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U N S F I R
United Nations Support Facility for Indonesian Recovery

DOES THE RELATIVE IMPORTANCE OF AGRICULTURE INCREASE AFTER THE ASIAN FINANCIAL CRISIS?

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Abstract

It is found that the short-term contribution of agricultural growth to economic growth at national level increases from 31 percent in 1996 to 48 percent in 1999, whereas that of industrial sector decreases from 36 to 23 percent for the same years. This pattern of change also takes place in most provinces, except in some provinces in the East Part of Indonesia, particularly in Kalimantan, Central and South Sulawesi, and Maluku, whereby growth contributions of both agricultural and industrial sectors to economic growth raise. Prior to the crisis, all provinces having 'high' growth contributions in both sectors are of West Part of the country. This, however, does no longer hold after the crisis. It is also found that the increase in the short-term contribution of agricultural growth to the nation economic growth comes with highest proportion from growth in forestry, output of which may have been partly obtained from extracting (non-cultivating) activities. There is evidence that the current share of agriculture on GDP is higher than its long run counterpart, which is 11 percent, suggesting that, unless sufficient efforts are to be made to improve agricultural technology and to overcome its supply bottlenecks, the relative importance of agricultural sector will inevitably decrease significantly. In addition to such efforts, this study also suggests that it is necessary to establish and secure strong linkages between agriculture and manufacturing and trade sectors.

About UNSFIR

The United Nations Support Facility for Indonesian Recovery (UNSFIR) is a project established by the government of Indonesia and the UNDP to stimulate examination of policy options for the country at an important point in the country's development. The work aims to engender wide public discussion of the issues involved in order to build a new social political consensus for effective and lasting policy implementation.

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1. Introduction

1.1. Background

It is mentioned, for instance, in Banerjee and Siregar (2002) that agriculture can be regarded as the leading sector for Indonesia. The importance of this sector is reflected for instance by its output contribution to GDP. As can be seen from Table 1, the shares of Indonesian agricultural output is relatively high compared to other ASEAN countries, i.e. Malaysia and Thailand, putting the relatively higher relevance of this sector in developing the economy. Although manufacturing sector has even higher shares to GDP than agriculture does, the latter remains the most important one in terms of providing employment. The sector is also commonly known as to provide surpluses that help other sectors, particularly manufactures, to grow. As the economy relies considerably on agriculture, fluctuations in this sector would thus lead to variability in output of other sectors and hence in the economy.

Table 1: Share on GDP of Agricultural and Manufacturing Sectors in Indonesia, Malaysia and Thailand (%)

	Agriculture				Manufacture			
Country	1996	1997	1998	1999	1996	1997	1998	1999
Indonesia	15.4	14.9	16.9	17.2	24.7	24.8	25.3	26.1
Malaysia	9.6	8.9	9.1	8.7	28.6	29.0	26.5	28.5
Thailand	10.6	10.7	11.6	11.4	31.5	32.4	32.2	34.6

Source: BPS for Indonesia and Statistical Appendix to 2001 Country Report for Each of the other two countries.

An important source of fluctuations in the economy recently is the 1997 Asian Financial Crisis (AFC). Following the crisis, output of most economic sectors of the Indonesian economy decreased in the year after.[1] Trade sector GDP decreased the most, i.e. from Rp 73.5 trillion (at 1993 constant prices) in 1997 to Rp 60.1 trillion in 1998, manufacturing output contracted significantly from Rp 107.6 trillion to Rp 95.3 trillion,

[1] The only exception is the electricity sector, whose output keeps increasing from Rp 3.29 trillion in 1993 to Rp 4.29, 5.48, 5.65, and 6.11 trillions in 1995, 1997, 1998, and 1999, respectively. As reflected by output share, this is, however, the smallest sector as its share is only between 1.0 and 1.6 percent.

while agricultural GDP *only* reduced from Rp 64.5 trillion to Rp 63.6 trillion through the same years (Appendix Table 1).

In 1999, while mining, construction, transportation, and financial sectors still contracted, the other sectors experienced growth, pushing the economy's GDP to grow slightly from Rp 376.4 trillion in 1998 to Rp 379.6 trillion in 1999. Among the growing sectors are agriculture, manufacturing industries, trade, and services. However, *except for agriculture*, there is no other sector with its output in 1999 that is higher than that in previous years. Manufacturing industries output, for instance, although it grew to Rp 98.9 trillion in 1999, this 1999 figure is, however, still lower than that in 1997 (or even than that in 1996, which is Rp 102.3 trillion). With GDP of Rp 65.3 trillion in 1999, agriculture strengthens its second position in terms of GDP after manufacturing sector, leaving trade sector in the third position. In sum, following the crisis, Indonesian agriculture seems to have increased relatively higher than other sectors have.

1.2. The Problem

The return of agriculture as the second important sector is reflected by its share on GDP, which raised from 14.9 percent in 1997 to 16.9 percent and 17.2 percent in 1998 and 1999, respectively. For manufacturing sector, although its growth in 1999 was insufficiently high, its big output (relative to the other sectors) brought about consistent increases in its share on GDP, i.e. from 24.8 percent, to 25.3 percent and 26.1 percent through the same years. The question is that, will the positive trend in manufacturing share as well as that in the share of agriculture, which is non-decreasing at approximately 17 percent lately, pertain in longer terms? Or, will there be a significant trade-off between the relative importance of these sectors?[2] If there will be a trade-off, should the government, which has been facing serious budgetary problems following the AFC,[3] put more development efforts on one sector against another, and what would be the effects on economic growth?

[2] In Ghatak and Ingersent (1984, p.31), this trade-off is termed as 'the trap of overlooking the critical importance of domestic agriculture's product', whereby a number of developing economies have fallen into in opting for a rapid industrialization strategy without parallel development in agriculture.

Among the general views regarding the role of agriculture in economic development, which are still commonly held until recently, are that expansion on manufacturing sector is strongly dependent on domestic agriculture and that the relative importance of agriculture in the economy inevitably declines with economic growth and development.[4] This view may imply that at initial stages of development, agriculture is greatly needed to have considerable surpluses, which are used to support development of manufacturing sector, and that at later stages --since the relative importance of agriculture is declining-- development policies tend to be formulated in favor of manufactures.[5] Implementing this kind of policy, which may reflect that resources are being devoted more on non-agricultural sectors, would certainly accelerate the relative importance decline of agriculture. On the basis of this view (and assuming that the economy is considerably away from the initial stage), one would answer 'yes' to the question regarding agriculture-manufacture trade-off.

However, this answer might not be always correct. That is, the decline in the relative importance of agriculture might not be the case if the government does adopt development policies that are in favor of both agricultural and manufacturing sectors such as agro-industry promoting policies.[6] Implementing this kind of policy, it should be the case that there would be no trade-off among these sectors. This and the view above indicate that the current changes in relative importance of agricultural and of the other sectors may or may not persist in the long term. This suggests that the posed question should be answered empirically.

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[3] The nature of budgetary problems faced by the Indonesian government is discussed, for example, in Dian and Taloputra (2002).

[4] Details can be found, among others, in Perkins et al. (2001, Chapter 3) and Todaro (2000, Chapter 3).

[5] Daryanto (1999) claims that the decline in the relative role of agriculture occurs due to: (a) domestic economic policies that tend to discriminate against agriculture, and (b) changes in external economic conditions, such as world agricultural liberalization, production technology, and some demand characteristics. More specific than this author, Tschiersch (1990) argues that, among internal factors, a major cause of agricultural stagnation is 'policy failure', i.e. erroneously formulating and implementing domestic policies that discriminate against agriculture.

[6] Governments in less developed economies tend to formulate policies that are against agriculture (Tschiersch, 1990). Political economy approach to causes of the discrimination against agriculture can be found, for instance, in Lipton's (1977) thesis of 'urban bias'.

1.3. Objectives

The general aim of this paper is to obtain empirical answers to this question. To do that, the aim is broken down to become two objectives. Firstly, to evaluate changes in contribution of agricultural (relative to manufacturing) output growth to economic growth before and after the AFC. Beside viewed at national level, to have a spatial perspective, these changes are also assessed at provincial level. Reasonable increases in the contribution of agricultural sector may indicate that the economy has adjusted to the crisis by fostering agricultural growth, and that development of manufacturing sector has been vulnerable to such a structural change as the crisis. Secondly, to analyze long run share of agricultural output (and other sectors') on the economy's output (GDP). This would provide knowledge on convergence points of each sector share, so that when the contribution of a sector in a particular year lies, for instance, above the relevant point, it may then be predicted that the share would decrease in the next year(s).

