CHANGES IN FARMER TERMS OF TRADE AND AGRICULTURAL NET-BARTER TERMS OF TRADE: AN EMPIRICAL ANALYSIS[1)]

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ABSTRACT

In line with the Prebisch-Singer hypothesis, it is found that the Indonesian *farmer terms of trade* in aggregate followed a negative trend. Spatially, this tendency was mainly the case for the Western Part of Indonesia, whereas in the Eastern Part of the country, especially in some Sulawesi and Kalimantan provinces, the farmer terms of trade increased significantly. This shows a potency to properly expand the agricultural sector in these provinces without risking the relative welfare of farmers to decline. Thus more agricultural development efforts should be devoted to these regions. The *net barter terms of trade* for agriculture, which may be seen as a proxy of relative welfare of farmers with some accesses to export/import markets, on the other hand, generally depict a non-negative trend. This suggests that in average this group of farmers, or perhaps a group of agricultural exporters, was less severely affected by the crisis or crisis-like events than the peasant farmers. Therefore, systematic development program, which should be more than a rescue-short-term-demand-side program, is needed with a main aim to stabilize the relative welfare of the peasants. The analysis also suggests that Indonesia agricultural exports are supply determined, which means that eliminations of supply bottlenecks and technological advancement leading to a lower unit cost relative to price received are necessary to undertake.

Key Words: Terms of trade, Net Barter Term of Trade, Agricultural Economics

INTRODUCTION

Background and Problems

The current economic crisis has put agricultural sector into a more important position in the Indonesian economy. The sector absorbed a significant number of unemployment resulted from the collapse of the manufacturing and other sectors. Employment in industrial sector was 19.1% of total employment in 1997, while that in agricultural sector was 40.7%. In 1999, the figure for industrial sector decreased to 17.8%, whereas that for agricultural sector rose to 43.2%. In terms of output, while industrial sector experienced a decline from Rp 107.6 trillion to Rp 96.9 trillion during the same years, the agricultural sector gained an increase from Rp 64.5 trillion to Rp 65.4 trillion (these are all at 1993 constant prices). In 2000, outputs of both sectors increased to Rp 66.1 trillion for agriculture and to Rp 105.1 trillion for industry; the latter was, however, still lower than its 1997 level.

The output trends above might occur due to an increase in the relative competitiveness of agricultural sector. Such an increase took place because agriculture is considerably less import intensive than manufactures. Thus, for agriculture, the high depreciation of rupiah following the crisis lowered dollar prices of its exports and hence increased the exports. Any referensi was not the case for the industrial sector because the depreciation increased its costs for imported inputs, resulting in unfavourable effects on its competitiveness. Are these changes in competitiveness explanation consistent with the reality?

During time period adjacent to the crisis, the above explanation seemed to match the reality. Agriculture exports increased from US$ 3.27 billion in 1997 to $ 3.65 billion in 1998, while industrial exports reduced slightly from $ 34.85 billion to $ 34.60 billion. In the next years, however, exports of both sectors declined to $ 2.90 billion and $ 33.33 billion for agriculture and industry, respectively.[2] This suggests that the depreciation-led competitiveness increase was only short-lived.[3] Since, as mentioned previously, more agricultural output had been consistently produced, the recent decreases in agricultural exports

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[2] According to recent BPS publication, agricultural exports decreased further to $ 2.71 billion in 2000.

[3] In addition, it is also explained, for instance by Duttagupta and Spilimbergo (2000), that exports responded with lags to the depreciation.

implies that agricultural sector's output must had been absorbed more by the domestic market. Does this market re-orientation affect relative welfare of farmers? Or put in a more general way: how does the crisis affect relative welfare of farmers? Before answering these questions, below standard theory on changes in the terms of trade is briefly outlined.

Standard Theory on Changes in the Terms of Trade

There are a few kinds of terms of trade; however, they can be grouped into two categories, namely 'domestic' and 'international' terms of trade. As suggested by its name, measurement of the latter uses export and import prices. This kind of terms of trade is called *net-barter terms of trade*. It is clear that this concept is appropriate for an open economy. The former, on the other hand, uses received and paid prices. In agricultural sector, for instance, it is the ratio of prices received to prices paid by farmers. Thus, in regard to measurement of farmers' welfare, domestic terms of trade is a more direct and appropriate concept than the net-barter one. A limitation of this domestic (or also called farmer) terms of trade concept is lacking of explicit acknowledgement on the openness of the economy.

Since most economy is open, the net-barter terms of trade concept is used wider in the literature than the domestic terms of trade. A famous observation on the net-barter terms of trade is the Prebisch-Singer hypothesis, which states that agricultural terms of trade follow a negative long run trend. This hypothesis obtains support as well as rejection, particularly in the more recent time. Lipsey (1994), for example, finds that the long term (1900-1992) net barter terms of trade for primary product increases, instead of decreases, by approximately 0.5% per annum. The same conclusion is also drawn, among others, by Cuddington and Urzua (1989) and Powell (1991).

According to Newbold and Vougas (1996), a support to the Prebisch-Singer hypothesis would be obtained when the series is trend stationary. In other words, the hypothesis is rejected when the terms of trade series is integrated of order one or more. Persson and Teräsvirta (1999) support Newbold and Vougas' (1996) claim. In regard to testing for the hypothesis, Persson and Teräsvirta suggest the use of a sufficiently long time series.

Scope and Outline of the Study

This study aims at providing answers to the question above. Being a desk study, that aim were reached by making use of secondary data from the BPS. The main variable to be studied is agricultural terms of trade, changes of which are asserted to be capable of representing dynamics of relative welfare of farmers. Several measures of terms of trade are discussed in Section 2. In the same section, an econometric time series model for analyzing factors affecting fluctuations in terms of trade is proposed. Section 3 is devoted for presenting and discussing results of the analysis. Concluding remarks are drawn in Section 4.

THE EMPIRICAL METHOD

Measurements of the Terms of Trade

Farmer terms of trade (*nilai tukar petani*, FT) is a domestic terms of trade published regularly by the BPS. FT is calculated using the formula as follows:

$$FT = (PR / PP) \times 100\% \qquad (1)$$

where PR is an index of prices received by farmers and PP is an index of prices paid by the farmers.[4] The indices are constructed using a particular base year. As such, a deviation of FT from 100 reflects a proportional change in the relative welfare of the farmers as compared to the base year situation.

The international terms of trade may be represented by several concepts; amongst others are net barter, income, and single factoral terms of trade.[5] Net barter, or also called commodity, terms of trade (NT) is defined as follows:

$$NT = (PX / PM) \times 100\% \qquad (2)$$

where PX is an index of export prices received by a nation and PM denotes an index of import prices paid by the nation. In this study, NT is calculated for the agricultural sector (and some of its sub-sectors) as an aggregate. For the sake of comparison, NT is also computed for the industrial sector. As

[4] PR is a weighted index, whereby value of each output sold by the farmers is used as the weight. PP is also a weighted index, with value of each good purchased by the farmers being used as the weight. The purchased items include both consumption goods/services and inputs for the farms, whereas the sold outputs are of food crops and small scale estate crops. See BPS (2001) for more details.

with FT, the indices in (2) are also constructed using a particular base year.

Income Terms of Trade (YT) is calculated using the formula as follows:

$$YT = (PX / PM) \times QX \times 100\% \qquad (3)$$

which is the same as NT × QX, whereby QX is an index of the volume of exports. It is easy to see that YT can be used as a measure of a nation's export-based capacity to import.

Single Factoral Terms of Trade (ST) can be measured as follows:

$$ST = (PX / PM) \times ZX \times 100\% \qquad (4)$$

which is the same as NT × ZX, whereby ZX is a productivity index in the nation's export sector. It is not difficult to see that ST can be interpreted as the amount of imports the nation gets per unit of domestic factors of production embodied in its exports.

