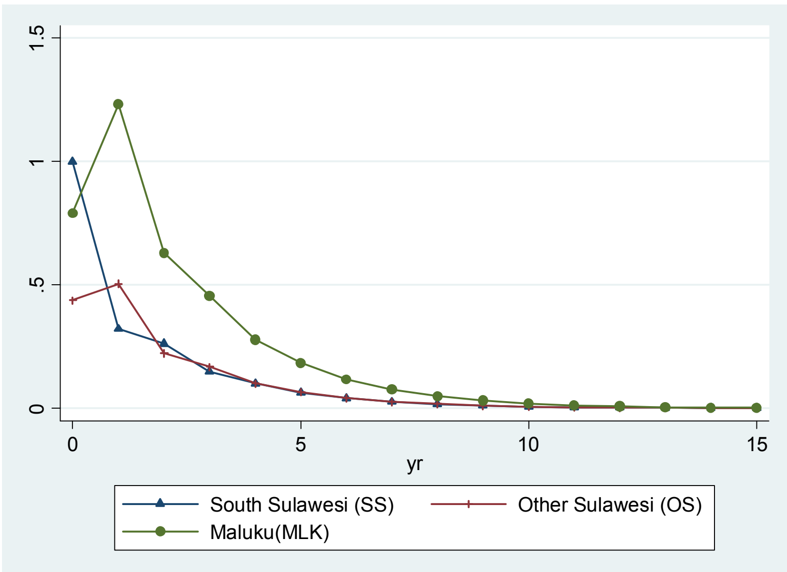

Figure 3. Response of OS to 1% shock to Agriculture in SS

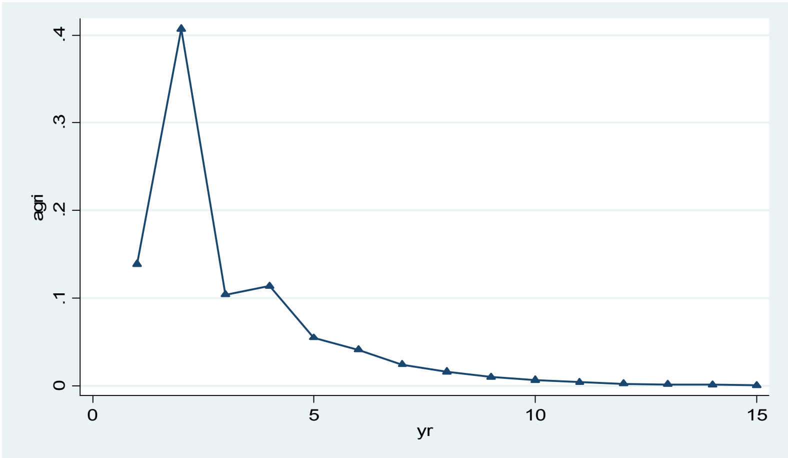

Figure 4. Response of MLK to 1% shocks to Agriculture and Industry Sector in SS

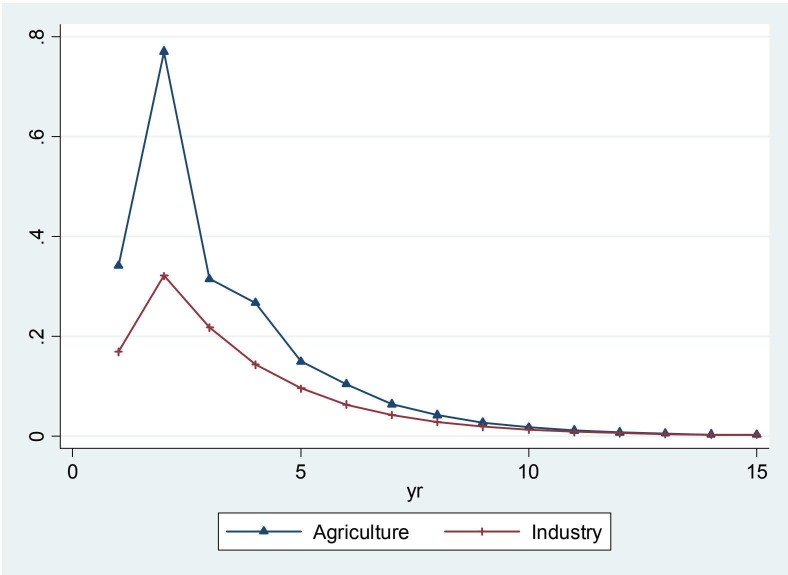

Figure5. Response of OS to 1% shocks to SS, EJ, and KAL