1.4. The Methods

Technically, the relative importance of an economic sector can be seen as output share of that sector on total output of the economy. Assessment on changes in the relative importance of a sector, in general, can be carried out using two approaches, namely arithmetic and theory led approaches. Through the first approach, which is developed for instance by Kuznets (1964) and employed among others by Ghatak and Ingersent (1984), the changes are analyzed by decomposing economic growth into relative growth in its sectors. This analysis allows one to obtain growth contribution of each sector to economic growth, which can be interpreted as short-term relative performance of each sector. The main disadvantage of this approach is its nature of simply being an 'arithmetic', in that it contains no explicit underlying economic theories. In addition, using this approach it is not possible to determine long run counterpart of a change in relative importance of a sector. Nevertheless, this approach has advantages of being simple and requiring relatively small data set.

The decomposition in the second approach is based on a specific economic theory. Using an input-output analysis, which is basically a production theory, Kubo, Robinson and Syrquin (1986), for example, develop a decomposition technique that enables one to identify various sources of economic growth, namely technological change effect, import substitution effect, as well as export and domestic demand effects. Daryanto (2000), for instance, has employed this technique to study structural change in the Indonesian economy. It is, however, apparent that this technique tends to overestimate domestic demand effect and underestimate technological change effect (see the figures in footnote 13). Another disadvantage of this approach is that it requires a large data set. In addition, as in the first approach, this approach cannot distinguish between short run and long run effects.

To overcome problems related to the two approaches, an error correction model (ECM) is developed to provide answers to objectives of this study. Within the ECM framework, it is possible to explicitly obtain long run relative contribution of each economic sector. In addition, the occurrence of the AFC can be accommodated explicitly in the model. This model, however, requires a reasonably long data series, and hence in this study it can only be employed at national level because of non-availability of sufficiently long provincial data. Since, besides at the national level, the analysis is also relevant for the provinces --because of the large size and variation of the country-- the assessment on changes in relative importance of agriculture will also be made using an arithmetic approach, which modifies the Kuznet's formula. More details on this approach and on the ECM are presented in Appendix A.

In order to carry out the analysis based on that approach, GDP and sector output data (at constant 1993 prices) are collected from all (26) provinces of Indonesia. Considering the first objective of the study, the collected data are of 1995, 1996, 1998 and 1999. Included sectors are agriculture, manufactures, trade-hotel-restaurant, services, and an aggregate of other sectors. These data are gathered from BPS. The ECM also requires GDP and those sectors' output data but at the national level, covering the 1971-1999 period --the longest period where the data are available from BPS. The available

data are, however, in different base years. Before employing them, it is therefore necessary to transform them so that it is at constant 1993 prices. These data are presented in Appendix Table 2.

This paper is organized as follows. Contribution of agricultural output growth at national and provincial level is presented and discussed in Section 2. Section 3 is devoted for analyzing estimation results of long run share of each economic sector and discussing their implications. Conclusions and recommendations are formulated in Section 4.

2. Contribution of Agricultural Output Growth to Economic Growth

2.1. National Level

Before presenting contributions to economic growth, it is important to firstly outline movements of outputs of agricultural and industrial sectors. As shown in Table 2 (Panel A), at the national level, the crisis has brought about an increase in real output of agriculture from Rp 62.8 trillion (the average for 1995-1996) to 64.6 trillion (the average for 1998-1999) and a decrease in real output of industrial sector from Rp 85.3 to Rp 78.7 trillion through out the same years. This pattern of changes also occurs in the West Part of Indonesia, whereby through the same years agricultural and industrial outputs change from Rp 47.2 to 48.2 trillion and from Rp 77.8 to 70.9 trillion, respectively. The pattern, however, is not mimicked in the East Part of Indonesia, where both sector outputs increase from Rp 15.6 to Rp 16.4 trillion and from Rp 7.5 to Rp 7.8 trillion, respectively.

Contributions of sector output growth to economic growth are presented in Table 2, Panel B. At the national level, contribution of agricultural output growth increases from 31.4 percent in 1996 to 48.1 percent in 1999. Contribution of industrial output growth, on the other hand, decreases from 35.6 percent to 22.7 percent for the same years. This indicates that the crisis has induced the former sector to grow relatively faster than the latter. From regional point of view, contribution of agricultural growth to regional economic growth also raises in both the West and East Parts of Indonesia with the former experiences a higher increase. Whereas contribution of industrial output

growth to regional economic growth declines from 36.0 to 27.9 percent in the West Part of Indonesia, this contribution increases from 34.5 to 40.6 percent in the other part of the country. It seems likely that this increase is due partly to increases in agroindustry activities, such as on oilpalm and cocoa, in the East Part of Indonesia.[7]

Table 2: Contribution of Agricultural and Industrial Sectors Growth to Economic Growth: Before (1996) and After (1999) the Asian Financial Crisis

No.	Region	Agriculture		Industry	
		1996	1999	1996	1999
A. Output (Rp Trillion)[1,2]					
1	Indonesia	62.8	64.6	85.3	78.7
2	West Part of Indonesia	47.2	48.2	77.8	70.9
3	East Part of Indonesia	15.6	16.4	7.5	7.8
B. Contribution of Sector Growth to Economic Growth					
1	Indonesia	0.314	0.481	0.356	0.227
2	West Part of Indonesia	0.312	0.446	0.360	0.279
3	East Part of Indonesia	0.306	0.392	0.345	0.406

Notes: 1. The outputs are at 1993 constant prices, and exclude oil and gas.
2. As the sector output growth that is employed in determining the contributions in Panel B is calculated relative to the previous years (1995 and 1998), the output figures in Panel A are averages for 1995-1996 and 1998-1999.

2.2. Provincial Level

Contributions of sector output growth to economic growth at the provincial level are presented in Table 3. It can be seen from the table that within the period immediately before and after the AFC, contributions of agricultural output growth to provincial economic growth increase in all provinces except in South Sumatra, Bengkulu, Jakarta, East Java, South East Sulawesi, West Nusa Tenggara and East Nusa Tenggara. Considerable increases in the contribution occur in all provinces of Kalimantan, almost all provinces of Sulawesi, Irian Jaya, and some other provinces in the West Part of Indonesia.

[7] Oktaviani and Drynan (1999) argue that, following APEC trade liberalization, Indonesian resource based processing sectors, including palm oil and cocoa processing units, are not competitive enough, hence would be left behind without government support.

Table 3: Provincial Contribution of Agricultural and Industrial Sectors Growth to Economic Growth: Before and After the Asian Financial Crisis

No.	Province	Agriculture		Industry	
		1996	1999	1996	1999
1	Spec. Region Aceh	0.329	0.776	0.391	0.202
2	North Sumatra	0.333	0.426	0.341	0.296
3	West Sumatra	0.331	0.368	0.364	0.370
4	Riau	0.240	0.253	0.406	0.262
5	Jambi	0.336	0.417	0.370	0.314
6	South Sumatra	0.305	0.296	0.366	0.372
7	Bengkulu	0.309	0.200	0.377	0.405
8	Lampung	0.247	0.339	0.380	0.362
9	Cap. Spec. Region Jakarta	0.375	0.273	0.307	0.427
10	West Java	0.051	0.492	0.506	0.164
11	Central Java	0.288	0.368	0.375	0.300
12	Spec. Region Yogyakarta	0.330	0.366	0.351	0.289
13	East Java	0.312	0.293	0.369	0.439
14	Bali	0.286	0.345	0.368	0.295
15	West Kalimantan	0.320	0.356	0.333	0.361
16	Central Kalimantan	0.316	0.362	0.274	0.284
17	South Kalimantan	0.289	0.320	0.350	0.350
18	East Kalimantan	0.338	0.415	0.305	0.330
19	North Sulawesi	0.314	0.331	0.363	0.354
20	Central Sulawesi	0.327	0.402	0.364	0.386
21	South Sulawesi	0.298	0.310	0.362	0.364
22	South East Sulawesi	0.251	0.229	0.367	0.388
23	West Nusa Tenggara	0.289	0.262	0.379	0.378
24	East Nusa Tenggara	0.303	0.289	0.371	0.353
25	Maluku	0.296	0.306	0.343	0.383
26	Irian Jaya	0.309	0.341	0.358	0.298
	Median	*0.309*	*0.340*	*0.365*	*0.354*

In contrast, contributions of industrial output growth to economic growth decrease in 13 out of the 26 provinces. In eight provinces, i.e. all provinces of Kalimantan and Sulawesi (excluding North Sulawesi), Maluku and West Sumatra, contributions of both agricultural and industrial outputs to economic growth in fact increase. These broadly reflect that responses to the crisis by growing activities in both agricultural and industrial sectors have occurred in these provinces. Therefore, spatial development policy should not segregate these sectors but should induce them to grow together proportionally. Ensuring the growth in both sectors to occur proportionally, then industrial development ought to be taking place in form of agro-based.