According to Salvatore (1998), YT and ST are the most important types of terms of trade for developing nations. NT is the easiest to compute, so most of studies on the terms of trade use it instead of YT and ST.[6] From (2) to (4), it can be seen that it is possible to have a condition where YT or ST still increases while NT is declining. This condition is still favorable to developing economies, next to the condition where NT, YT, and ST are all up. Unfavourable condition occurs when these three measures deteriorate; this is the so-called 'immiserizing growth'.[7]

The Model and Econometric Testing

In order to analyse effects of exogenous shocks on terms of trade and other closely related variables, a time series econometric model is proposed. Aiming at analysing dynamics of Indonesian agricultural terms of trade, the model or system is assumed to consist of three variables, namely net-barter terms of trade, volume of agricultural exports, and real exchange rate. Discussion on reasons to choose these variables and the data are provided in Appendix 1.

In order to analyse non-causality of a variable to the others, the Granger causality test is performed. Based on this test, it is found that the null hypothesis that the terms of trade is not causal to the other two variables cannot be rejected; and this is also the case for the volume of agricultural exports.[8] For the real exchange rate, on the other hand, it is found that such a null hypothesis is rejected. This indicates that the variables in the system should be arranged in the following order:

- The real exchange rate (LRE) in the first row and the volume of agricultural exports (LVA) and the agricultural terms of trade (LTA) in the second and the third row, respectively, or:
- The order is as follows: LRE, LTA, and LVA.

This study assumes the former order, indicating that contemporaneously the real exchange rate affects volume of agricultural exports and the terms of trade, and that the exports volume influences the agricultural net-barter terms of trade. This assumption reflects a view that as a measure of relative welfare of farmers, the agricultural terms of trade is relatively more endogenous than the other variables. The contemporaneous relations contained in this system can then be expressed as follows:

$$LRE = r(e^{RE}) \qquad (5)$$
$$LVA = v(LRE, e^{VA}) \qquad (6)$$
$$LTA = t(LRE, LVA, e^{TA}) \qquad (7)$$

Equation (5) asserts that the real exchange rate is solely determined by its own shocks (e^{RE}). It is expected that a positive shock to the exchange rate will result in an increase in the exchange rate, i.e. $re_{RE}>0$. This increase is interpreted as a real depreciation because this variable is expressed in terms of domestic currency per foreign currency multiplied by the ratio of foreign to domestic prices.

In (6), it is specified that volume of agricultural exports is affected by the real exchange rate and exogenous shocks to the exports (e^{VA}). Favourable shocks to exports are expected to result in an increase in the volume of exports, i.e. i.e. $ve_{VA}>0$. It is generally expected that a depreciation in real exchange rate would induce exports to grow, indicating that $v_{LRE}>0$.

[5] Salvatore (1998).

[6] The unavailability of data on ZX, however, forces us to exclude computation of ST.[7] This term, due to Jagdish Baghwati (1958), is a situation where a nation's terms of trade deteriorate so much as a result of growth that the nation is worse off after growth than before, even if growth without trade tends to improve the nation's welfare.

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[8] The tests were carried out on a vector autoregression system (i.e., VAR(2)) containing the three variables (in the logarithm form) specified in the first differences. The specification in this system is in the first differences because each of the variables in levels contains a unit root. Details on the results of the unit root tests are presented in Appendix 2.

Lastly, it is apparent from (7) that agricultural terms of trade are affected contemporaneously by an exogenous shock to the terms of trade (e^{TA}), the real exchange rate, and agricultural exports volume. It is expected that a favorable shock to terms of trade leads contemporaneously to an improvement in the terms of trade, i.e. $te_{TA}>0$. Real exchange rate may relate positively or negatively to the terms of trade. When these two variables are positively related (i.e. $t_{LRE}>0$), exports –which have a positive correlation with the real exchange rate– would also have a positive correlation with the terms of trade (i.e. $t_{LVA}>0$). In a LTA-LVA space, this positive correlation means that volume of exports and terms of trade form a supply function. Thus, a movement along this function is due to a movement in a shifter(s) of export demand, suggesting that the export is demand determined. Analogue with this discussion, therefore, a negative relation between real exchange rate and terms of trade (i.e. $t_{LRE}<0$) would indicate that exports are supply determined. In this case, it should be clear that (i.e. $t_{LVA}<0$).

Simultaneously the contemporaneous relations expressed in (5) through (7) can be specified neatly in a matrix notation that, within the Structural Vector Auto-regression (SVAR) framework, may be written as follows.

$$\underset{\mathbf{A}}{\begin{pmatrix} 1 & 0 & 0 \\ a_{21} & 1 & 0 \\ a_{31} & a_{32} & 1 \end{pmatrix}} \underset{\mathbf{e}}{\begin{pmatrix} e^{LRE} \\ e^{LVA} \\ e^{LTA} \end{pmatrix}} = (b_{jj}) \underset{\mathbf{B}}{\begin{pmatrix} \varepsilon^{LRE} & 0 & 0 \\ 0 & \varepsilon^{LVA} & 0 \\ 0 & 0 & \varepsilon^{LTA} \end{pmatrix}} \quad (8)$$

A **e** **B** e

where each row of the matrices refers to each of the equations, e^i is non-structural shock (innovation) to equation-i, e^j denotes a structural shock to equation -j, a_{ij} and b_{jj} (for i,j=1,2,3) are both contemporaneous parameters of the model, and B is an orthogonal matrix. It is obvious that the structure of the system as depicted by (8) is just-identified, and hence is not testable. Based on estimated parameters of this system, dynamics of terms of trade will be evaluated by employing the innovation accounting techniques, covering impulse response functions (IRF) and forecast error variance decompositions (FEVD). The IRF allows one to scrutinize dynamic effects of a particular shock on each variable in the system, whereas the FEVD is useful to trace relative importance of each shock in driving variability of each variable.

The innovations or shocks contained in (8) will be computed from a vector error correction model, in which a long run relation(s) amongst the variables may be imposed on the long run (cointegrating) component of the model. The number and specification of long run relations are subject to statistical tests in the cointegration framework. These relations may, however, be specified so as to take the forms as follows:

LTA = T(LRE, T), and/or
LVA = V(LRE, LTA).[9]

where T is a linear trend, and all variables, except for T, are in the logarithm form.

The first long run relation would be imposed on the first cointegrating vector (CV_1) and the second relation (if it turns out that there are two cointegrating / long run relations) on the second cointegrating vector (CV_2). These long run relations can be written as follows:

$$CV_1 = b_{11}\ LRE + LTA + b_{14}\ T \quad (9a)$$
$$CV_2 = b_{21}\ LRE + LVA + b_{23}\ LTA \quad (9b)$$

where CV_i (i=1,2) denotes white-noise disturbances to i^{th} long run equation, and b_{ij} represents parameter of the long run relations. Given T, b_{11} may be greater or less than zero, depending on whether exports are supply or demand determined as discussed previously. As for the coefficient of the trend, given LRE, the Prebisch-Singer hypothesis (that is, net barter terms of trade exhibits a negative trend) will be supported if (in (9a)) $b_{14}>0$. The second long run relation (9b) can be interpreted as long run export supply or demand. It is expected that the sign of b_{23} is consistent with b_{11}; when it is positive then exports are supply determined. Finally, it is assumed that $b_{21}<0$, and hence LVA correlates positively with LRE as generally expected.

RESULTS AND DISCUSSION

Before analysing fluctuations in the terms of trade due to various exogenous shocks, it is important to firstly present dynamics of domestic or farmer terms of trade. This will be undertaken by comparing its levels before, during, and after the Asia crisis, and across regions in the following section.

[9] Since the system contains three variables, it should be clear that the maximum number of long run relations containing linear combinations among the variables in the cointegrating space is two.

[10] The aggregate figures in Table 1 were calculated based on farmer terms of trade data for 14 provinces published by BPS (2001). We constructed the figures as a weighted index, with agricultural output in each province being used as the weight.

