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IMPULSE RESPONSE ANALYSIS OF COINTEGRATED INDONESIAN RICE MARKETS

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ABSTRAK

Impulse response *yang terjadi oleh karena kejutan harga di masing-masing pasar regional di pasar beras di Indonesia yang mengalami kointegrasi diselidiki dengan menggunakan data mingguan antara tahun 1982 sampai dengan tahun 1993. Analisis* impulse response *menunjukkan pengaruh dari kejutan satu unit terhadap salah satu variabel di sistem pasar yang mengalami kointegrasi. Signifikans dari setiap kejutan harga ditentukan dengan menggunakan analisis integrasi Monte Carlo.*

Delapan series *harga yang relevan dipilih untuk mewakili pasar beras di Indonesia, yaitu, Medan, Palembang, Jakarta, Surabaya, Banjarmasin, Menado, Ujung Pandang, serta Denpasar. Setiap* series *harga diberi kejutan harga yang berpengaruh terhadap semua pasar lainnya dan menghasilkan berbagai reaksi dan umpan balik.*

Hasil analisis menunjukkan bahwa kejutan harga di beberapa pasar yang besar seperti di Surabaya, Ujung Pandang, Jakarta, Palembang dan Medan sangat berpengaruh terhadap pasar-pasar lain. Kejutan harga yang terjadi di Surabaya menyebabkan response *yang terbesar, terutama terhadap pasar beras di Jakarta, Denpasar, dan Ujung Pandang dan juga berpengaruh lebih lama daripada kejutan harga di pasar lain. Implikasi dari hal ini adalah bahwa pasar beras di Surabaya yang paling berpengaruh di seluruh pasar beras Indonesia yang terintegrasi. Pasar-pasar lain yang berpengaruh, dalam urutan dari yang lebih berpengaruh sampai yang paling kecil pengaruhnya adalah: Ujung Pandang, Jakarta, Medan, Palembang, Menado, Banjarmasin, and Denpasar. Kejutan harga di pasar di Banjarmasin and Denpasar mempunyai pengaruh sangat kecil terhadap pasar-pasar lain. Hasil penelitian ini menunjukkan bahwa pasar beras yang terintegrasi di Indonesia menyebabkan penyesuaian yang cepat jika terjadi kejutan harga di salah satu pasar regional dan bahwa pasar beras di Indonesia menjadi efisien.*

BACKGROUND AND RELATED LITERATURE

Indonesia is one of the world's largest producers and exporter of rubber, coconuts, palm oil and spices, and grows large amounts of coffee and tea as well. However, the growth of agriculture during the last two decades has been powered by a rapid growth of the food crop sector. Rice is the most important food crop accounting for over 60 percent of the total food-crop production and providing an estimated 50 percent of both calories and proteins (FAO). The price of rice is also the most important component of the retail price structure in Indonesia because of the large weight of rice in the representative consumption basket. Based on National Socio-Economic Survey (Susenas) data (BPS, 1982), van de Walle estimated that rice accounts for nearly one-third of the total food expenditures for the entire population.

The archipelago of Indonesia is geographically dispersed, consisting of both rice surplus and deficit regions. Previous analysis has shown that these widely dispersed rice markets in Indonesia are cointegrated (Alexander and Wyeth; Ismet, et al.) indicating that the regional markets are connected geographically and temporally in the long run. If prices are cointegrated, the market linkages are spatially efficient. The markets are said to be efficient if any information available in a market is instantaneously transmitted to other markets and reflected in prices.

Market cointegration is a matter of degree which varies across regional markets. The relationships of price in a cointegrated system can be demonstrated using impulse response analyses to show the dynamic relationships within the system. These interrelationships within the cointegrated system can also be depicted graphically to obtain visual impressions of the dynamics of the system. The analyses indicate the Granger causality of the price variables within the cointegrated system. Granger causality refers to price transmissions in which past movements of prices in one regional market affect prices in other market, followed by feedback relationships between the prices.

This study uses the eight most relevant price series for the Indonesian rice market, namely Medan, Palembang, Jakarta, Surabaya, Banjarmasin, Menado, Ujung Pandang, and Denpasar to evaluate the price interrelationships which exist between these cointegrated regional markets. A shock is given to a price series which affects all of the other prices, producing reactions and feedbacks, the results of which are shown graphically for each regional market.

As noted, previous research has concluded that the Indonesian rice market is cointegrated, indicating that a stable long-run relationship between spatial price series exist and that the market is operating efficiently. Alexander and Wyeth used cointegration tests developed by Granger to evaluate cointegration in Indonesian rice markets and found that the market was cointegrated. They used monthly data for seven regions in Indonesia. Another study by Ismet, et al., utilized Johansen and Juselius cointegration tests with weekly data for nine provinces of Indonesia and discovered similar results. In addition they found that government intervention in the form of rice procurement significantly affected market cointegration.

Cointegration analysis is limited however, in the information it can provide. The government of Indonesia is actively involved in the rice market, with the explicit goal of rice price stabilization. Government interventions in the rice market, administered by the National Food Logistics Agency (BULOG) are intended to avoid a sharp decrease in price during the harvest seasons as well as to maintain the acceleration of a sufficient rice supply over times and places at a reasonable price. It is thus important to know how local price shocks affect other prices, both regionally and nationally. The purpose of this analysis is to provide understanding of the effect of local price shocks on important regional rice markets in Indonesia.

IMPULSE RESPONSE ANALYSIS IN COINTEGRATED SYSTEMS

Impulse response analysis is tool used to investigate the response of a system of economic variables to specified shocks of an exogenous variable. The type of causality of an impulse response can be observed by tracing out the effect of an exogenous shock in one of the variables on some or all of the other variables. These responses indicate the dynamic response of each endogenous variable to a shock to the system (Doan and Litterman).

This analysis is also valuable in cointegrated systems because a direct interpretation of the cointegration relations may be difficult, as noted by Lütkepohl and Reimers. They also argue that any shock to one of the variables in cointegrated systems leads to time paths which will settle down in a new equilibrium. The effect of a unit shock in any of the variables in the system may die away due to the stability of the systems. The response may be depicted graphically to get a visual impression of the dynamic interrelationships within the system.

Consider the vector autoregressive (VAR) model in equation 1, parameterized as follows (Lütkepohl and Reimers):

$$\Delta Y_i = \Gamma_1 \Delta Y_{i-1} + \ldots + \Gamma_{n-1} Y_{i-n+1} - BY_{i-n} + e_i \tag{1}$$

where $\Gamma_i = -(I_n - \alpha_1 - \ldots - \alpha_i)$, $I = 1, \ldots, p-1$.

The response of variable y_i to a unit shock in variable k, p periods ago can be defined as:

$$\Phi_p = (\varphi_{ik,p}) = \sum_{j=1}^{p} \Phi_{p-j} \alpha_j \tag{2}$$

where $\Phi_0 = I_K$, $\alpha_j = 0$ for $j > k$ and $\varphi_{ik,n}$ is the ik^{th} element of Φ_p and represents the response of variable y_i to a unit shock in variable k, p periods ago. Lütkepohl and Reimers note that orthogonalized responses can be defined as $\Psi_p = (\psi_{ik,p}) = \Phi_p T$ where T is the lower triangular Choleski decomposition of Σ_e where $\Sigma_e = TT'$. $\psi_{ik,p}$ represents the response of variable I to shocks in variable k, p periods ago. $\psi_{ik,p}$ is the transformed residuals $P^{-1}e_t = v_t$ where residuals v_t have identity covariance matrix I_n. Since the variables may have different scales, it is useful to rescale the impulse responses. Thus, a unit impulse has one standard deviation.