Furthermore, based on the figures in Table 3, each province can be classified as to have relatively: (a) high contributions of agricultural and industrial outputs growth to provincial economic growth (high $s_{ra\text{-}adj}$ and $s_{ri\text{-}adj}$, typology 1), (b) high contribution of agricultural output growth and low contribution of industrial output growth to provincial economic growth (high $s_{ra\text{-}adj}$ and low $s_{ri\text{-}adj}$, typology 2), (c) low contribution of agricultural output growth and high contribution of industrial output growth (low $s_{ra\text{-}adj}$ and high $s_{ri\text{-}adj}$, typology 3), and (d) low contributions of agricultural and industrial outputs growth to provincial economic growth (low $s_{ra\text{-}adj}$ and $s_{ri\text{-}adj}$, typology 4). Distributions of the provinces following these typologies for 1996 and 1999 are summarized in Figure 1.

As shown in Figure 1, there is no province that being classified consistently as to be in typology 1. An interesting result worth pointing out with regard to this fact is that, while immediately before the crisis all provinces in typology 1 are those located in the West Part of Indonesia, after the crisis this domination does no longer hold. This may suggest that, despite the crisis, investments on both industrial and agricultural sectors might have taken place in West as well as East Parts of Indonesia. Since, following the crisis, foreign investment has been so limited, the investments are likely to be domestic ones, which seem to be induced by booming in exports of selected agricultural commodities from Central Sulawesi, West Kalimantan, and West Sumatra.

As for typology 4, South Kalimantan appears to be the only province that consistently having low $s_{ra\text{-}adj}$ and $s_{ri\text{-}adj}$. This indicates that, regardless the crisis, economic growth in this province comes mainly from sectors other than agriculture and industry. Provinces that consistently to be in typology 2 are North Sumatra, Yogyakarta,

Figure 1: Typologies of Provinces Based on Their Sectoral Growth Contribution to Provincial Economic Growth

		s_{ri-adj}			
		High		**Low**	
		1996	1999	1996	1999
s_{ra-adj}	**High**	Aceh Jambi Bengkulu East Java	West Sumatra (21.4) West Kalimantan (24.2) Central Sulawesi (42.2)	*North Sumatra* West Sumatra Jakarta *Yogyakarta* West Kalimantan *Central Kalimantan* *East Kalimantan* North Sulawesi Central Sulawesi *Irian Jaya*	Aceh (41.4) *North Sumatra* (32.0) Jambi (29.9) West Java (15.9) Central Java (22.1) *Yogyakarta* (15.1) Bali (19.5) *Central Kalimantan* (38.2) *East Kalimantan* (14.9) *Irian Jaya* (16.7)
	Low	Riau *South Sumatra* *Lampung* West Java Central Java Bali *South East Sulawesi* *West Nusa Tenggara* East Nusa Tenggara	*South Sumatra* (25.0) Bengkulu (30.7) *Lampung* (37.7) Jakarta (0.2) East Java (18.5) North Sulawesi (27.4) South Sulawesi (36.6) *South East Sulawesi* (33.3) *West Nusa Tenggara* (36.1) Maluku (32.6)	*South Kalimantan* South Sulawesi Maluku	Riau (19.0) *South Kalimantan* (22.6) East Nusa Tenggara (38.3)

Notes: For i=1,…,26 (provinces), the contribution is called 'high' if it is at least the same as its median and 'low' otherwise. For agricultural sector, as shown in Table 2, the medians of s_{ra-adj} are 0.309 and 0.340 for 1996 and 1999, respectively; whereas for industrial sector the medians of s_{ri-adj} are 0.365 and 0.354 for the same years. Figures in the brackets are shares (%) of agricultural output to provincial GDP in 1999. Italics denote provinces that are consistent to be in the same typology.

Central Kalimantan, East Kalimantan and Irian Jaya, whereas those in typology 3 are South Sumatra, Lampung, South East Sulawesi and West Nusa Tenggara. This suggests that, despite the crisis, agriculture output growth has kept contributing dominantly to economic growth of North Sumatra, Yogyakarta, Central Kalimantan, East Kalimantan and Irian Jaya, and that industrial output growth has been the main contributor to economic growth of the other set of provinces.

Aceh and Jambi shift from typology 1 to 2 and West Java, Central Java and Bali move from typology 3 to 2. This reflects swings to relatively higher contributions of agricultural output growth to economic growth have occurred in these provinces.[8] Bengkulu and East Java shift from typology 1 to 3, Jakarta and North Sulawesi rotate from typology 2 to 3, and South Sulawesi and Maluku moves from typology 4 to 3. This suggests relatively higher contributions of industrial output growth to economic growth in these provinces.

Having understood distribution of provinces into the typologies, it is now important to find out sub-sectors that give the highest contribution to agricultural growth and hence to economic growth. Contributions of output growth of five agricultural subsectors to agricultural output growth are presented in Table 4. As shown in this table, at the national level, contribution of livestock output growth to agricultural growth is almost unchanged at around 20.5 percent, whereas that of fishery output, whose growth contribution (21.3 percent) was the highest in 1996, decreases considerably to 17.5 percent. Decreases in the contribution are also the case for both food and non-food crops subsectors. On the other hand, the crisis has led forestry subsector to gain as its output growth contribution to agricultural growth raises from 19.8 percent in 1996 to 25.6 percent in 1999. These facts indicate that the increase in the contribution of agricultural

[8] Of course this also reflects a relatively lower importance of industrial output growth in determining economic growth.

Table 4: Growth Contributions of Food Crop, Non-Food Crop, Livestock, Forestry, and Fishery Sub-sectors to Agricultural Growth

No.	Provinces	Food Crops		Non-Food Crops		Livestock		Forestry		Fishery	
		1996	1999	1996	1999	1996	1999	1996	1999	1996	1999
1	Spec. Region Aceh	0.231	0.249	0.224	0.198	0.240	0.184	0.136	0.193	0.169	0.176
2	North Sumatra	0.192	0.139	0.180	0.202	0.216	0.230	0.214	0.222	0.198	0.208
3	West Sumatra	0.185	0.184	0.209	0.173	0.185	0.179	0.204	0.188	0.216	0.276
4	Riau	0.133	0.118	0.209	0.226	0.237	0.232	0.191	0.206	0.231	0.217
5	Jambi	0.126	0.192	0.221	0.191	0.221	0.180	0.214	0.234	0.217	0.203
6	South Sumatra	0.187	0.224	0.159	0.185	0.197	0.176	0.260	0.234	0.196	0.182
7	Bengkulu	0.187	0.385	0.177	0.154	0.178	0.152	0.257	0.155	0.202	0.155
8	Lampung	0.145	0.048	0.170	0.234	0.220	0.191	0.236	0.243	0.230	0.284
9	Cap. Spec. Region Jakarta	0.303	0.226	0.226	0.157	0.224	0.324	n.a.	n.a.	0.247	0.294
10	West Java	0.292	0.166	0.175	0.214	0.178	0.198	0.174	0.215	0.181	0.207
11	Central Java	0.195	0.070	0.176	0.187	0.179	0.182	0.231	0.201	0.219	0.361
12	Spec. Region Yogyakarta	0.195	0.183	0.176	0.192	0.189	0.184	0.220	0.228	0.220	0.212
13	East Java	0.164	0.214	0.203	0.215	0.224	0.173	0.190	0.209	0.219	0.189
14	Bali	0.138	0.508	0.232	0.148	0.199	0.029	0.218	0.146	0.213	0.170
15	West Kalimantan	0.154	0.188	0.231	0.194	0.173	0.187	0.206	0.240	0.236	0.190
16	Central Kalimantan	0.197	0.186	0.208	0.189	0.207	0.185	0.154	0.254	0.234	0.186
17	South Kalimantan	0.197	0.234	0.210	0.045	0.218	0.253	0.208	0.240	0.167	0.228
18	East Kalimantan	0.210	0.219	0.228	0.204	0.232	0.241	0.105	0.128	0.224	0.208
19	North Sulawesi	0.165	0.198	0.182	0.239	0.219	0.023	0.218	0.339	0.217	0.201
20	Central Sulawesi	0.182	0.094	0.232	0.218	0.214	0.297	0.158	0.190	0.214	0.201
21	South Sulawesi	0.179	0.167	0.202	0.195	0.212	0.220	0.220	0.217	0.187	0.201
22	South East Sulawesi	0.177	0.202	0.075	0.119	0.243	0.132	0.262	0.246	0.243	0.300
23	West Nusa Tenggara	0.151	0.149	0.226	0.229	0.187	0.200	0.223	0.217	0.213	0.204
24	East Nusa Tenggara	0.214	0.139	0.226	0.254	0.104	0.134	0.239	0.257	0.216	0.215
25	Maluku	0.022	0.093	0.045	0.189	0.033	0.244	0.869	0.260	0.031	0.213
26	Irian Jaya	0.035	0.171	0.257	0.182	0.239	0.194	0.236	0.199	0.232	0.254
1	Indonesia	0.172	0.167	0.211	0.195	0.206	0.205	0.198	0.256	0.213	0.175
2	West Part of Indonesia	0.193	0.156	0.230	0.195	0.221	0.211	0.122	0.256	0.234	0.181
3	East Part of Indonesia	0.173	0.182	0.217	0.187	0.217	0.216	0.185	0.254	0.207	0.161