Dynamics of Farmer Terms of Trade

Short Run Dynamics of Farmer Terms of Trade

The farmer terms of trade, in general (aggregate of 14 provinces) tended to be higher during or just after the crisis (1997-1998) than during the period 1992-1996 (Table 1, Panel C).[10] The aggregate terms of trade then decreased to 101.9 during the period 1999-2000, which was only 1.9% higher than its value in the base year (1993) and lower than those in the other time periods. This trend suggests that the increase in the aggregate relative welfare of farmers following the Asian crisis is only a temporary phenomenon.

Table 1. Average Domestic Terms of Trade in Various Provinces of Indonesia

Provinces	1987–1991	1992–1996	1997–1998	1999–2000
A. Some Provinces in Western Part of Indonesia:				
1. West Java	110.8	106.5	108.3	107.7
2. Central Java	114.8	109.6	112.2	88.7
3. DI Yogyakarta	111.3	106.9	108.9	116.7
4. East Java	119.7	113.4	117.0	95.3
5. DI Aceh	105.4	102.3	103.0	90.1
6. North Sumatera	118.9	112.8	116.2	87.2
7. West Sumatera	94.9	94.1	92.8	99.4
8. South Sumatera	103.9	101.1	101.6	99.4
9. Lampung	116.5	111.0	113.9	79.2
B. Bali, NTB, and Some Provinces in Eastern Part of Indonesia:				
1. Bali	97.7	96.2	95.5	138.4
2. NTB	94.5	93.7	92.4	110.9
3. South Kalimantan	105.2	102.1	102.9	122.6
4. North Sulawesi	104.6	101.7	102.3	132.2
5. South Sulawesi	101.8	99.5	99.6	120.3
C. Weighted Average:				
Aggregate 14 Provinces	111.8	107.3	109.3	101.9

Note: The terms of trade index is of 1993=100.

Spatially, the negative trend of the terms of trade was mainly the case in the Western Part of Indonesia (Table 1, Panel A). In the Eastern Part of the country, whereby contributions to growth of both agriculture and industry raised after the crisis (Siregar, 2002), the terms of trade increased considerably (Table 1, Panel B).[11] South Kalimantan, North Sulawesi and South Sulawesi were provinces which continuously enjoying terms of trade increases since the 1992-1996 period. Since the increase is likely due to less intensive use of commercial inputs —and hence to fewer amounts of outputs supplied (see footnote 10), this suggests that a proper expansion of the agriculture in these regions would not risk the farmer terms of trade. Similarly, an Asian-crisis-like event would not deteriorate the farmer terms of trade in those regions.

The negative trend in the terms of trade after the crisis may manifest in changes in distribution of the number of farm households by land ownerships. As can be seen from Table 2, the number of landless farm households increased from around 5.1 million in 1995 to 7.1 million in 1999. In terms of percentage to the total number of households, this means an increase from 11.1% to 14.1% during those years. Likewise, the number of farm households with less than 0.5 ha of land went up from 8.0 million (17.6%) to 10.1 million (20.0% of the total number of households) through the same years.

[11] Farmers in the Eastern Part of Indonesia generally apply fewer inputs that contain considerable amount of imported materials, such as fertilizers and other chemicals, and supply smaller amount of outputs. In paddy cultivation in 1999, for instance, aggregate use of chemical fertilizers in Kalimantan and Sulawesi was 91.4 and 202.8 kg/ha, respectively, whereas that in Java was as high as 417.7 kg/ha (BPS, 2000). That is also the case in maize cultivation, whereby the corresponding figures were 83.2 and 92.1 kg/ha in Kalimantan and Sulawesi, respectively, as compared to 219.3 kg/ha in Java. Thus, increases in prices of these inputs brought about by the rupiah depreciation have raised the production costs with lower proportion than increases in output prices. This results in a rise in net income, which is reflected by the increase in the farmer terms of trade.

The increases in the figures above may originate from: (a) natural growth (i.e. new households emerge from within the class), on which no data are available, (b) farm downsizing, as implied by the decrease in the number of farm households owning 0.5–1.0 ha of land from around 3.1 million in 1995 to 2.9 million in 1999, and (c) flow back of some of the crisis-induced unemployment from urban to rural areas. Although there is no published data on the unemployment, figures in Table 2 may support this conjecture. The numbers of households classified as farm labourer and as those owning < 0.5 ha of land grow by 40.2% and 25.8%, respectively, from 1995 to 1999.[12,13] Each of these is much higher than the respective figure for the total number of households, i.e. 10.6%, which may be grossly assumed as the natural growth. There is a possibility that the unemployment entered non-agricultural activities in rural areas. This possibility is, however, quite small because the number of households involved in these activities, especially those earning low income, only increased by 6.8% (i.e. from 6.8 million in 1995 to 7.3 million in 1999). This may provide evidence that, with regard to the Asian crisis, agriculture has served as an 'employment sink' for the economy.

Table 2. Distribution of Households Based on Land Ownership and Per Capita Income

	Population (000)		No. H-holds (000)		Disp. Income (Rp	
Items	1995	1999	1995	1999	1995	1999
1. Number/Amount	194,755	207,437	45,653	50,504	2,035.1	3,737.8
2. Agriculture:						
a. Farm labourer	20,794	30,608	5,065	7,099	616.7	1,629.7
b. < 0.5 ha	32,991	40,009	8,024	10,098	934.5	1,676.9
c. 0.5 – 1.0 ha	13,796	13,695	3,076	2,916	1,200.2	2,650.5
d. > 1.0 ha	10,697	10,619	2,191	2,38	1,758.8	3,422.3
3. Non-agriculture:						
a. Rural:						
- Low income	28,702	29,933	6,844	7,31	1,765.3	3,138.7
- Non-labour forces	9,098	9,877	2,796	3,052	1,719.8	3,978.2
- High income	15,268	13,805	3,264	3,202	3,429.0	7,301.2
b. Urban:						
- Low income	33,835	30,856	7,709	7,387	2,278.0	4,650.2
- Non-labour forces	10,197	10,131	2,66	2,931	2,076.3	4,180.8
- High income	19,377	17,903	4,025	4,131	5,181.8	9,264.5

Source: Processed from the National Social Accounting Matrices of 1995 and 1999 (BPS 1998; 2000).

Long Run Dynamics of Farmer Terms of Trade

The discussion in paragraphs above is on short run dynamics of the farmer terms of trade. But what is the long term trend of the aggregate farmer terms of trade? To have a clearer figure of the trend than the one depicted from Table 1, we smooth the aggregate figures of the terms of trade.[14] Results of the smoothing are summarized and presented in Figure 1.

As shown in this figure, the long term trend of domestic or farmer terms of trade index tends to be negative. The index decreased from around 105-106 during the end of the 1980s or the beginning of the 1990s to approximately 94 in 2000. Taking into account all the ups and downs of the index, it can be shown that the terms of trade depicted a compounded growth rate of approximately -0.68% per annum,

[12] The growth is not of annual but total between 1995 and 1999.

[13] The total number of wealthier farm households (own 0.5-1.0 and > 1.0 ha of land) tended to be unchanged, i.e. around 5.3 million (Table 2). In 1999, these households gained average annual per capita disposable income of between Rp 2.65 and Rp 3.42 millions, which are considerably higher than those earned by the labourers and the households with less than 0.5 ha farm land (i.e. between Rp 1.63 and 1.68 millions). The closeness of the latter pair of figures is more than proportional to the corresponding figures in 1995, i.e. Rp 0.62 and Rp 0.93 millions. This may occur because, among the farm labourers in 1999, the new entrants use their saving that was obtained from working in urban sectors.

[14] The smoothing was carried out using the third order centered moving average (CMA(3)) and the resulting index was then adjusted so that its value for 1993 equals 100.