Lütkepohl noted that a shock in one variable has no effect on other variables in the system if the former variable does not Granger-cause the set of the remaining variables. Each variable in the system should be determined in its respective order. The more exogenous the variable, the higher the ordering the variable is placed (Featherstone, Goodwin and Barkema). The effects of a shock in one of the variables in cointegrated systems will not die out in the long run since the variables are non-stationary. In other words, the variables will not return to their initial values even if there are no further shocks. The shocks shift the system to a new equilibrium due to the stability of the system.

To minimize the prediction error, a proper lag is determined by using a mechanical method suggested by Akaike, the final prediction error (FPE) criterion. This technique is done by assuming that the distributions of the predictors of two data sets, one used for fitting the model and the other for prediction, are identical. The FPE statistic for multiple variables as found in Judge, Griffiths, Hill, Lütkepohl and Lee is given by :

$$FPE = \left(\frac{T+K}{T-K} \right)^M |\hat{\Sigma}_K| \tag{3}$$

where T is the number of observations, k is the lag order, M is the number of variables, and $|\Sigma_k|$ is the estimated residual variance-covariance matrix with k lags. The optimal p is chosen such that:

$$FPE(\hat{p}) = \min\{FPE(k) \mid k = 1, \ldots, m\} \tag{4}$$

The impulse response analyses are done using RATS software (Doan and Litterman).

MONTE CARLO INTEGRATION ANALYSIS

As suggested by Doan and Litterman the standard errors of the responses of each price series are calculated using the Monte Carlo integration technique developed by Kloek and van Dijk. Consider the following linear simultaneous equation, using Kloek and van Dijk notation, as follows:

$$Y\Gamma + ZB = U \tag{5}$$

where Y is a matrix of n observation on G endogenous variables and Z is a matrix of n observations on *K* predetermined variables, *Γ* is a matrix of *G* and *B* is a matrix of constants, and *U* is a matrix of error terms.

Kloek and van Dijk argue that posterior moments can be computed by a Monte Carlo method. All of the moments are expectations of function of θ where vector θ contains all remaining elements of Γ and *B* which are all *a priori* unknown apart from the constant term. Likelihood and prior distribution of θ determine the existence of the posterior moments. The expected function of θ, *g*(θ), can be written as follows:

$$E(g(\theta \mid Y,Z)\} = \frac{\int g(\theta)k(\theta \mid Y,Z)\,p(\theta)d\theta}{\int k(\theta \mid Y,Z)\,p(\theta)d\theta} \quad (6)$$

The numerator of equation (6) can be written as:

$$\int M(\theta)I(\theta)d\theta = E\{M(\theta)\} \quad (7)$$

where:

$$M(\theta) = \frac{g(\theta)k(\theta \mid Y,Z)P(\theta)}{I(\theta)} \quad (8)$$

and *I*(θ) is a density function where parameter values θ are drawn at random from the distribution of the density function. The function of *M*(θ) is evaluated for each value of θ.

Doan and Litterman note that *M*(θ) = *g* (θ) because the computation is done directly from the posterior distribution of the VAR coefficient. With a vector autoregression as follows:

$$Y_t = (I(\theta)X_t)\beta + U_t, \quad (9)$$

and y_t is *n*-variate, the prior distribution is:

$$f(\beta,\Sigma)\alpha \mid \Sigma \mid^{\frac{-(n+1)}{2}} \quad (10)$$

and the posterior distribution of (β, Σ) is an inverted-Wishart function.

DATA

The impulse analyses described above are conducted using weekly provincial level data on retail rice prices for Java and off-Java rice markets during the period of 1982 to 1993 (a 624 week series, from January 1982 to December 1993). Weekly data provide certain advantages over longer period data since weekly data allow greater detail and should show more price dynamics.

There are 27 provinces in Indonesia, however only price in eight relevant provinces are chosen for this analysis. The relevant markets were chosen based on work by Sapuan who divided the Indonesian rice market based on several factors, such as ratio between rice production and consumption, the volume of private rice trade, and government intervention. The markets included in this study are Medan and Palembang (representing Sumatra), Jakarta and Surabaya (representing Java), Banjarmasin (representing Kalimantan), Menado and Ujung Pandang (representing Sulawesi) and Denpasar (Bali-Nusa Tenggara).

The data used in this study are from the Indonesian Central Bureau of Statistics (BPS), collected weekly by Consumer Price Evaluation Team (THE) in each province. Thus, lagged and feedback effects as a price shock transmitted through the entire spatial market that occur in less than a week will be masked. Since the analyses require a homogeneous product across regional markets, one price was chosen for each provincial capital rice price data based on its similarities in variety and availability of continuous time series. All rice prices were quoted in Indonesian monetary terms, rupiah per kilogram.

There are a great many rice varieties in Indonesia. The variety of rice used in this study is the IR variety, even though its market name may be different. The IR variety is selected to reflect national statistics in which it occupied more than 80 percent of all harvested rice acreage (Hadiwigeno *et al*.). It is expected that by choosing the IR variety, the likelihood of grain quality variability is reduced.

ANALYSIS AND RESULTS

Cointegrated systems should be interpreted cautiously. The system shows a long-run equilibrium between variables in the system, however the long-run effect of one variable innovation on the other variables may be difficult to explain only by interpreting the coefficients of the relations. The variables in the cointegrated systems may interact in the short-run and in the long-run. The interpretations of the coefficients may ignore the dynamics of the system.

Impulse response analysis gives a better picture of the relations between variables in the system in the long-run. Impulse response or dynamic multiplier analysis of vector autoregressive (VAR) systems with cointegrated variables were conducted using RATS software package (Doan and Litterman). As suggested by Doan and Litterman, the standard errors of the responses are calculated using Monte-Carlo integration techniques. The results of the analyses are depicted graphically, with the numerical results also included.

The graphs show the responses of variables in the cointegrated Indonesian rice market to a unit shock (forecast error) in one variable get visual impressions of the dynamic interrelationships within the system. If the cointegration relations are interpreted as stable long-run relationships between prices (in other words, spatial competition exists), a shock in one variable will create responses in other. The graphs show that due to the existence of the unit roots in the system the impulse response function does not return to zero. After 52 week periods, the responses settle to a new equilibrium. An innovation in one variable has no effect on the other variables if the former variable does not Granger-cause the set of the remaining variables (Lütkepohl and Reimers). Granger causality refers to price transmissions in which past movements of prices in one market affect prices of other markets, followed by feedback relations among markets. It implies that the price are in a single economic market.