growth to the national economic growth comes with highest proportion from forestry sector.

As this subsector is relatively much more important in East rather than in West Part of Indonesia,[9] the change led by the crisis might have favorable effects in narrowing the output gap between the two regions of the country. Since, however, logging companies and wood-processing industries tend to violate sustainability principles in managing their businesses,[10] the increase in growth contribution of forestry sector may not sustain in longer terms. Therefore, the spatial effect is likely to be short lived.

3. Long Run Shares of Each Economic Sector and Their Implications

3.1. Short Run Adjustments of GDP and Long Run Shares of Each Sector

As discussed in Appendix A, the error correction model (ECM) is estimated using the non-linear least squares.[11] Results of the estimation are presented in Table 5. In contrast to the initial estimates presented in Appendix Table 6, it can be seen from Table 5 that the coefficient on the long run share (LRS) of agricultural sector on economic growth (B_1) now becomes significant under the usual (0.05) significance level. The other estimates are statistically still significant and the statistics presented are reasonably similar to the initial ones.

It can be seen from Table 5 that the Asian Financial Crisis (AFC) affects the *long run* rate of growth of the economy negatively, as summarized by B_d, by approximately -18 percent. This is comparable to the *short run* growth of the economy of -13.1 percent in 1998, a year after the crisis inflicted. The short run adjustment of GDP (economic)

[9] Forestry subsector contributes to approximately 18 percent of output of the East Part of Indonesia, whereas in the other region of the country the subsector share is only 8 percent (Appendix Table 3).

[10] World Bank (2001) claims that forestry practices by concessionaires deviate significantly from the goal of production forest sustainable management. According to its estimates, pulpwood production and illegal log, for instance, are as many as nearly three times of the official harvest in 1998. An important source of illegal logging, furthermore, is an excess capacity of wood-processing industry. These and other factors result in deforestation with the rate of approximately 1.64 million Ha p.a. between 1985 and 1997.

[11] Statistical justification of using the error correction model is provided also in Appendix A. Initial estimates of the ECM with five sectors (agriculture, manufacture, trade, services, and 'others') are presented in Appendix Table 6.

growth to a one percent change in agricultural output growth (A_1) is 0.221, whereas that for manufacturing sector (A_2) is 0.161. This means a one percent increase in the growth rate of agricultural output would be able to increase short run growth of the economy by approximately 0.22 percent; and the same increase in that of manufacturing output would increase short run growth of the economy by 0.16 percent. Thus, if the ECM can represent the true data generating process for GDP, this may be seen as evidence that support the finding from the previous section that, after the AFC, growth contribution of agricultural output to short run economic growth is higher than that of manufacturing output.

Table 5: Estimated Long Run Shares of (LRS) of Main Sectors on GDP and Short Run Adjustments (SRA)

Estimated Coefficient	Symbol	Magnitude	Standard Error	T-Value
SRA to Agricultural Sector	A_1	0.221	0.0147	14.990
SRA to Manufacturing Sector	A_2	0.161	0.0078	20.763
SRA to Trade Sector	A_3	0.172	0.0088	19.651
SRA to Other Sectors	A_4	0.431	0.0115	37.353
Error Correction Term	G	0.084	0.0192	4.381
Intercept	B_0	1.539	0.0655	23.508
LRS of Agricultural Sector	B_1	0.105	0.0475	2.220
LRS of Manufacturing Sector	B_2	0.212	0.0272	7.790
LRS of Trade Sector	B_3	0.429	0.0721	5.948
LRS of 'Others' Sector	B_4	0.254	0.0745	3.406
Long Run Effect of the AFC	B_d	-0.180	0.0703	-2.565
Autocorrelation Parameter	Rho	-0.524	0.1646	-3.185
Dependent variable: Change in logged GDP. Estimation Period: 1972-1999. R^2 between Observed and Predicted Dependent Variable = 0.999 Durbin-Watson Statistic = 2.206 Run Test for Normality of Residuals (Z-statistic) = 0.597				

The estimated LRS of agricultural sector (B_1) is approximately 11 percent, suggesting that the growth contribution of this sector to economic growth of 48 percent after the AFC (i.e. 1999) as presented in the previous section is an overshoot. This is so because in order for current agriculture share on GDP, which is approximately 17 percent

in 1999, to reach its long run counterpart (11 percent), the growth contribution of this sector is required to be less than that of others'.

The same estimate for manufacturing sector (B_2) is 21 percent, indicating that the growth contribution of this sector to economic growth of 23 percent in 1999 may also be an overshoot. This is because the current share of this sector on GDP (of approximately 26 percent in 1999) is higher than its long run counterpart (21 percent). Thus, in the absence of any significant structural shocks to this sector or to the economy, manufacturing sector would seem to grow at slower rate than its current or previous growth rate. It is notable, however, that the overshoot in this sector is much less than that in agricultural sector.

The overshoot phenomena in both sectors imply that current growth of agricultural and manufacturing sectors is likely to slow down in the future. The question is that why does agriculture experience higher overshoot. A possible explanation on this question is that, in aggregate this sector does not significantly depend on imported capital, thus the depreciated Rupiahs following the crisis has induced export demands for such output to increase to a level that is higher than its steady state or long run level. In addition, the relative high protection on various agricultural commodities by the government may have impeded the sector to converge to its long run level.[12] As for manufacturing sector, a considerable dependence of this sector on imported capital or imported intermediate inputs led the depreciation to reduce these imports in such a way that the reduction hinders the ability of the sector to respond positively to possible increases in export demand for manufacturing products. The relatively more liberalized state of manufacturing sector than agricultural sector, however, may have put the former to deviate in a less distance from its long run path than the latter.

[12] Soesastro (1999) states that decreases in the performance of Indonesian exports in the first half of the 1990s led the government to implement a series of trade liberalization packages starting from May 1995. This author, nevertheless, highlights that a number of sectors, including agriculture, steel, chemicals and automotive, are still highly protected. With this protection included in the data, Siregar and Manning (2000) found that the long run or *permanent component* of agricultural exports indeed exhibits a declining trend.