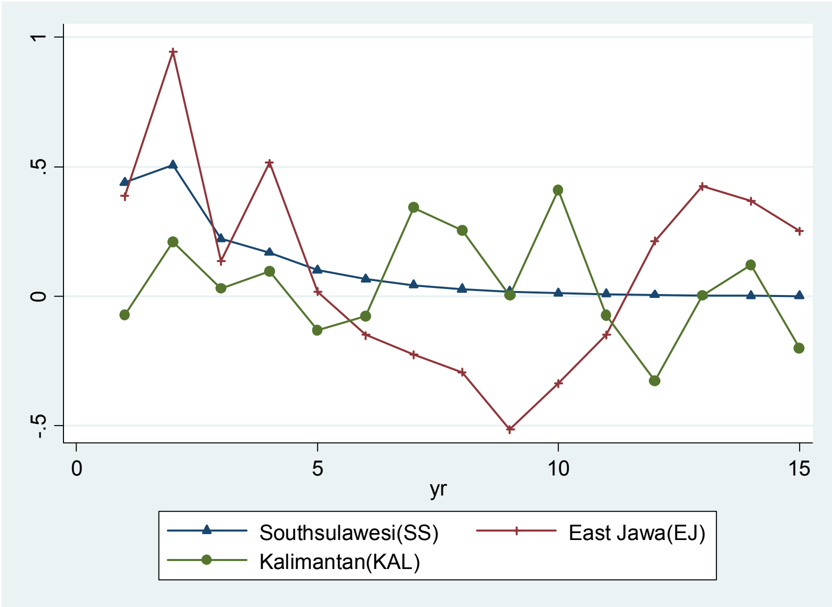

Figure 6. Response of MLK to 1 % shocks to SS, EJ, and KAL

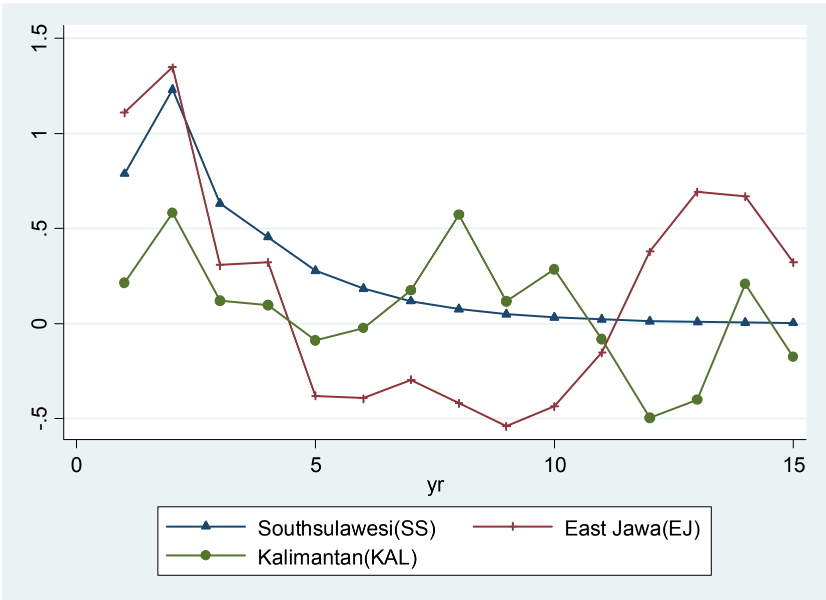

Figure 7. Accumulated Response of OS to 1% shocks to SS, EJ, and KAL

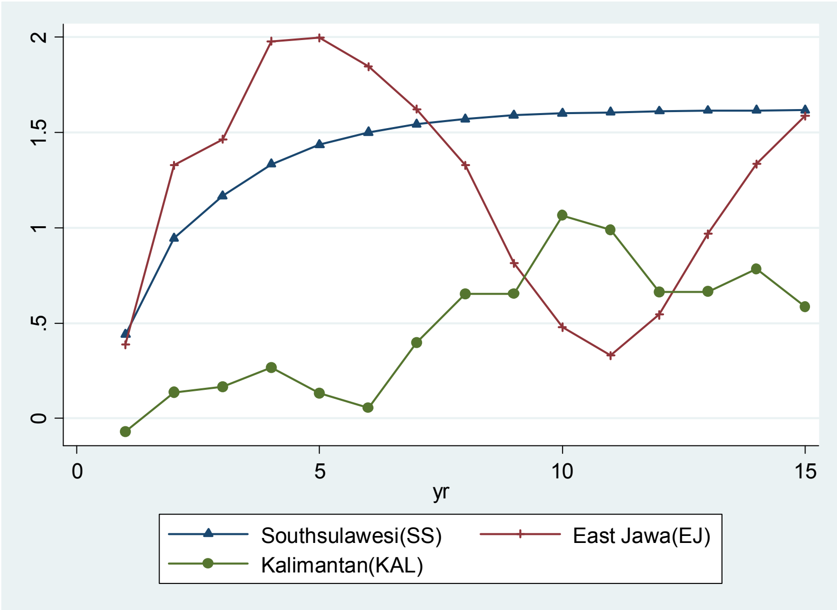

Figure 8. Accumulated Response of MLK to 1 % shocks to SS, EJ, and KAL