In the analysis, the most relevant price series were chosen based on work by Sapuan. They are Medan and Palembang (representing the deficit region of Sumatra), Jakarta and Surabaya (representing the surplus region of Java), Banjarmasin (representing Kalimantan), Menado, Ujung Pandang (representing Sulawesi), and Denpasar (representing Bali-Nusa Tenggara). Since rice is a non-tradeable product (because exports and imports are monopolized by BULOG), its prices vary mainly because of domestic supply shocks. Thus, price variables of surplus markets are considered as exogenous variables while price variables in non-surplus regions are considered as endogenous variables. Surabaya and Ujung Pandang are considered the most exogenous variables, while Menado, Medan and Palembang are the most endogenous variables.

Time series data for 624 weeks, from January 1982 to December 1993, were used. Two lags, determined by the minimum Akaike's final prediction error (FPE), are considered the optimal lag length for the entire system for both the impulse response and the Monte-Carlo analyses. The impulse response analyses are intended to show that in the spatially competitive market, a price shock to a particular price series will produce price responses in the other prices and a series of reaction and feedback effects may arise. The responses or dynamic multipliers represent the effects of shocks in the variables of the cointegrated system. The Monte-Carlo analyses indicate the statistical significance of individual responses in each week.

Figure 1 shows the responses of rice prices in Jakarta, Palembang, Medan, Banjarmasin, Ujung Pandang, Menado, and Denpasar to a shock of one standard deviation in the Surabaya rice price. The graph reveals that the impulse leads to permanent (long-term) increase in the other seven prices, assuming no changes in government market interventions. The effects of the shocks on Jakarta, Denpasar, and Ujung Pandang prices, the closest markets to Surabaya, are more apparent than that of the rest. During the first ten weeks after the shock, prices soar in the three cities, then decline and settle to a new equilibrium. The results of the Monte-Carlo integration analysis indicate that a shock to Surabaya price has a significant effect on the Jakarta price during 1 to 40-week period, to Ujung Pandang price from week 1 to week 35, to Denpasar (from week 2 to week 41), and to Menado (from week 10 to week 52) (Table 1). The significant periods to Banjarmasin, Palembang and Medan are shorter (also Table 1).

Surabaya is the capital city of East Java, the nation's leading producer of rice and largest surplus region. As expected, the impacts of a shock to the largest surplus supplier are very rigorous. This result suggests that Surabaya is the most influential driving force in rice price formation in the entire price system. The graph indicates that the other prices rapidly adjust. It also shows that prices reach their long-term new equilibrium after 52 weeks if no further shocks happen in the system. The reactions of the prices are in accordance with the interpretation of the cointegration relations.

Figure 2 shows the price responses to shocks to Ujung Pandang prices. Ujung Pandang is the largest rice surplus region outside Java. As expected, its driving force in rice formation is significant, especially to outside Java prices. The most affected prices are Banjarmasin (significant responses occur from week 3 to week 24) and Menado (significantly affected during weeks 2 to 16). After ten weeks the shock also affects the Medan and Palembang prices, however they are not significant. The impacts on Jakarta (only significant at week 2), Surabaya and Denpasar prices are less obvious. The results of the impulse response and Monte Carlo integration analyses are presented in Table 2.

The effects of a price shock in Jakarta, the capital city, are presented in Figure 3. Jakarta is the largest deficit region. However, the city also borders to West Java, the second largest rice producer. Thus, the price series may represent the Jakarta-West Java area. Jakarta is considered the most important rice market by the government due to its economic size as well as national commercial and political-administrative dominance. As a center of transportation and communication, Jakarta is an indirect supplier of rice to other regions. The largest capacity of government owned rice warehouses are also located in Jakarta.

The graph indicates that shocks to Jakarta prices significantly affect other prices. During the first 15 weeks, the shocks significantly influence the Surabaya (during week 2 to week 8), Palembang (weeks 2 to 8), Ujung Pandang (weeks 3 to 12), and Medan (weeks 1 to 5). The impacts on Banjarmasin prices are significant during weeks 2 and 3 then during weeks 11 to 46. The Menado prices are significantly affected during weeks 5 to 39. The Denpasar price is significantly affected in the 2-3 week period. These results indicate that Jakarta is the second most influential price maker after Surabaya. Table 3 presents the impulse response and the Monte Carlo integration analyses results.

Figure 4 depicts the impacts of shocks to Denpasar rice prices. The prices represent the Bali-Lombok area, a relatively small rice production region outside Java. It indicates that shocks to Denpasar rice prices are less influential. In this case, only Surabaya (during weeks 3-4), Ujung Pandang (only week 2), Banjarmasin (only week 2) and Jakarta (during weeks 3 to 5) are significantly influenced by the shocks. The relatively small market share of Bali-Nusa Tenggara makes the impacts less obvious, especially to Ujung Pandang and Banjarmasin, the other rice production areas outside Java. The impulse response and the Monte Carlo integration analyses results are shown in Table 4.

The effects of shocks to Palembang rice prices are presented in Figure 5 as well as Table 5. Palembang is the capital city of South Sumatra, the largest province on the island. The price for Palembang represents the southern part of Sumatra: South Sumatra, Lampung, Bengkulu and Jambi. The graph indicates that all of the prices are affected with Medan and Jakarta being the most affected. However, the effects on Surabaya and Banjarmasin prices are not significant. A relatively large market share in the area makes the impacts significant, especially to Medan (from week 2 to 26) and Jakarta (from week 2 to 20), the closest cities to Palembang. Significant impacts to Ujung Pandang prices occur during weeks 2 to 9, while in Denpasar significant impacts occur from week 2 to 21. The Menado rice price is significantly affected during weeks 6 to 45.

Figure 6 shows the responses to shocks to Medan prices. These prices represents the northern part of Sumatra: Aceh, North Sumatra, Riau and West Sumatra. This region is one of the largest economies and the most populous area outside Java. The region is dominated by agriculture with a relatively open economy, having major links to both domestic and international markets. The result of impulse response analysis indicates that Palembang (during weeks 2 to 52), Jakarta (weeks 2 to 18) and Ujung Pandang (weeks 2 to 31) are the most affected by the shocks to Medan prices, followed by Surabaya (during weeks 2 to 9) and Denpasar (during weeks 2 to 6). It shows that shocks to this relatively sizeable rice market have significant impacts on other important rice markets. The impulse analysis and Monte Carlo integration results for Medan are shown in Table 6.

The responses to the shocks to Banjarmasin rice prices is depicted in Figure 7. This price series represents the South Kalimantan rice market. South Kalimantan is one of Indonesia's smaller provinces, however, its rice production has grown rapidly so that the province can supply neighboring areas. Inter-island trade usually occurs with Ujung Pandang, Surabaya and Jakarta. The graph shows that only the Ujung Pandang (in week 2) and Menado (during weeks 2 to 4) prices are affected significantly. The results of the impulse response and the Monte Carlo integration analyses are presented in Table 7.

Figure 8 shows the responses to shocks to Menado prices. The Menado price represents North Sulawesi, the eastern section of the northern peninsula of Sulawesi. Even though small in market size and relatively far from potential markets, the impulse responses to the shocks to Menado prices are more obvious than that of Banjarmasin. Impulse analyses indicate that Banjarmasin (during weeks 4 to 33), Medan (weeks 5 to 22), and Surabaya (weeks 10 to 26) are the most significantly prices. Denpasar is only affected in week 2.