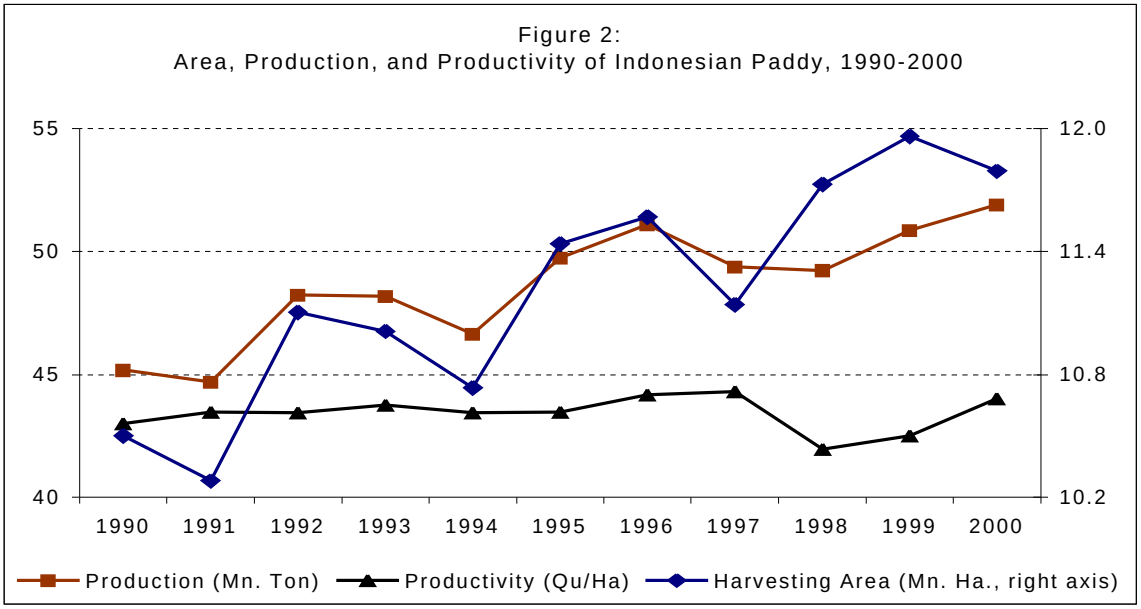
3.2. Implications

Having understood that the relative importance particularly of agriculture will considerably decrease in the future, the question is then: how would the current relative importance of agricultural sector be maintained, or is it possible to maintain it anyway? Looking from the demand side, properly satiating the needs of the huge and still increasing population of this country (with the size of 203.5 million in 2000 and growth rate of 1.35 percent p.a. during 1990-2000) is likely by itself able to induce growth of the sector.[13] From the supply side, the availability of land for agricultural expansion, although by no means unrestricted, is still reasonably large. This is reflected, for example, by the continuous increase in harvesting area of Indonesian paddy with a compounded growth rate of 1.32 percent p.a. during the last eleven years (Figure 2). Oil palm area grows with an even higher rate than this, i.e. 11.16 percent p.a. (Figure 3). Therefore, there seems likely a possibility of maintaining the importance of agricultural sector in the economy.

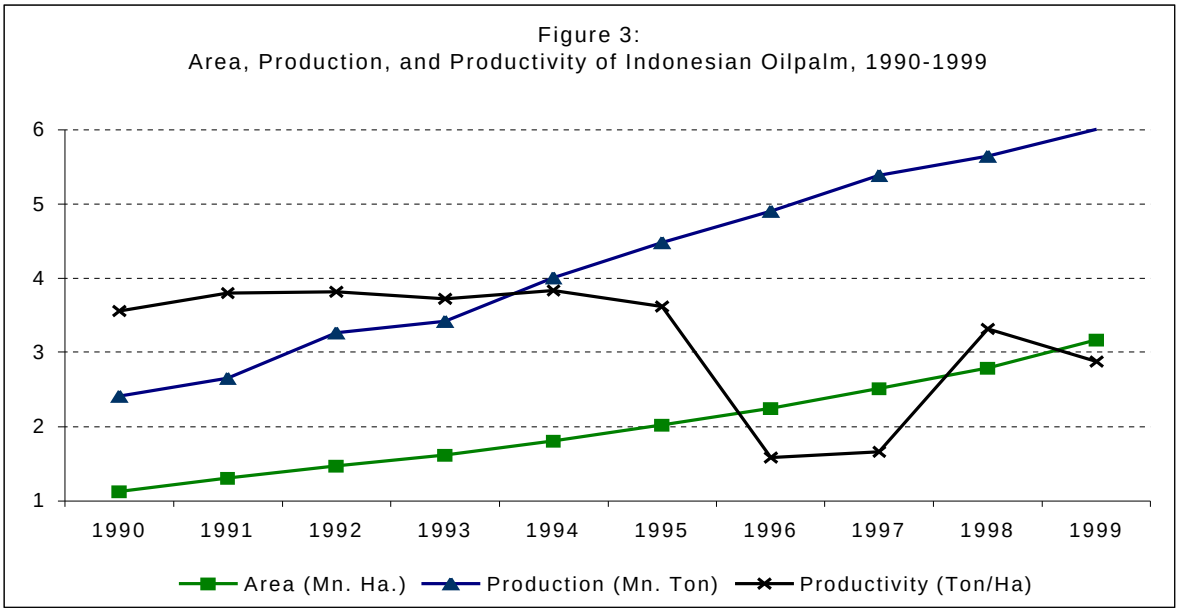
The strategy should, however, be focused more on improving total factor productivity of the sector rather than merely on expanding the area. This is because advancement of agricultural technology seems, in a broader term, to have been reasonably limited. As can be seen Figures 2 and 3, the positive trends in productions of paddy and oil palm, respectively, are associated more with those in area than with trends in productivity. The productivity itself --the trend of which may reflect a technological advancement-- tends to have been stagnant, with slumps after the AFC, for the cases of both paddy and oil palm. In order to overcome this problem, it is therefore necessary to substantially increase investments in agricultural R&D, which ironically have so far followed a declining trend (Hill, 1995).[14]

[13] Using an input-output model, Daryanto (2000), for example, finds that domestic final demand remains the most important source of growth in agricultural sector of Indonesia. This author finds that, contrary to the common expectation, technological change affects negatively (-27 percent) to the sector, whilst domestic final demand effect is as large as 116 percent.

[14] For a broader term, Tambunan (1998) highlights the under-investment problem in agriculture. He argues that failures to invest in this sector would affect the size of manufactured domestic markets in the long run.



Note: Using the regression equation of $Y_t = A\, e^{r\,t\,+\,\varepsilon t}$, where Y_t is the variable in question at time-t, t denotes a linear time trend, A is a constant, e is the natural number and ε is error terms, it is found that the compounded growth rate (r) for the paddy area is 1.32 percent p.a., which is statistically significant with the p-value equals 0.0003. Data for this Figure and for Figure 3 were collected from the website of Ministry of Agriculture.



Note: Using the same equation as the one in Note to Figure 2, the compounded growth rate of oilpalm area can be found to be 11.16 percent p.a., which is significant with the p-value of 0.0000.

In addition, provision of infrastructure that fulfills internationally accepted standards is also crucial for advancing agricultural technology. This is supported by, for instance, Hartoyo (1994) who econometrically finds that rural roads in fact possess a more important role than the R&D or than the irrigation system does. Another means, which is supportive in improving the state of technology in agricultural sector, is to increase quality and quantity of agricultural extension workers. According to data from the Ministry of Agriculture, in 1998 there were only 37,288 extension workers serving farmers in the whole areas of Indonesia. Assuming that they only serve food crop farmers, this means that every extension workers provides her/his service to 716 farmers. Besides this workload, it is worth mentioning that the task of these workers is not easy due to low education level of the farmers. Based on 1997 data, approximately 88 percent (19.4 million) of all food crop farmers attributes to 'graduated from primary school' or lower. The figure is 84 percent (6.7 million) for estate plantation farmers.[15] All of these articulate the need to increase investments not only in agricultural R&D but also in infrastructure and human resource.

Returning to Table 5, long run share of trade sector (as reflected by B_3) is approximately 43 percent, which suggests the relative importance of trade sector in supporting the country's economic growth in the long run. To reach this level, which is relatively high compared to that of agricultural, manufacturing or 'others' sector, it can then be predicted that the current share of trade sector --which is approximately 16 percent (Appendix Table 1)-- would increase in the long run. To maintain the current relative importance of agricultural sector on the economy,[16] it is therefore crucial to improve linkages between this sector and not only manufactures but between agriculture and manufacturing as well as trades. This would require not only promotion of agro-industry activities, but also improvement of agricultural markets down to at least at the

[15] According to Tabor (2001), Indonesian Government has consistently under-invested in education and health care. The country's public expenditures on education, for instance, were only 1.4 percent of GDP in 1997, which was significantly lower than those in the Philippines (3.4 percent), Thailand (4.8 percent) and Malaysia (4.9 percent), and devoted in a larger proportion on urban (non-agricultural) areas.

[16] One of the reasons to maintain the relative importance of agriculture is that it absorbs most of employment. Although employment absorption of this sector is exhibiting a negative trend, it nevertheless provides jobs to 43.2 percent of Indonesian total employment (Appendix Table 4).

district level and expansion of the scope of the futures market for agricultural products, which now is still considerably limited.[17]

4. Conclusions and Recommendations

This paper analyzes changes brought about by the Asian Financial Crisis (AFC) in the short-term perspective by decomposing economic (GDP) growth immediately before and after the crisis and questions whether such changes would last in the longer horizons. The finding from the growth decomposition analysis, that the contribution of agricultural (industrial) output growth to economic growth through the period *immediately* before and after the AFC the increases (decreases), reflects that the economy has adjusted to the crisis by inducing (reducing) growth in agricultural (industrial) sector. The increase in agricultural output growth contribution originates mainly from forestry sector, output of which may partly be obtained from extracting (non-cultivating) activities. This indicates that the positive effect of the crisis in fostering agricultural growth may not be sustainable unless constraints that impede development in the other subsectors, particularly of livestock, non-food (estate) crops, and fishery are overcome efficiently in timely manner.