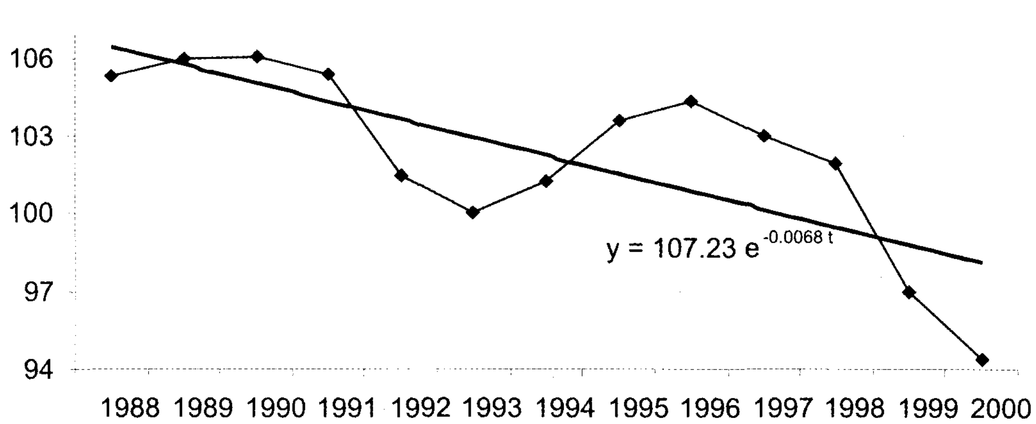


Figure 1: Indonesian Farmer Terms of Trade:
CMA(3) Adjusted Index

which seemed to be small but statistically significant with the p-value of 0.003. It can, therefore, be concluded that the Prebisch-Singer hypothesis, that agricultural terms of trade follows a negative trend, is supported by the farmer terms of trade index.

Would the conclusion above be supported when another measure of agricultural terms of trade is used? This is discussed in the following section.

Agricultural Net Barter Terms of Trade

It is described by BPS (2001, pp.5-6) that the raw data for calculating the farmer terms of trade were collected from farmers domiciled in- and sub-district markets in the rural areas. Therefore, the negative long term trend in the farmer terms of trade happened mainly to smaller non-exporting farmers. What happens to the relative welfare of farmers or agricultural companies which had access to export markets? This question cannot be directly answered because there is no published data separately for that cluster. However, it may be answered by analyzing fluctuations in agricultural net barter terms of trade.

Dynamics of Agricultural Net Barter Terms of Trade

It can be seen from Figure 2 that net barter terms of trade of agriculture had been approximately stagnant during the period 1981-1993, up during 1993-1997, and down during 1997-2000 (i.e., after the crisis). The *long term* trend of the agricultural net barter terms of trade, as depicted by the permanent component of the terms of trade in Figure 2.a, suggests that the ratio of export prices to import prices in agricultural sector had been *approximately stagnant.*[15] Overall, this indicates that the positive trend during the period 1993-1997 and the negative trend during the period 1997-2000 were only temporary, as reflected from Figure 2.b.

Comparing the results above to those in Section 3.1, it may therefore be concluded that the *long term* trend of the relative welfare of farmers with no access to export markets (i.e. the farmer terms of trade) tends to be worse than the relative welfare of farmers with some accesses to international markets (i.e. the agricultural net-barter terms of trade). If this is true, it should be reflected from a widening gap between farm gate prices and export or wholesale prices. Taking rice as a case, it can be seen from Figure 3 that the gap indeed has tended to increase. The gap, which was around Rp 102 per kg in 1996 and up to Rp 193 per kg in 1997, increased consistently after the onset of the Asia crisis, e.g. Rp 289 per kg in 1998, Rp 313 per kg in 2000, and Rp 347 per kg in 2002 (up to June).

In regard to effects of the Asian crisis taking place during the period 1998-2000, both the farmer and the agricultural net barter terms of trade had similar negative responses. There are at least two possible factors that led these terms of trade to decrease after the crisis, namely increases in prices of inputs whose components are partly imported (e.g., fertilizers and

[15] The terms of trade index is decomposed using the Hodrick-Prescott filter, which enables one to separate the trend component from the cyclical component. The trend component depicts the long term permanent part of the series, whereas the cyclical one represents its temporary parts.

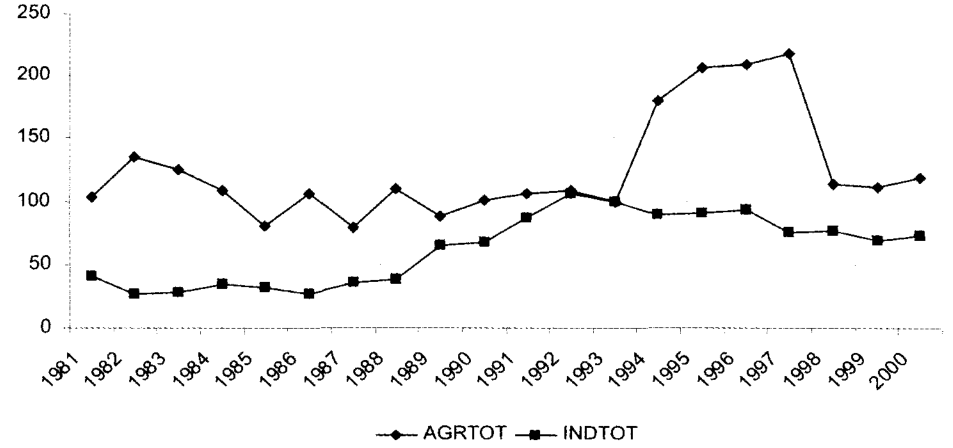


Figure 2: Terms of Trade of Agriculture and Industry

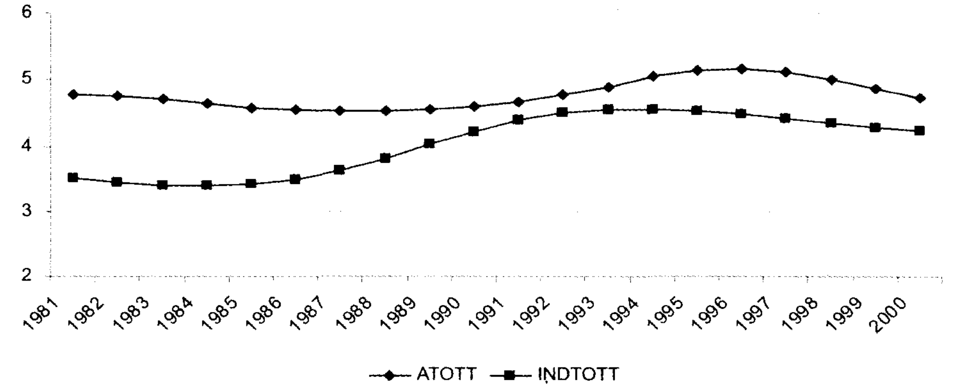


Figure 2.a: Permanent Components of Agricultural and Industrial (Logged) Terms of Trade