Surprisingly, the Ujung Pandang prices which represent South Sulawesi, the closest surplus region to Menado, are not affected significantly. This suggests that rice deficits occuring in the Menado market may not be supplied directly by private traders from the Ujung Pandang market and may indicate the significant role of the government market injections in the Menado market. There are no significant impacts to the Jakarta and Palembang prices. These responses show that Menado rice prices are obviously linked to other prices in the system but not Ujung Pandang. The impulse response and the Monte-Carlo integration analyses results are shown Table 8.

The impulse responses in the cointegrated Indonesian rice markets indicate that generally, the responses from the closest markets are more obvious than the others. In all of these cases, the impulse response demonstrates quite plausible reactions. The results show that Surabaya, Jakarta, Ujung Pandang, Medan, and Palembang are the largest driving forces in price formation in the cointegrated system.

The prices used in the analyses are retail (not wholesale) prices prevailing in the provincial capitals which may give less indication of spatial market cointegration due to the presence of government intervention and some lagged adjustments in each market. However, impulse analyses indicate plausible reactions, as would be expected in a cointegrated market. The results also indicate that the order of the variables are reasonable. These results provide additional understanding of Indonesian rice market dynamics which may not be obtained from the cointegration test results alone.

SUMMARY AND CONCLUSIONS

This study investigates impulse responses due to shocks to local prices in cointegrated rice markets, using weekly data from 1982 to 1993. The impulse response analysis shows the effect of a unit shock in any of the variables in a cointegrated system. The significance of each response is determined by applying Monte Carlo integration analyses.

The eight most relevant price series are selected representing the Indonesian rice markets, including Medan, Palembang, Jakarta, Surabaya, Banjarmasin, Menado, Ujung Pandang, and Denpasar. A shock is given to an individual price series which affects all of the other prices, producing reactions and feedbacks. The results of the analyses show that the response functions do not return to zero indicating a permanent response to local price shocks. The analyses of the spatial pricing relationships reveal the extent to which regional events influence the national market.

The results show that shocks to sizeable rice markets such as Surabaya, Ujung Pandang, Jakarta, Palembang, and Medan are very influential to other prices. A shock to Surabaya rice prices results in the most rigorous responses, especially in Jakarta, Denpasar and Ujung Pandang markets. The shock to the Surabaya price also creates the longest significant period relative to shocks to other prices, suggesting that Surabaya is the most influential driving force in the entire spatially-linked economic market. The other important prices as a driving force in the entire spatially-linked economic market, in order from the most to the least influential, are Ujung Pandang, Jakarta, Medan, Palembang, Menado, Banjarmasin, and Denpasar. Shocks to Banjarmasin and Denpasar prices individually have minimal effects on the other prices. The analyses indicate that market forces in the cointegrated system adjust the prices quickly in response to other price shocks.

In cointegrated markets, competitive profit-seeking activities of commodities arbitragers occur. Results from the impulse response analysis indicates that the government can provide a more favorable rice price policy environment that promotes economic efficiencies in some regional markets, noting the influence that certain markets have on other markets. Overall, it implies that the country's diversity requires a rice price policy which is sensitive to the varied markets of the vast Indonesian archipelago.

REFERENCES

Akaike, H. "Fitting Autoregressive Models for Prediction." *Annals of the Institute of Statistical Mathematics*, 21(1969):243-247.

Alexander, C. and J. Wyeth. "Cointegration and Market Integration: An Application to the Indonesian Rice Market." *The Journal of Development Studies*, 2(1994):303-328.

Central Bureau of Statistics (BPS). *National Socio-Economic Survey (Susenas)*. Jakarta, Indonesia. 1982.

Central Bureau of Statistics (BPS). *Statistics of Indonesia (Statistik Indonesia)*. Jakarta, Indonesia. Various years.

Doan, T.A. and R.B. Litterman. *Regression Analysis of Time Series: Version 2.00, User's Manual*. Evanston, IL: VAR Econometrics, 1986.

Featherstone, A.M., B.K. Goodwin, and A.D. Barkema. "Dynamics of Farm Interest Rates" in *Regulatory, Efficiency and Management Issues Affecting Rural Financial Markets* edited by LaDue, E. and Allen, S. Dec., 1993, pp. 75-88.

Food and Agriculture Organization (FAO). "Demand Prospects for Rice and Other

Foodgrains in Selected Asian Countries." United Nations FAO Economic and Social Development Paper. 1991.

Hadiwigeno, S., D.S. Damardjati, and M.O. Adnyana. "Food Diversification and Nutrition in Agricultural Development." *Indonesian Food Journal*, 5(1992):83-94.

Ismet, M., A.L. Barkley, and R.V. Llewelyn. "Government Intervention and Market Integration in Indonesian Rice Markets". *Agricultural Economics*. Vol. 19, No 3. November, 1998. pp. 283-295.

Johansen, S. and K. Juselius. "Maximum Likelihood Estimation and Inference on Cointegration - With Application to the Demand for Money." *Oxford Bulletin of Economics and Statistics*, 52 (1990):169-210.

Judge, G.G., W.E. Griffiths, R.C. Hill, H. Lütkepohl, and T.C. Lee. *The Theory and Practice of Econometrics.* New York: John Wiley and Sons, 1985.

Kloek, T., and H.K. van Dijk. "Bayesian Estimates of Equation System Parameters: An Application of Integration by Monte Carlo." *Econometrica*, 46(1978):1-19.

Lütkepohl, H. *Introduction to Multiple Time Series Analysis*. Berlin: Springer-Verlag, 1993.

Lütkepohl, H. and H. Reimers. "Impulse Response Analysis of Cointegrated Systems." *Journal of Economic Dynamics and Control*, 16 (1992):53-78.

Sapuan. "Analisis Faktor-faktor Yang Mempengaruhi Margin Pemasaran Beras di Indonesia (The Analyses of Factors Affecting Rice Marketing Margin in Indonesia)." Unpublished PhD Dissertation. Gadjah Mada University. 1991.

van de Walle, D.P. "The Welfare Analysis of Rice Pricing Policies Using Household Data for Indonesia." Unpublished PhD Dissertation. The Australian National University. 1989.