There is evidence that contributions of both agricultural and industrial outputs growth to economic growth have increased in some provinces, particularly in East Part of Indonesia. To optimize growth in both sectors, economic development should be undertaken proportionally for these sectors in this region. A plausible choice is to develop agro-industry.

Although agro-industry development seems likely to be a crucial means of not only developing agricultural and industrial sectors themselves but also developing East

[17] The futures market is *PT. Bursa Berjangka Jakarta* (Jakarta Futures Exchange, JFX), which was established on 19 August 1999 --following the Act No. 32/1997 (the Commodity Futures Trading Act)-- and has been licensed to operate since 15 December 2000. Based on this Act, the commodities traded on JFX are only six items, which all are agricultural or agro-industry products, i.e. coffee, olein, cocoa, pepper, rubber, and plywood. The President Decree No. 119/2001 issued on 20 November 2001 has added 16 more products to this list, seven of which are of agricultural or agro-industry, namely: sugar, peanuts, soybean, glove, shrimp, fish, and pulp/paper. Given huge diversity of Indonesian agricultural or agro-industry commodities, the scope of trading merely the thirteen agricultural/agro-industry products may be considered as still small, and thus is potential to be expanded.

Part of Indonesia, the finding from the error correction model that trade sector possesses a relatively high long run growth contribution indicates that long term industrial policy choices should promote linkages of agricultural, manufacturing and trade sectors all together. Once such a policy is formulated, however, there is no guarantee that the importance of agriculture in terms of its output share on GDP can be protected from falling. This is indicated by a significantly lower growth contribution of this sector in the long run compared to that in the short term. It is nevertheless believed that such a long run tendency may be changed by advancing agricultural technology including encouraging private investment in knowledge-intensive agro-industries[18] --where human capital can be accumulated, enhancing quantity and quality of extension workers so as to enable them to increase effectiveness of the extension works and of dissemination methods of new technologies, and improving rural infrastructure.

[18] Gumbira-Sa'id and Intan (2001) argue that in order to link agriculture to manufacturing in a sustainable manner, the most plausible choice of technology is biotechnology. Implementation strategies of biotechnology according to these authors include development and applications of: (a) DNA recombinant, genetic transfer, plant regeneration, tissue culture, bio-process engineering and the like, (b) bio-fertilizer, bio-pesticides and integrated pest management, and (c) bio-conversion and enzyme technology in order to do food diversification.

Appendix Table 1:
Indonesian GDP by Sector at 1993 Constant Prices (Rp Trillion)

Sector	1993	1994	1995	1996	1997	1998	1999
Agriculture	58.96	59.29	61.89	63.83	64.47	63.61	65.34
	(17.9)	(16.7)	(16.1)	(15.4)	(14.9)	(16.9)	(17.2)
Mining and Quarrying	31.50	33.26	35.50	37.74	38.54	37.47	36.57
	(9.6)	(9.4)	(9.3)	(9.1)	(8.9)	(10.0)	(9.6)
Manufacturing Industries	73.56	82.65	91.64	102.26	107.63	95.32	98.95
	(22.3)	(23.3)	(23.9)	(24.7)	(24.8)	(25.3)	(26.1)
Electricity, Gas and Water Supply	3.29	3.70	4.29	4.88	5.48	5.65	6.11
	(1.0)	(1.0)	(1.1)	(1.2)	(1.3)	(1.5)	(1.6)
Construction	22.51	25.86	29.20	32.92	35.35	22.47	22.29
	(6.8)	(7.3)	(7.6)	(8.0)	(8.2)	(6.0)	(5.9)
Trade, Hotel and Restaurant	55.30	59.50	64.23	69.48	73.52	60.13	60.20
	(16.8)	(16.8)	(16.7)	(16.8)	(17.0)	(16.0)	(15.9)
Transportation & Communication	23.25	25.19	27.33	29.70	31.78	26.98	26.77
	(7.1)	(7.1)	(7.1)	(7.2)	(7.3)	(7.2)	(7.1)
Financial, Ownership & Business	28.05	30.90	34.31	36.38	38.54	28.28	26.15
	(8.5)	(8.7)	(8.9)	(8.8)	(8.9)	(7.5)	(6.9)
Services	33.36	34.29	35.41	36.61	37.93	36.48	37.18
	(10.1)	(9.7)	(9.2)	(8.8)	(8.8)	(9.7)	(9.8)
Total	329.78	354.64	383.79	413.80	433.25	376.38	379.56
	(100)	(100)	(100)	(100)	(100)	(100)	(100)

Note: Figures in the brackets are shares of the sectors on GDP.

Appendix Table 2:
Data Employed to Estimate the Error Correction Model (Rp Tn. 1993 Constant Prices)

Year	GDP	Output of				
		Agriculture	Manufacture	Trade	Services	Others
1971	71.1	27.0	5.2	12.0	7.1	19.2
1972	77.7	27.4	5.9	13.3	8.7	22.4
1973	86.5	29.9	6.9	14.5	8.9	26.3
1974	93.1	31.0	8.0	15.9	9.5	28.7
1975	97.8	31.0	8.9	16.8	11.2	29.7
1976	104.5	32.5	9.8	17.5	11.8	32.9
1977	113.6	32.9	11.2	18.7	13.1	37.8
1978	122.6	34.6	13.0	19.9	14.2	40.8
1979	130.2	36.0	14.7	21.8	14.8	42.9
1980	143.3	37.8	18.0	24.0	17.1	46.4
1981	154.5	39.7	19.8	26.5	18.6	49.9
1982	157.9	40.5	20.0	28.0	19.2	50.1
1983	164.5	42.5	20.5	29.1	20.2	52.3
1984	184.5	44.2	24.4	29.4	21.1	65.3
1985	189.1	46.1	26.6	30.1	22.3	63.9
1986	212.5	47.3	36.6	32.5	23.5	72.5
1987	223.1	48.5	40.5	34.7	25.0	74.3
1988	235.9	50.8	45.4	37.9	26.6	75.2
1989	253.6	52.6	49.5	42.0	28.2	81.3
1990	272.0	53.7	55.7	44.9	29.6	88.1
1991	290.9	54.5	61.3	47.4	30.7	97.0
1992	309.7	58.1	67.3	50.8	32.0	101.4
1993	329.8	59.0	73.6	55.3	33.4	108.6
1994	354.4	59.3	82.7	59.4	34.3	118.8
1995	383.8	61.9	91.6	64.2	35.4	130.6
1996	413.8	63.8	102.3	69.5	36.6	141.6
1997	433.2	64.5	107.6	73.5	37.9	149.7
1998	376.4	63.6	95.3	60.1	36.6	120.8
1999	379.6	65.3	98.9	60.2	37.2	118.0

Appendix Table 3:
Shares of Agricultural Subsectors to Agricultural Output in 1999

No.	Province	Food Crops	Non-Food Crops	Livestock	Forestry	Fishery
1	Spec. Region Aceh	0.334	0.146	0.181	0.157	0.182
2	North Sumatra	0.320	0.421	0.087	0.054	0.118
3	West Sumatra	0.555	0.143	0.099	0.097	0.105
4	Riau	0.224	0.353	0.049	0.235	0.139
5	Jambi	0.381	0.349	0.100	0.136	0.034
6	South Sumatra	0.275	0.413	0.077	0.092	0.143
7	Bengkulu	0.543	0.194	0.081	0.063	0.120
8	Lampung	0.416	0.281	0.175	0.005	0.123
9	Cap. Spec. Region Jakarta	0.495	0.078	0.065	0.000	0.363
10	West Java	0.756	0.065	0.106	0.011	0.063
11	Central Java	0.676	0.051	0.166	0.043	0.064
12	Spec. Region Yogyakarta	0.818	0.031	0.136	0.001	0.014
13	East Java	0.669	0.149	0.090	0.023	0.068
14	Bali	0.590	0.044	0.255	0.000	0.111
15	West Kalimantan	0.271	0.302	0.071	0.281	0.075
16	Central Kalimantan	0.138	0.188	0.045	0.525	0.104
17	South Kalimantan	0.369	0.181	0.043	0.089	0.317
18	East Kalimantan	0.166	0.056	0.096	0.515	0.167
19	North Sulawesi	0.322	0.384	0.070	0.096	0.128
20	Central Sulawesi	0.406	0.334	0.091	0.085	0.083
21	South Sulawesi	0.579	0.173	0.033	0.007	0.208
22	South East Sulawesi	0.405	0.228	0.131	0.048	0.189
23	West Nusa Tenggara	0.659	0.087	0.126	0.032	0.097
24	East Nusa Tenggara	0.518	0.117	0.260	0.012	0.093
25	Maluku	0.278	0.163	0.040	0.083	0.436
26	Irian Jaya	0.388	0.043	0.050	0.273	0.247
A.	Indonesia (26 provinces)	0.514	0.184	0.107	0.082	0.112
B.	West Part of Indonesia	0.556	0.185	0.118	0.049	0.092
C.	East Part of Indonesia	0.390	0.180	0.077	0.179	0.173