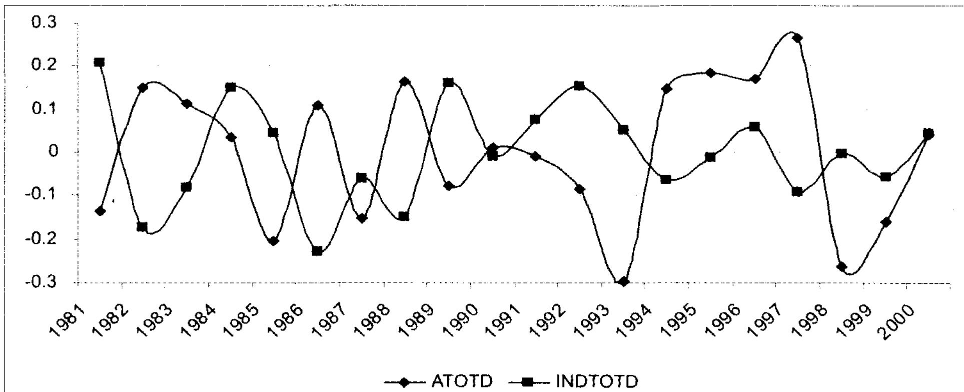
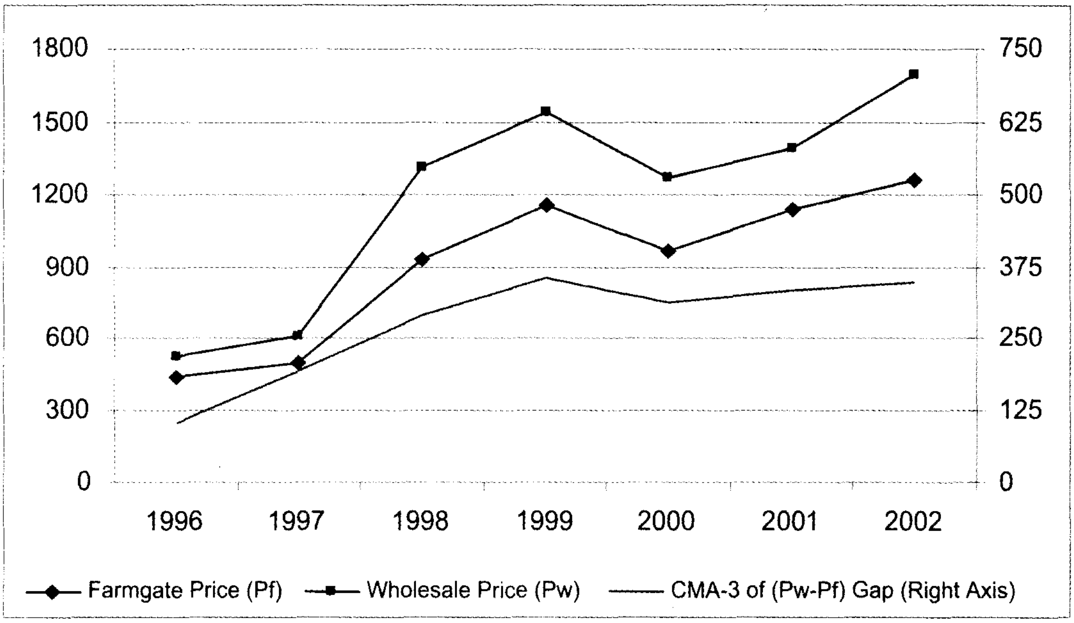


Figure 2.b: Detrended Components of Agricultural and Industrial (Logged) Terms of Trade

pesticides) and decreases in yields of crops. The elimination of subsidies for such important inputs as fertilizers combined with the rupiah-depreciation-induced lent, respectively, in 1999.[17] Since the farmers received less, as reflected from the decrease in yield, and paid more, then the farmer terms of trade deteriorated. This



Source: Processed from BULOG.
Note : Wholesale price (P^w) was originally in terms of Rp / kg of rice (IR III). It is then adjusted to be Rp / kg of paddy (i.e. the same unit of measurement for farm-gate price, P^f) by multiplying P^w by 0.65 (the conversion factor from paddy to rice used by BULOG for 1989 and after).

Figure 3: Widening Gap between Wholesale and Farm-gate Prices of Paddy

increases in prices of these inputs had caused prices of fertilizers to triple compared to those before the crisis (Adnyana et al., 2000). With a lower rate, increases in prices of pesticides and other inputs also occurred. Such increases led to considerable reductions in the uses of fertilizers and pesticides, which then claimed by Adnyana et al. to cause a decrease in wetland paddy yield by 0.5-1.0 ton/ha.

In addition to that, the increases in inputs prices also led the farmers to bear higher real costs for these inputs.[16] It was found by Adnyana et al. (2000) that per hectare real costs of urea and pesticides increased from 88 and 24 kg of rice equivalent, respectively, in 1995 to 101 and 36 kg of rice equiva- is also believed to be the case for many other crops including those reaching the export markets.[18]

Returning to Figure 2, it is interesting to compare agricultural net barter terms of trade index with industrial net barter terms of trade index. In almost all years, the latter had been lower than the former. This indicates that import prices in industrial sector (relative to its export prices) are higher than those in agricultural sector, which might be the case because the industry is much more import dependent than the agriculture. Furthermore, gaps between net barter terms of trade of the two sectors had tended to narrow (Figure 2.a). This is because of the faster increases in the long term component of the industrial net barter

[16] Although the increases in inputs prices reduced the applications of such inputs, the relatively low elasticities of these farm inputs (see for instance Siregar (1991) on various estimates of elasticities) meant that the increases in such prices occurred with higher proportion than the reductions in the applications of such inputs.

[17] In addition, the crisis also induced labour costs to increase more than double from an equivalent of 162 kg of rice in 1995 to 382 kg of rice in 1999 (Adnyana et al., 2000).

[18] In their study on secondary crops (*palawija*), Supriyati and Muchjidin (2001) also draw the same conclusion.

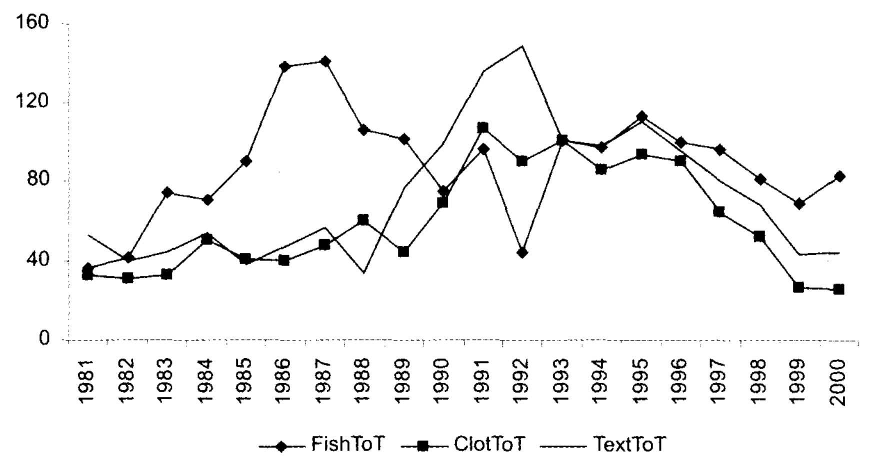


Figure 4: Terms of Trade of Fishery, and of Clothing and Textile Industries

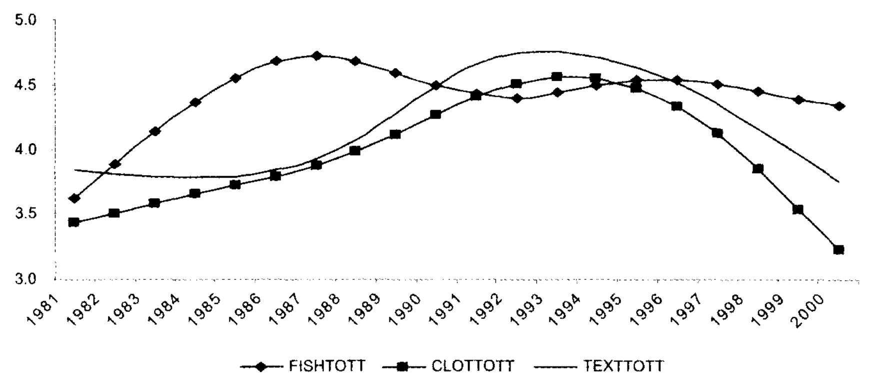


Figure 4.a: Permanent Components of (Logged) Terms of Trade of Fishery, and Clothing and Textile Industries