Figure 1: Response To Shock To Surabaya Rice Price

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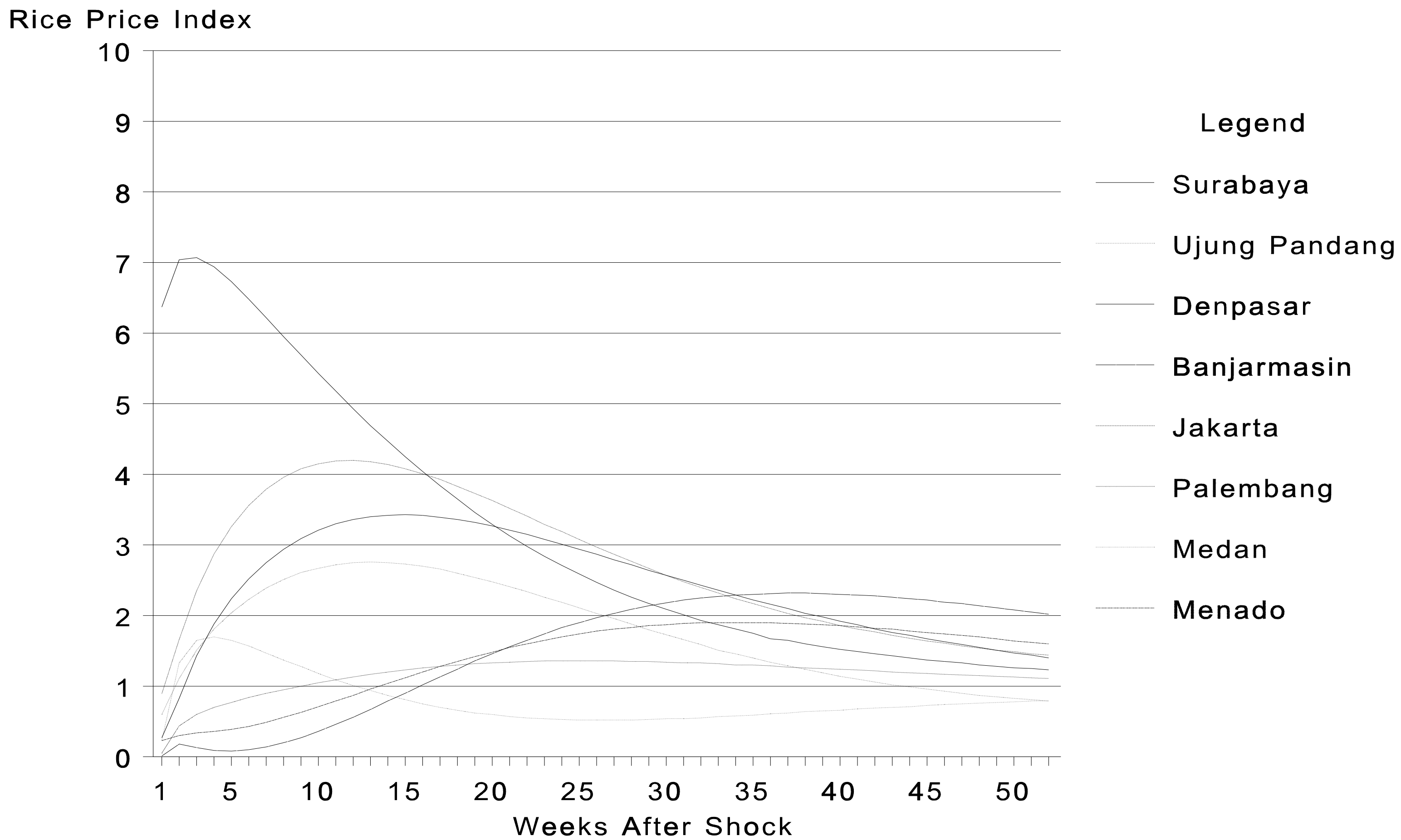
Rice Price Index
10
9
8
7
6
5
4
3
2
1
0
1
5
10
15
20
25
30
35
40
45
50
Weeks After Shock
Legend
Surabaya
Ujung Pandang
Denpasar
Banjarmasin
Jakarta
Palembang
Medan
Menado