Appendix Table 4:
Employment Absorption by Sector and Gender (%)

Year	Male			Female			Male + Female		
	Agric.	Industry	Others	Agric.	Industry	Others	Agric.	Industry	Others
1990	54.8	14.8	30.4	56.0	12.3	31.8	55.2	13.8	30.9
1991	52.8	15.8	31.4	54.4	12.7	32.9	53.4	14.6	32.0
1992	52.2	15.6	32.1	54.2	13.3	32.5	53.0	14.7	32.3
1993	49.4	16.7	33.9	50.9	14.3	34.8	50.0	15.8	34.2
1994	44.7	20.4	34.9	47.1	16.1	36.7	45.6	18.8	35.6
1995	44.0	19.6	36.4	44.0	15.6	40.3	44.0	18.2	37.8
1996	42.7	19.7	37.6	44.8	15.8	39.4	43.5	18.2	38.3
1997	40.1	20.8	39.1	41.8	16.2	42.0	40.7	19.1	40.2
1998	44.3	17.8	38.0	46.0	13.9	40.0	45.0	16.3	38.8
1999	43.3	19.3	37.5	43.1	15.5	41.4	43.2	17.8	38.9

Source: Adapted from ILO-Jakarta (2000).

Appendix A:

Empirical Methods

A.1. Decomposition of Economic Growth

Let Y_a denotes agricultural product, Y_i industrial product, Y_n other sectors' product, and Y national product (GDP). Then the latter can be expressed as:
$Y = Y_a + Y_i + Y_n$

The rate of economic (GDP) growth can be written as:

$$\frac{dY}{Y} = \frac{d\left(Y_a + Y_i + Y_n\right)}{Y} = dY_a \frac{1}{Y} + dY_i \frac{1}{Y} + dY_n \frac{1}{Y}$$

$$r = \frac{dY_a}{Y_a}\frac{Y_a}{Y} + \frac{dY_i}{Y_i}\frac{Y_i}{Y} + \frac{dY_n}{Y_n}\frac{Y_n}{Y}$$

$$= r_a s_a + r_i s_i + r_n s_n \qquad (1)$$

where r represents the economic growth rate, r_j and s_j denote growth rate of sector-j and the share of sector-j to GDP, respectively. Equation (1) can be expressed as:
$r_a s_a = r - r_i s_i - r_n s_n$

Following Kuznets (1964), contribution of agricultural product growth rate to the growth rate of the economy can then be calculated as follows:

$$\frac{r_a s_a}{r} = 1 - \left(\frac{r_i s_i}{r} + \frac{r_n s_n}{r} \right) \tag{2}$$

Substituting (1) into the right hand side of (2) results in:

$$\frac{r_a s_a}{r} = 1 - \left(\frac{r_i s_i + r_n s_n}{r_a s_a + r_i s_i + r_n s_n} \right) \tag{3}$$

Defining $(r_a\ s_a) / r$ as s_{ra}, the contribution of agricultural output growth to the rate of economic growth is then:

$$s_{ra} = \frac{1}{1 + \left(r_i s_i / r_a s_a \right) + \left(r_n s_n / r_a s_a \right)} \tag{3a}$$

Using the same steps, contributions of growth of industrial and other sectors to the economic growth can also be obtained, respectively, as:

$$\frac{r_i s_i}{r} \equiv s_{ri} = \frac{1}{1 + \left(r_a s_a / r_i s_i \right) + \left(r_n s_n / r_i s_i \right)} \tag{3b}$$

$$\frac{r_n s_n}{r} \equiv s_{ri} = \frac{1}{1 + \left(r_a s_a / r_n s_n \right) + \left(r_i s_i / r_n s_n \right)} \tag{3c}$$

Therefore, contribution of any k-sector to the growth of the economy, which has s sectors, can be measured using a more general formula as follows:

$$\frac{r_k s_k}{r} \equiv s_{rk} = \frac{1}{1 + \sum_{j=1}^{s} \left(r_j s_j / r_k s_k \right)} \tag{3d}$$

It is, however, easy to see that calculations following (3d) will not be valid when one of the sectors or the economy experiences a negative growth. This is because the left hand side of this equation may be expressed as: $\exp[\log(r_k\ s_k)/r] = \exp[\log(r_k) + \log(s_k) - \log(r)]$, hence the attributes in the right hand side of this expression is required to be positive for the log of a negative number is undefined. This problem can be solved by taking the square root of a quadratic form of (3d) as follows:

$$s_{rk-adj} \equiv \sqrt{\frac{r_k^2 s_k^2}{\sum_{j=1}^{s} r_j^2 s_j^2 + 2\sum_{j\neq k>0}^{s} r_j s_j r_k s_k}} = \sqrt{\frac{1}{\left[1+\sum_{j=1}^{s}\left(r_j s_j / r_k s_k\right)\right]^2}} \qquad (4)$$

where s_{rk-adj} denotes the adjusted version of (3d).

Equation (4) is employed in this study to determine contributions of growth in agricultural and industrial sectors, respectively, to the economic growth for each province of Indonesia.[19] Besides, the contribution will also be examined in a more aggregate spatial frame of the East and the West Parts of the country. In addition to these sector growth contributions, growth contributions of agricultural sub-sectors (i.e. food crops, non-food (estate plantation) crops, livestock, forestry, and fishery) to agricultural sector growth for each province will also be analyzed. The analyses are carried out using data from Central Bureau of Statistics (1999 and 2000) regarding gross regional domestic product (excluding oil and gas products) for the 26 provinces.

A.2. Determining Long Run Relative Contribution of Each Share

In order to evaluate whether or not the current changes in outputs of Indonesian economic sectors have reflected full adjustments to the crisis, and to predict directions to which they would converge, an error correction model (ECM) can be employed. Two kind of knowledge can be acquired from this type of model, namely short run adjustments of a dependent variable (GDP) to changes in independent variables (outputs of sectors) and long run relations between the dependent and independent variables.[20] To relate to the objective of this paper, an ECM is specified as follows:

$$\Delta y_t = \Sigma_j \Sigma_k \alpha_{k,j} \Delta y_{jt-k} - \gamma [y - \beta_0 - \Sigma_j \beta_j y_j]_{t-1} + \varepsilon_t \qquad (5)$$

where lower cases denote that the variables are in the natural logarithm form, k=0,1,…,K is the number of lags for Δy_j, $\alpha_{k,j}$ denotes a short run response of economic growth (Δy_t) to growth of output of sector-j for lag-k (Δy_{jt-k}), β_j is the long run relation between log GDP and log output of sector-j, γ is a positive number denoting the adjustment parameter, and ε_t is error terms. More details on these interpretations are presented below.

A.3. Non-Linear Least Squares Model of Equation (5)

Let data generation process (DGP) for GDP with five economic sectors follows an auto-regressive distributed lag (ARDL) of (1,1,1,1,1,1) as follows:

[19] The calculations actually include agriculture, industry, and 'other sectors'. Since the focus of this paper is on the relations between the first and the second sectors, for the sake of brevity the last one will not be reported.