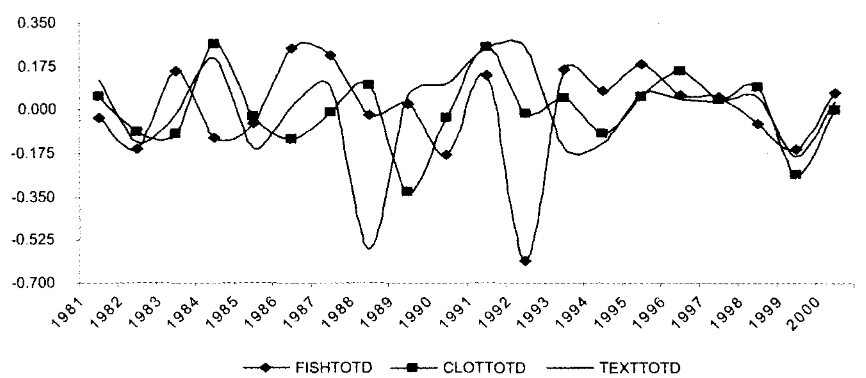


Figure 4.b: Detrended Components of (Logged) Terms of Trade of Fishery, and Clothing and Textile Industries

terms of trade during the period 1986-1994. Such accelerating increases might be due to trade deregulation packages launched in mid 1980s, which decreased transaction costs for imports and hence reduced the unit value (price) of imports.[19] Since imports are significantly larger in the industrial sector than in the agricultural sector, this gave a greater favourable effect on the industry.[20]

What happens to the terms of trade of several commodities? First we shall describe their net barter terms of trade. As can be seen from Figure 4, net barter terms of trade of fishery, as well as of clothing and textile industries are presented. In terms of these commodities, the terms of trade of fishery (as a sub-sector of agriculture) also exceeded those of the industry (as exemplified by clothing and textile products) but mainly during the 1980s and beyond 1995. Consistent with graphs in Figure 2, it is apparent from Figure 4 that the three indices of terms of trade decrease beyond 1995. Since cyclical components of these terms of trade fluctuate around the zero line during this period (Figure 4.b), it can then be concluded that the decreases are likely due to negative trends in the permanent (long term) components of the terms of trade (Figure 4.a). These negative trends were perhaps due to a series of trade liberalization packages introduced in May 1995, which brought about more open and freer nature of such industries, leading to increases in the number of exporters internally and externally and in turn raising the exports.

The situation above was perhaps due to a quite rapid liberalization on such activities particularly between the mid 1995 and just before the crisis. As concluded by Oktaviani and Drynan (1999, p.45), 'Indonesia gains more [from trade liberalization] if she *precisely* eliminates the implied barriers existing after trade liberalization by other APEC members than if she under-adjusts or over-adjusts' (emphasis added).Given demand for such commodities unchanged, increases in volume of exports could depress world prices for such commodities, reduce net export revenue,[21] and deteriorate the terms of trade of each commodity.

Income terms of trade of the aforementioned commodities (Appendix Figures 2, 2.a, and 2.b) exhibit quite different dynamics from these commodities' net barter terms of trade. The most important difference perhaps is the higher level of the textile income terms of trade than the fishery income terms of trade during the recent years. This is partly in line with their aggregate counterparts (Figures 2, Appendix Figures 1 and 1.a). Albeit that difference, a similarity between the two concepts of terms of trade is the tendency of the clothing income and net barter terms of trade being the lowest during the more recent years. This suggests that the clothing's exports based capacity to import has been lower than that of the other commodities.

Responses of the Agricultural Net Barter Terms of Trade to Various Shocks

Empirically, variables that relate closely to the terms of trade are volume of exports, the real exchange rate, which was severely affected by the Asian crisis like events, and of course shocks to these variables and to the terms of trade itself. The question is that which is the most important one amongst these variables/shocks? This question may be answered by undertaking analyses based on the models depicted by equations (8), (9a), and (9b), with the focus on the net barter terms of trade. The first step to do this is to determine the number of long run relation(s) existed amongst the three variables (net barter agricultural terms of trade (LTA), volume of agricultural exports (LVA), and the real exchange rate (LRE)). This is carried out using the Johansen approach, results of which are presented in Table 3.

As can be seen from Table 3, the cointegration test based on maximal Eigenvalue suggests that the number of long run relation in the system is one, whereas the test based on the trace of the stochastic matrix indicates none. To have a decisive conclusion, a selection criterion (SBC) is employed. As shown in panel B of the table, SBC suggests that the number of long run relation (the number of cointegration vector) is one. The next analysis is to identify such a relation.

Since there is only one cointegration vector and since the focus of this paper is to study dynamics of the terms of trade, then it is instructive to specify the vector as a long run equation of the terms of trade. This requires that the coefficient on LTA in the cointegration vector is set to one. Under this situation, as presented in Table 3 (the second column), the coefficient on agricultural volume of exports (LVA) is statistically insignificant. By restricting this coeffi-

[19] See Fane and Condon (1996) on these trade deregulation packages.
[20] Similar dynamics also occur for the income terms of trade. For the sake of brevity this kind of terms of trade is not presented in this paper, but is available from the author upon request.
[21] The phenomenon that increases in exports lead to reductions in net export revenue is known as 'the adding up problem' (Daryanto, 1999).

Table 3. Determination of the Number of Long Run Relations (r) Involving LRE, LVA, and LTA

Null Hypothesis	Alternative Hypothesis	Test Statistic	95% Critical Value
A.1. Johansen Cointegration Test Based on Maximal Eigenvalue:			
r=0	r=1	28.047	25.42
r≤1	r=2	10.080	19.22
r≤2	r=3	0.893	12.39
A.2. Johansen Cointegration Test Based on Trace of the Stochastic Matrix:			
r=0	r≥1	39.020	42.34
r≤1	r≥2	10.973	25.77
r≤2	r=3	0.893	12.39
B. Determination of r Based on the Schwarz Bayesian Criterion (SBC):			
The Number of Cointegration Vector (r)		SBC	
r=0		15.270	
r=1		20.460	
r=2		19.611	
r=3		17.113	

Note: The tests were conducted under the specification of cointegration with unrestricted intercepts and restricted trends in the VAR system.

cient to zero, the cointegration vector will follow the specification as in (9a). The likelihood ratio test for this restriction (the last row of the second column of Table 4) indicates that the restriction is consistent with the data (i.e. the restriction cannot be rejected). This supports the identification of the cointegration vector as a long run equation of agricultural net-barter terms of trade.

From the estimated cointegration vector (i.e. the restricted CV_1), the long run agricultural net-barter terms of trade can be written as follows:

$$L\hat{T}A_t = 0.105 \text{ Trend} - 1.541 \text{ LRE}_t + E(CV_1)$$

where $E(CV_1) = 0$, i.e. the expected value of the white noise disturbance (CV_1) is zero, and each of the regression coefficients is statistically significant. The elasticity of the terms of trade with respect to the real exchange rate is negative, confirming that Indonesian agricultural exports are supply determined.[22] The fact that this estimate is elastic suggests that the agricultural terms of trade is responsive to changes in the real exchange rate. The negative sign of the estimate reflects that a real depreciation turns out to have a negative effect on the terms of trade in the long run. Moreover, the equation above also shows that the net barter terms of trade follow a positive trend, and hence

Table 4. Identification of the Long Run Relation and Its Maximum Likelihood Estimates

Variables	Cointegration Vector (Unrestricted CV_1)	Cointegration Vector (Restricted CV_1)
LRE	1.684	1.541
	(0.526)	(0.497)
LVA	-0.154	0
	(0.446)	
LTA	1	1
Trend	-0.106	-0.105
	(0.019)	(0.016)
		Likelihood Ratio Test of Restriction
		$(\chi^2_{(1)}) = 0.145$ with the p-value = 0.703.

Note: Figures in the parentheses are the standard errors.