Figure 2: Response To Shock To Ujung Pandang Rice Price

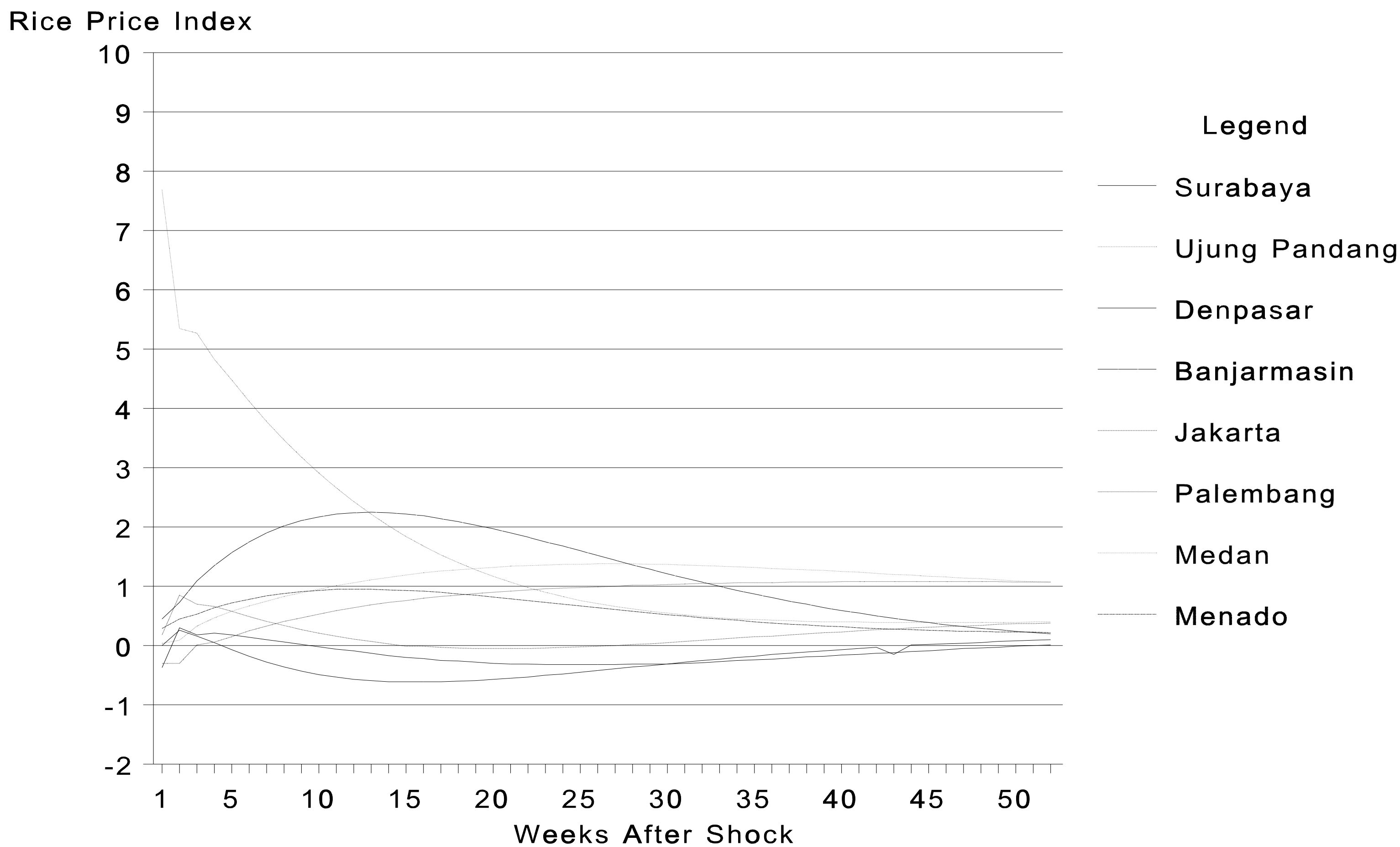

Figure 3: Response To Shock To Jakarta Rice Price

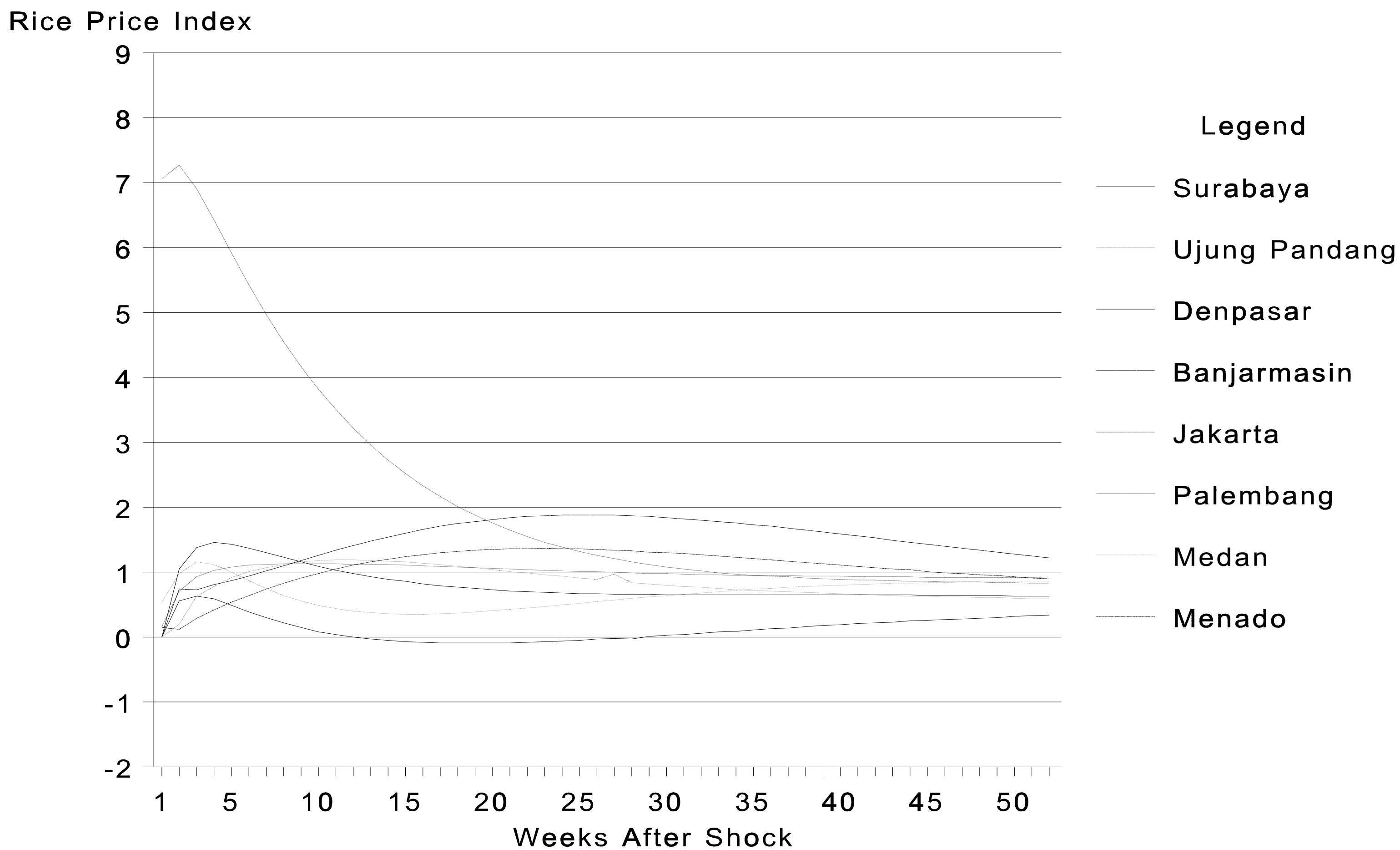

Figure 4: Response To Shock To Denpasar Rice Price

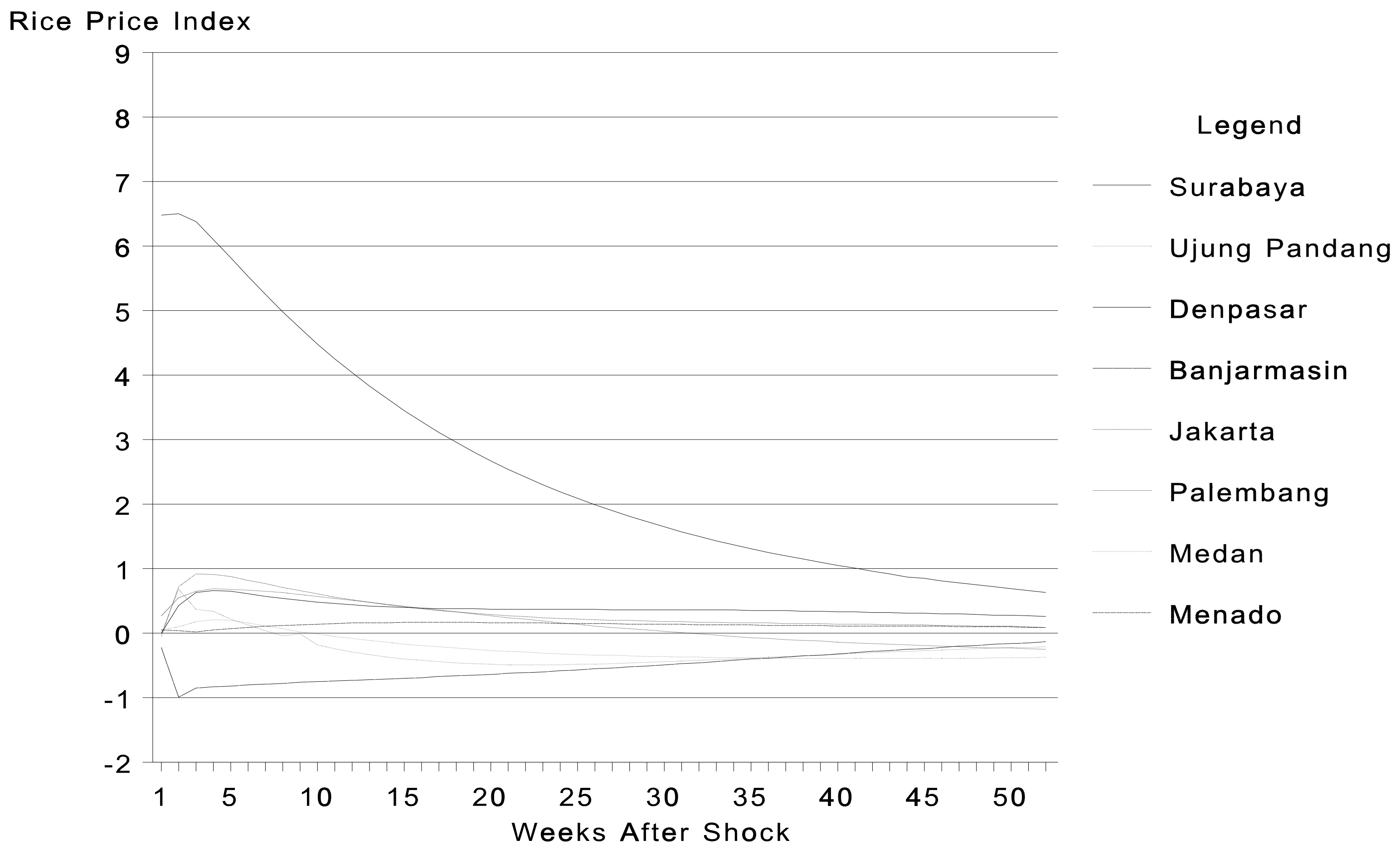

Figure 5: Response To Shock To Palembang Rice Price

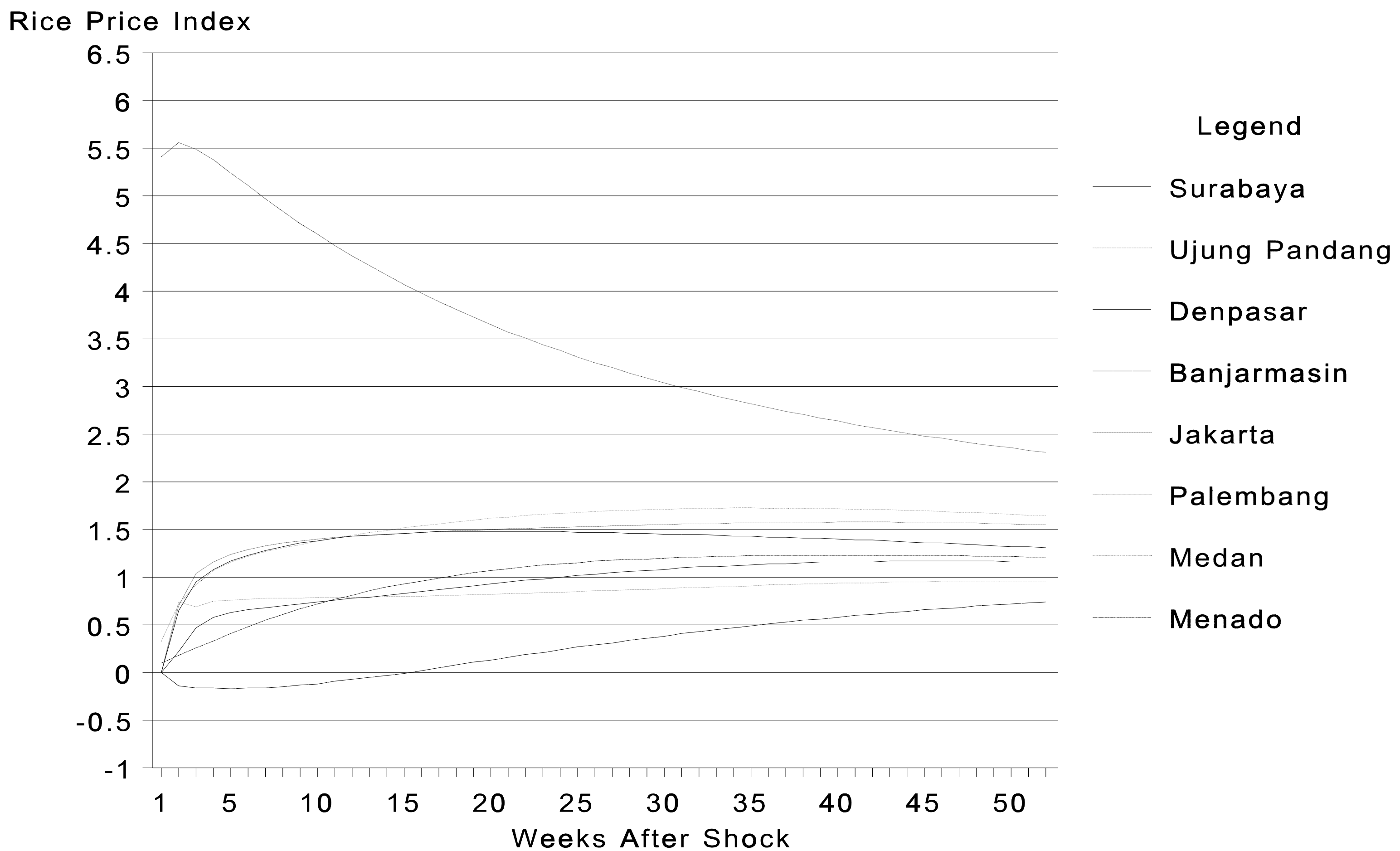

Figure 6: Response To Shock To Medan Rice Price

Figure 7: Response To Shock To Banjarmasin Rice Price

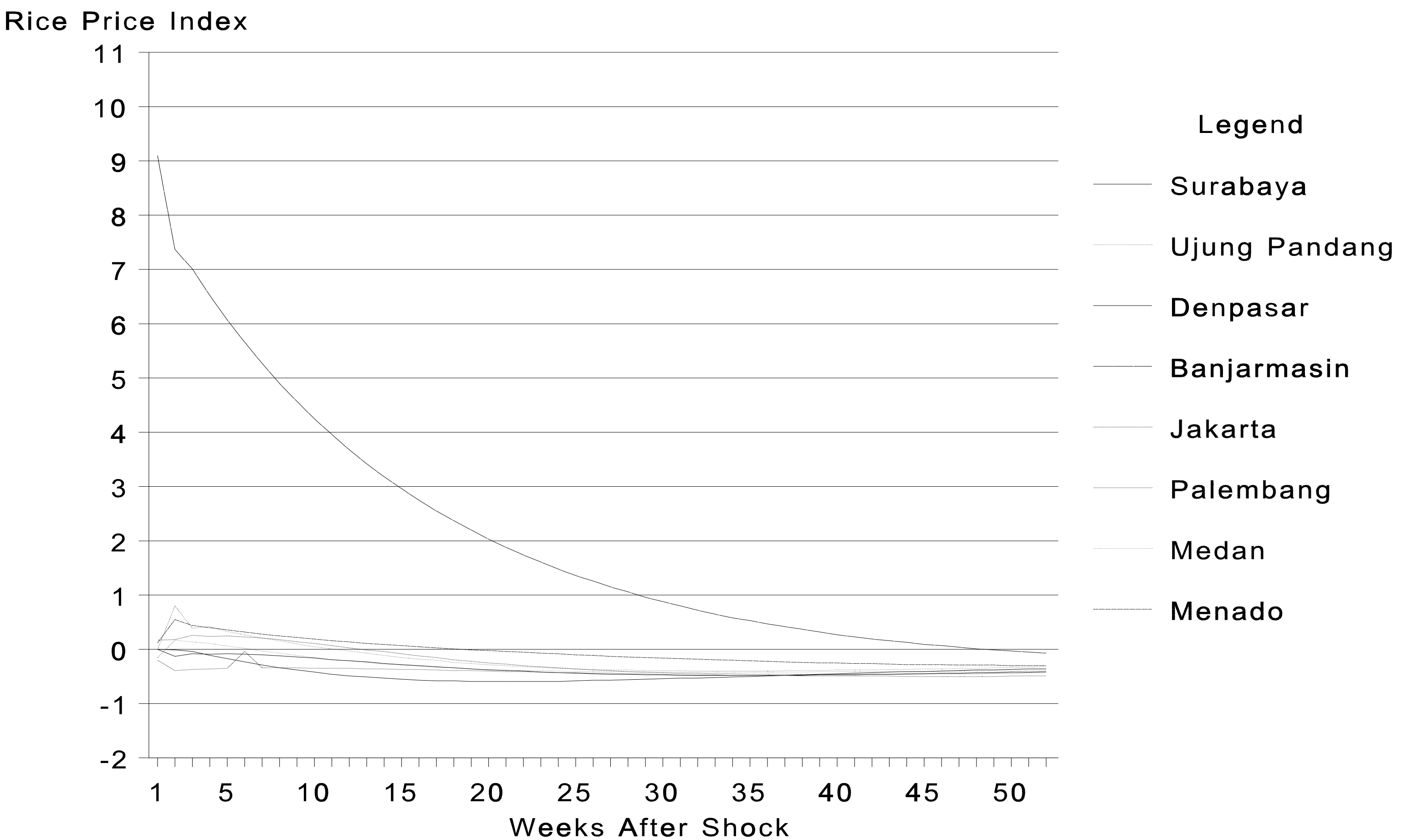

Figure 8: Response To Shock To Menado Rice Price