[20] Details on an error correction model can be found, for instance, in Maddala and Kim (1998).

$$y_t = \theta_0 + \theta_1 y_{1t} + \theta_2 y_{1t-1} + \theta_3 y_{2t} + \theta_4 y_{2t-1} + \theta_5 y_{3t} + \theta_6 y_{3t-1} + \theta_7 y_{4t} + \theta_8 y_{4t-1} + \theta_9 y_{5t} + \theta_{10} y_{5t-1} + \lambda y_{t-1} + \varepsilon_t \quad (6)$$

where small cases denote that the variables are in the log form. In the *long run*, the time subscripts (t and t-1) can be ignored, so (6) can be compactly rewritten as:

$$y = \beta_0 + \beta_1 y_1 + \beta_2 y_2 + \beta_3 y_3 + \beta_4 y_4 + \beta_5 y_5 + \varepsilon \quad (7)$$

where $\beta_0 = \theta_0/(1-\lambda)$, $\beta_1 = (\theta_1+\theta_2)/(1-\lambda)$, $\beta_2 = (\theta_3+\theta_4)/(1-\lambda)$, $\beta_3 = (\theta_5+\theta_6)/(1-\lambda)$, $\beta_4 = (\theta_7+\theta_8)/(1-\lambda)$, and $\beta_5 = (\theta_9+\theta_{10})/(1-\lambda)$. Since the βs are coefficients on variables in the log form, it can be shown that β_j represents long run share of output-j sector on GDP.

It can also be shown that an error correction representation relating the ARDL and the long run relations is as follows:[21]

$$\Delta y_t = \Sigma_j \alpha_j \Delta y_{jt} - \gamma [y - \beta_0 - \Sigma_j \beta_j y_j - \beta_d D]_{t-1} + \varepsilon_t \quad (8)$$

where j=1,…,5, there is no lags of Δy_{jt} --i.e. K as written in equation (5) equals zero, which rises as a consequence of the ARDL specification, and D is a dummy variable inserted so as to capture effects of the Asian Financial Crisis. Denoting A_1 to A_5 as estimates of α_j (i.e. estimated short run responses of GDP change to one percent change in output of agriculture, manufactures, trade, services, and other sectors, respectively), G as an estimated parameter of the error correction term, and B_0, B_1, …, B_d as estimates of β_j (i.e. estimated long run parameters), the estimated model can, therefore, be written as:

$$\Delta \hat{y}_t = A_1\Delta y_{1t} + A_2\Delta y_{2t} + A_3\Delta y_{3t} + A_4\Delta y_{4t} + A_5\Delta y_{5t} - G [y - B_0 - B_1y_1 - B_2y_2 - B_3y_3 - B_4y_4 - B_5y_5 - B_d D]_{t-1} \quad (9)$$

where y denotes log GDP, y_1, …, y_5 represents log output of agricultural, manufacturing, trade, services, and other sectors, respectively.

When a restriction that:

$$B_1 + B_2 + B_3 + B_4 + B_5 = 1 \quad \text{or:} \quad B_1 = 1 - B_2 - B_3 - B_4 - B_5 \quad (10)$$

is imposed on (7) or (9), it can be shown that B_j may be interpreted as estimated long run share of sector-j growth to GDP growth.[22]

Substituting (10) into (9) results in:

[21] More (intuitive) explanation on the link between a long run equation and an ECM can be found for example in Franses (1998).

[22] The long run equation, i.e. (A.2), can be rewritten as: $\ln Y = \beta_0 + \Sigma_j \beta_j \ln Y_j + \varepsilon_t$, from which $\delta \ln Y/\delta \ln Y_j = \delta Y/Y \,/\, \delta Y_j/Y_j \equiv \%\Delta \text{ in } Y \,/\, \%\Delta \text{ in } Y_j = \beta_j$ can easily be found. Since (A.5) implies that $\Sigma_j \beta_j = 1$, then β_j can be interpreted as long run share of growth of sector-j on GDP growth.

$$\Delta\hat{y}_t = A_1\Delta y_{1t} + A_2\Delta y_{2t} + A_3\Delta y_{3t} + A_4\Delta y_{4t} + A_5\Delta y_{5t} - G\,[(y-y_1) - B_0 - B_2(y_2-y_1) - B_3(y_3-y_1) - B_4(y_4-y_1) - B_5(y_5-y_1) - B_d\,D]_{t-1} \quad (11)$$

It is clear that once (11) has been estimated, B_1 can be retrieved using equation (10) and the standard error for this estimate can be calculated based on the covariance matrix of the Bs using the usual formula. It may obviously be expected that the signs of A_j (for j=1,…5) are positive, those of B_j are also positive, that of B_d is negative (i.e. the negative impact of the AFC on the real sectors), and that of G is positive.

To overcome the possibility of autocorrelation problem, which is likely to rise due to the short number of lags in the ARDL process, the model is corrected for the problem by applying the generalized least squares (GLS) method. Because equation (11) is non-linear in the parameters and because the degrees of non-linearity becomes more severe as a result of application of GLS, the model is therefore estimated using the non-linear least square (NL) technique. Before estimating the model, it is however necessary to test whether or not each variable in levels is I(1), i.e. contains a unit root (or integrated of order one), that in the first differences is I(0), and the error correction term (i.e. the linear combination in the squared bracket of (11)) is also I(0).

The unit root tests are carried out using the Augmented Dickey-Fuller (ADF) test. It can be seen from Appendix Table 5 that the null hypothesis of unit roots cannot be rejected for each of the variables in levels as contained in (11). This suggests that directly estimating the long run relation would results in spurious regression equation. The error correction term (EC term), on the other hand, is I(0) because the null for this term is rejected. This is also the case for all variables in the first differences. These testing results, therefore, justify the use of the error correction model.

Applying the NL method on (9) yields estimates as presented in Appendix Table 6. It can be seen from the table that the signs of the estimates are as expected. The DW statistic, furthermore, suggests that there is no serious autocorrelation problem. The run test statistic indicates that the residuals of the model are approximately normal. The R^2, moreover, reflects that the model has a high determination coefficient. The estimated share of services sector is, however, statistically insignificant under any meaningful significance level and that of agricultural sector is also insignificant under the 10% significance level. Given the limited number of sample size (i.e. 29 observations), this naturally suggests a reduction in the number of independent variables, which may be carried out by merging services sector --the sector that have the most insignificant regression coefficient-- with 'others' sector. The error correction model is thus estimated with only agricultural, manufacturing, trade, and 'others' sectors.[23]

[23] Before estimating this model, however, it is necessary to carry out the unit root tests for the new 'others' sector (LOTHER1) and the new error correction term (EC Term1) after the exclusion of service sector. As shown in Appendix Table 4, the null of unit root cannot be rejected for LOTHER1 in levels, whereas that for LOTHER1 in the first differences as well as for EC Term1 is well rejected. Therefore, the new model that contains no service sector can also be specified as an error correction model.

Appendix Table 5:
Unit Root Tests for the Error Correction Model

Variable	Variable in Levels		Variable in the First Differences	
	p	ADF Statistic	p	ADF Statistic
LGDP	0	-0.120	0	-4.320
LAGRIC	0	-0.383	0	-5.731
LMANUF	0	-0.249	0	-4.276
LTRADE	1	-2.414	0	-3.701
LSERVC	0	-0.021	0	-5.682
LOTHER	0	-1.054	0	-4.759
EC Term	0	-4.226	n.a.	n.a.
LOTHER1	0	-0.598	0	-4.758
EC Term1	0	-4.063	n.a.	n.a.

Notes: The tests are carried out using the maximum number of lags in the ADF testing equation equals four; an intercept and a linear trend are included in the equation. The optimal number of lag (p) is then selected based on the Schwarz Bayesian Criterion. LOTHER1 is log of output of 'others' sector when service sector is excluded from the ECM; EC Term1 is the error correction term when service sector is excluded from the ECM. Under the conventional 0.05 significance level, the critical value for the tests for variable in levels is -3.622, whereas that for variable in the first differences is -3.633. The null hypothesis of I(1) is rejected if the ADF statistic is 'more negative' than the critical value.

Appendix Table 6:
Initial Estimates of the ECM (Equation (A.6))

Coefficient	Magnitude	Standard Error	T-Ratio
A_1	0.187	0.0147	12.752
A_2	0.163	0.0064	25.417
A_3	0.192	0.0071	26.912
A_4	0.072	0.0093	7.717
A_5	0.320	0.0073	43.647
G	0.110	0.0388	2.841
B_0	1.637	0.0903	18.133
B_1	0.127	0.0869	1.460
B_2	0.170	0.0166	10.256
B_3	0.415	0.0827	5.020
B_4	0.036	0.0649	0.559
B_5	0.251	0.0584	4.300
B_d	-0.160	0.0678	-2.356
Rho	-0.577	0.1427	-4.040
Dependent variable: Change in logged GDP. Estimation Period: 1972-99.			
R^2 between Observed and Predicted Dependent Variable = 0.9996			
Durbin-Watson (DW) Statistic = 2.124			
Run Test for Normality of Residuals (Z-statistic) = 0.663			

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