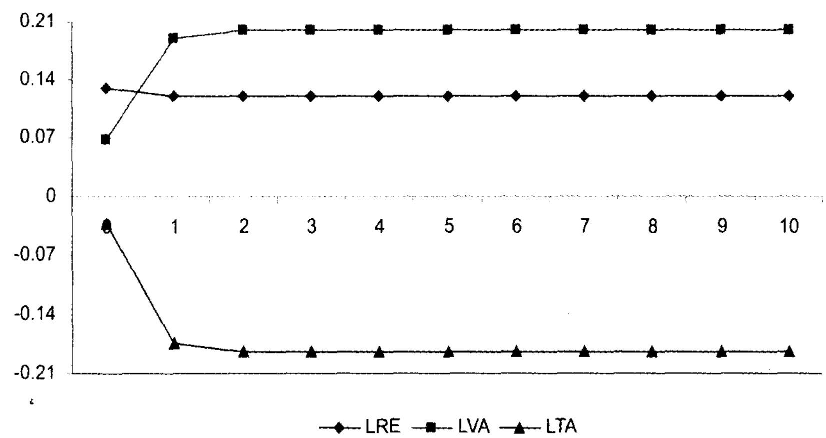


Figure 5: Responses of Each Variable to One Standard Error Shock to the Real Exchange Rate (LRE)

lends no support to the Prebisch-Singer hypothesis.[23]

Having estimated the long run net-barter terms of trade of agriculture, the next step is to analyze the impulse response functions (IRF) and the forecast error variance decomposition (FEVD). As can be seen from Figure 5, a one standard error shock to the real exchange rate (a 13.0 percent depreciation of LRE), deteriorates the terms of trade by approximately 3.1 percent at the impact period, 17.4 percent after a year,

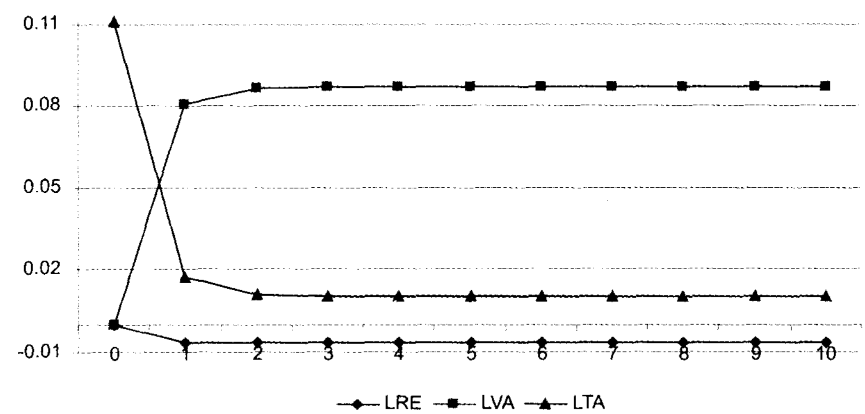


Figure 6: Responses of Each Variable to One Standard Error Shock to Agricultural Net-Barter Terms of Trade (LTA)

and 18.5 percent in longer horizons. This is consistent with the result from the estimated cointegration equation. The shock to the real exchange rate, which permanently depreciates LRE by approximately 12.0 percent in longer horizons, induces agricultural volume of exports (LVA) to increase by 6.8 percent at the impact period and by around 20.0 percent in longer horizons. Therefore, any increases in value of agricultural exports due to real exchange rate depreciation would be originated from increases in volume of exports.

Figure 6 presents responses of each variable to a one standard error shock (around 11.1 percent) to the terms of trade. It can be seen from the figure that the terms of trade shock tends to be short lived. The increase, which is 11.1 percent at the impact, drastically lowers to 1.7 percent a year after the onset of

[22] This is consistent with Athukorala (1998), who discussed that for most developing countries exports are supply determined.

[23] This is consistent with Lipsey (1994) that found that the long term (1900-1992) net barter terms of trade for primary product increases, instead of decreases, as well as with Cuddington and Urzua (1989) and Powell (1991).

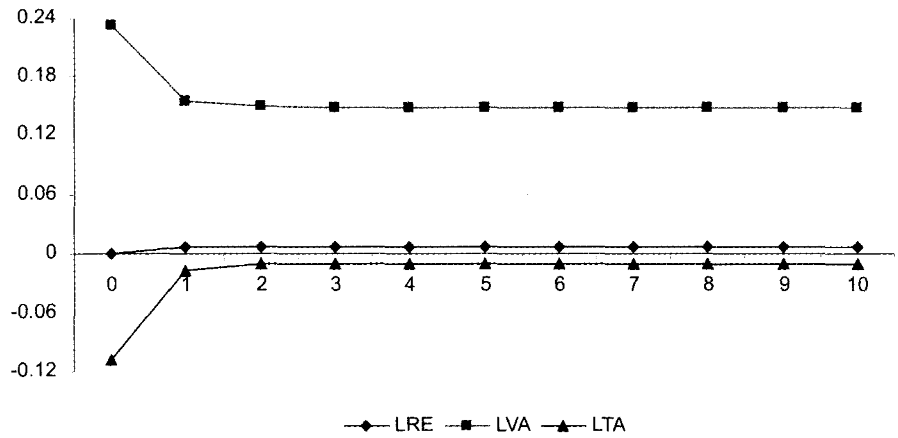


Figure 7: Responses of Each Variable to One Standard Error Shock to Agricultural Volume of Exports (LVA)

the shock and to 1.0 percent in longer horizons. Volume of exports responds to these movements with the opposite direction. That is, soon after the improvement in the terms of trade has started to decline, the exports increase by approximately 8.1 percent after a year and 8.7 percent in the longer horizons. As generally expected, Figure 5 also shows that the terms of trade shock affects the real exchange rate trivially.

As in the case of the terms of trade shock, the real exchange rate also responds negligibly to a shock to the volume of exports (Figure 7). A one standard error shock (approximately 23.3 percent) to the volume of agricultural exports would lead to 14.9 percent increase in the exports in the longer run. This shock, which can be represented by a technological progress, however can only affect the terms of trade within a year. The shock would deteriorate the terms of trade by 10.9 percent within the impact period and by as small as 1.0 percent in the longer horizons [24]. Thus, technological advancement that leads to more outputs and exports alone is not sufficient for improving the relative welfare of the agriculture sector. Such advancement should also be able to secure that the unit cost born with the application of such technology lower than the priced received.

The next analysis is on relative contribution of each shock to explain variability of each variable. It can be seen from Table 5 that the real exchange rate variability is mainly explained by its own shock. This reflects that this variable is exogenous in nature. As for the agricultural net-barter terms of trade, its fluctuations in the very short run (i.e. at the impact) are explained by its own shock (49 percent) as well as by a shock to volume of agricultural exports (47 percent). The role of both shocks will, however, vanish in the longer run, whereby a real exchange rate shock will drive the fluctuations by the vicinity of 56 to 97 percent.

The role of a shock to terms of trade in driving variability in the volume of agricultural exports is found to be trivial in the shorter horizons. Even in the long run, this shock is only capable of explaining the exports variability by approximately 11 percent. Regarding the relationship between the terms of trade and agricultural exports, direction of the causality is, therefore, from the former to the latter. And as clearly suggested from Figures 5-7, regardless of the underlying shock that induces each of these two variables to move out from its initial level, they always move in the opposite directions. This indicates that a tendency to increase agricultural exports, particularly through a shock to the supply side of the exports, will deteriorate the terms of trade, especially in the shorter horizons. In regards to volume of agricultural exports, as can be seen from Table 5, short run fluctuations in this variable are mainly due to its own shock, whereas real exchange rate shocks play more important role in driving long run fluctuations in the variable.

CONCLUDING REMARKS

The farmer terms of trade in aggregate followed a negative trend (i.e. -0.68% p.a.), supporting the Prebisch-Singer hypothesis. Spatially, this tendency

[24] This is consistent with Cypher and Dietz (1998) who claim that agricultural technological advancement tends to deteriorate the terms of trade in developing nations.

Table 5. Sources of Variability in Each Variable (%)

Variable / Equation	Time Horison	Shocks to		
		LRE	LTA	LVA
1. Real Exchange Rate	Impact (0)	100	0.0	0.0
	1	99.8	0.1	0.1
	2	99.6	0.2	0.2
	5	99.5	0.3	0.2
	10	99.4	0.3	0.3
	30	99.4	0.3	0.3
2. Agricultural Net-Barter Terms of Trade	Impact (0)	3.9	49.2	46.9
	1	55.9	22.6	21.5
	2	72.3	14.2	13.5
	5	86.8	6.8	6.5
	10	92.7	3.7	3.6
	30	97.1	1.5	1.4
3. Volume of Agricultural Exports	Impact (0)	7.8	0.0	92.2
	1	32.6	5.2	62.2
	2	41.3	7.2	51.5
	5	49.7	9.1	41.3
	10	53.3	9.9	36.8
	30	56.0	10.5	33.5

was mainly the case in the Western Part of Indonesia, particularly on farmers with less than 0.5 ha of land or farm labourers. In the Eastern Part of the country, especially in some Sulawesi and Kalimantan provinces, the farmer terms of trade increased significantly. This shows a potency to properly expand the agricultural sector in these regions, which would not risk the relative price of agricultural output to decline. Thus, more agricultural development efforts should be devoted to these regions.

Unlike the farmer terms of trade, the net barter terms of trade for agriculture, which may be seen as a proxy of relative welfare of farmers with some accesses to export/import markets, in general depict a non-negative trend. This suggests that in average this group of farmers, or perhaps a group of agricultural exporters, was less severely affected by the crisis or crisis-like events than the peasant farmers. Therefore, systematic development program, which should be more than a rescue-short-term-demand-side program, is needed with a main aim to stabilize the relative welfare of the peasants.

The long run agricultural net barter terms of trade was found to be significantly negatively affected by the real exchange rate. That is, a real depreciation would decrease, instead of increase, the relative welfare of agents in the agricultural sector. Thus, having a stable real exchange rate is preferred more than having an artificial increase in the competitiveness (e.g. in terms of a real depreciation). Furthermore, the negative effect also suggests that Indonesia agricultural exports are supply determined. This implies that eliminations of supply bottlenecks and technological advancement that lead to a lower unit cost relative to price received are necessary to undertake.

APPENDICES

APPENDIX 1: Data and Model Specification

The system is asserted to consist of three variables, namely real exchange rate, agricultural terms of trade, and volume of agricultural exports. All of these variables are expressed in the logarithm form, with mnemonics LRE, LTA, and LVA, respectively. When each of these time series variables contains no unit root, then a vector auto-regression (VAR) model would be appropriate for analyzing the variables, if, on the other hand, each of the series follows a unit root process, then a vector error correction (VEC) model would be more appropriate to use (Enders, 1995). Thus, it is instructive to firstly carry out unit root tests.

Before presenting results of these tests, it is important to explain about the data. The data are of annual, covering the period of 1981-2000. The real exchange rate (RE_t) is calculated as follows:

$RE_t = S_t \times P_t^* \times P_t^{-1}$

where S_t is nominal exchange rate, which is proxied by Rp/US$, P_t^* is the CPI of the US, and P_t is the CPI of Indonesia. These variables were gathered from the International Financial Statistics of the IMF. The agricultural terms of trade (TA_t) are calculated as follows:

$TA_t = EP_t \times IP_t^{-1}$

where EP_t is agricultural exports price index, IP_t is agricultural imports price index. TA_t is then expressed as an index with its 1993 value set to 100. EP_t and IP_t are collected from the Central Bureau Statistics of Indonesia (BPS). Volume of agricultural exports (VA_t, in thousand tons) is also collected from the same institution.

The unit root test employed on LRE, LTA, and LVA is the Augmented Dickey-Fuller (ADF) test. Results of this test are presented in Appendix Table 1. As can be seen from the table, for the variables in levels, each of the statistics is less than the corresponding critical value (both in absolute value), suggesting the null hypothesis of unit root cannot be rejected. For the variables in the first differences (Panel B), each of the statistics is higher than the corresponding critical value (both in absolute value), indicating that the first differenced variables contain no unit root. Therefore, each of LRE, LTA, and LVA is I(1), i.e. the variables in levels contain a unit root, but they will be stationary if differenced once. This justifies the use of a VEC model for the next analyses.

Appendix Table 1: Results of Unit Root Tests for Variables of the Model

Variable	Test Equation Includes an Intercept		Test Equation Includes an Intercept and a Linear Trend	
	Optimal Lag in the Equation	Statistic	Optimal Lag in the Equation	Statistic
A. Variables in Levels				
LRE	0	-1.336	0	-2.038
LTA	0	-1.942	0	-1.843
LVA	0	-2.870	0	-3.160
B. Variables in the First Differences				
DLRE	0	-3.936	0	-3.863
DLTA	0	-4.457	0	-4.321
DLVA	0	-5.133	0	-4.963

Notes: For the tests for variables in levels, the 95% critical value for the test equation which includes an intercept is -3.082, and that which includes an intercept and a linear trend is -3.761. For the tests for variables in the first differences, the 95% critical value for the test equation which includes an intercept is -3.100, and that which includes an intercept and a linear trend is -3.792.

Before constructing a VEC model, it is however important to firstly acquire empirical knowledge on causality amongst the variables. This can be carried out using the Granger causality test. This test was undertaken on an unrestricted VAR containing the variables in the first differences.[25] The optimal number of lags in the unrestricted VAR model, as shown from Appendix Table 2, should be two.

Since the degree of this acceptance is only slightly and since the sample period is so limited (twenty), then it is more preferable to employ only one lag in the VAR system. Under this specification, and incorporating a dummy variable depicting the Asian Crisis as a determinant component of the model,[26] results of the Granger

[25] The variables are in the first differences because the ADF tests suggested that each variable follows a unit root process.

[26] The underlying VAR model actually started with the presence of two determinant components, namely a dummy variable depicting the Asian Crisis and an intercept. The incorporation of only the dummy variable (without the intercept) in the VAR model is supported by results of the likelihood ratio tests for deletion of deterministic components. That is, when the dummy variable is deleted from the model, the statistic (c^2 with three degrees of freedom) is 21.296 with the p-value 0.000, whereas when the intercept is discarded from the model, the statistic is 4.070 with the p-value 0.254.

Appendix Table 2: The Number of Lags Used in the VAR Model for Undertaking the Granger Causality Test for the Variables of the System

Number of Lags (p)	Adjusted Likelihood Ratio Statistic
2	n.a.
1	16.834 (0.051)
0	27.498 (0.070)

Notes: Figures in the parentheses are the p-values. The null hypothesis that p=2 is not different statistically from p=1 is only slightly 'accepted' under the 5% significance level, indicating that the underlying VAR model should have two lags.

causality tests are presented in Appendix Table 3. The null hypothesis that the real exchange rate does not Granger cause agricultural terms of trade and volume of agricultural exports (all in the first differences) is strongly rejected (with the p-value equals 0.003), suggesting that the real exchange rate Granger causes the other two variables. The null hypothesis that the agricultural terms of trade do not Granger cause the real exchange rate and the export volume can be 'accepted' because the p-value, which is about 0.31, is larger than the usual significance level. The same conclusion with an approximately the same 'degrees of acceptance' (i.e. the p-values are about 0.31) can be drawn for the null that agricultural exports do not Granger cause the real exchange rate and the terms of trade. These suggest that the order of the variables in the underlying VAR model should, from the top, be the real exchange rate, followed by either the agricultural terms of trade – the agricultural exports volume or by the agricultural exports volume – the agricultural terms of trade.

Appendix Table 3: Results of Granger Causality Tests

Null Hypothesis	LR Statistic (DoF)	P-Value
DLRE does not Granger cause DLTA and DLVA	11.445 (2)	0.003
DLTA does not Granger cause DLRE and DLVA	2.369 (2)	0.306
DLVA does not Granger cause DLRE and DLTA	2.320 (2)	0.313

Note: Figures in the parentheses are the degrees of freedom for the test.

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