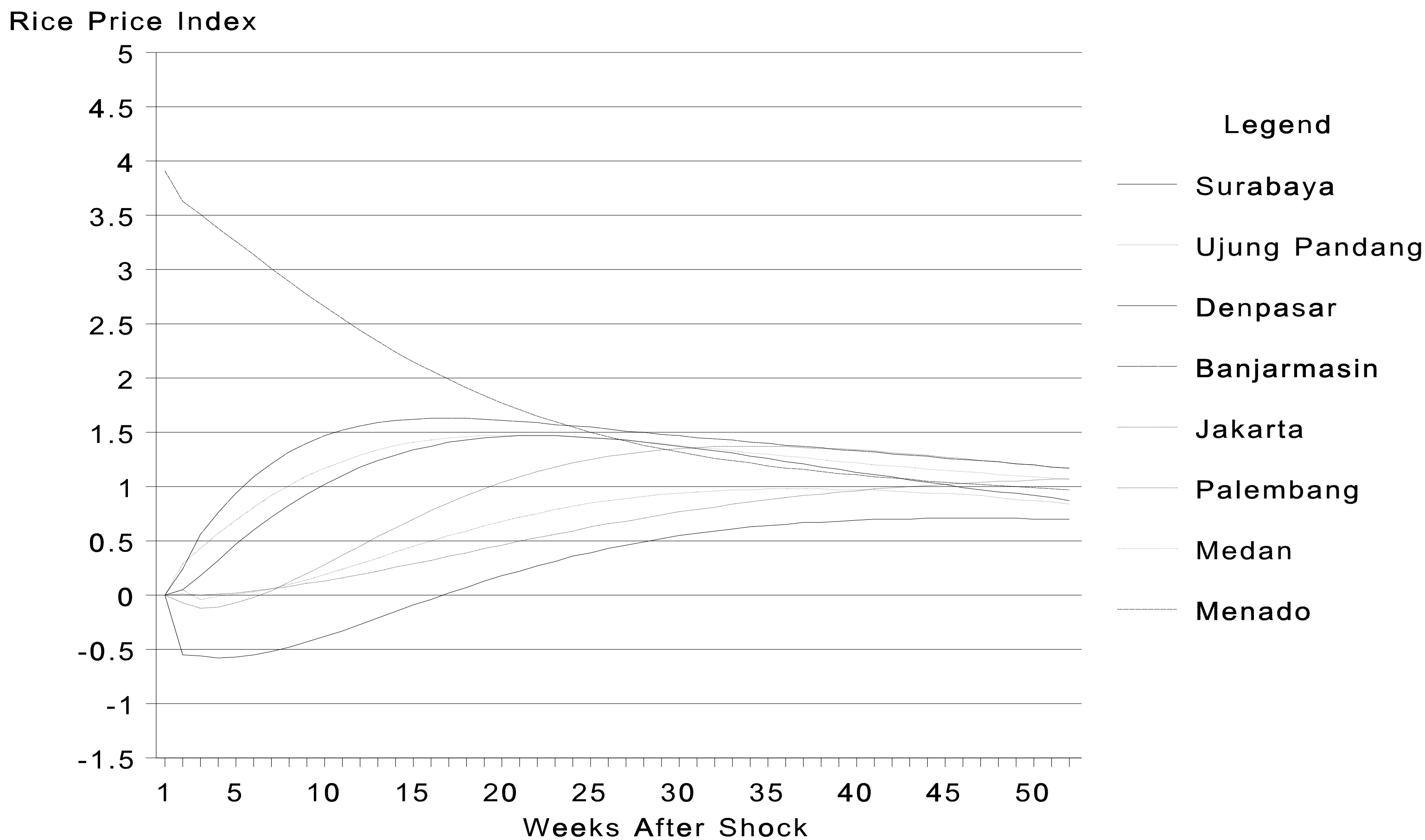

Table 1: Responses to a One-Standard Deviation Shock in Surabaya Rice Prices

Week	SBY	UPG	DPS	BMS	JKT	PLB	MED	MND
1	6.37*	0.60*	0.27	0.01	0.89*	0.05	0.23	0.23
2	7.04*	1.11*	0.83*	0.18	1.66*	0.44	1.33*	0.30
3	7.07*	1.51*	1.43*	0.13	2.35*	0.60	1.65*	0.34
4	6.94*	1.81*	1.88*	0.09	2.87*	0.70*	1.70*	0.36
5	6.73*	2.04*	2.24*	0.08	3.26*	0.77*	1.65*	0.39
6	6.48*	2.23*	2.52*	0.10	3.56*	0.84*	1.57*	0.43
7	6.22*	2.39*	2.75*	0.14	3.79*	0.90*	1.47*	0.49
8	5.95*	2.51*	2.94*	0.20	3.96*	0.95*	1.37*	0.56
9	5.69*	2.61*	3.09*	0.27	4.08*	1.00	1.28	0.63
10	5.43*	2.67*	3.21*	0.36	4.15*	1.05	1.18	0.71*
11	5.18*	2.72*	3.30*	0.46	4.19*	1.09	1.09	0.79*
12	4.93*	2.75*	3.36*	0.56	4.20*	1.13	1.01	0.87*
13	4.69*	2.76*	3.40*	0.67	4.18*	1.17	0.94	0.96*
14	4.47*	2.75*	3.42*	0.79	4.14*	1.20	0.87	1.04*
15	4.25*	2.73*	3.43*	0.90	4.08*	1.23	0.81	1.12*
16	4.04*	2.70*	3.42*	1.02	4.01*	1.26	0.75	1.20*
17	3.84*	2.66*	3.39*	1.13	3.93*	1.28	0.70	1.28*
18	3.65*	2.60*	3.36*	1.24	3.83*	1.30	0.66	1.35*
19	3.46*	2.54*	3.32*	1.36	3.73*	1.32	0.62	1.42*
20	3.29*	2.48*	3.27*	1.46	3.63*	1.33	0.60	1.48*
21	3.13*	2.41*	3.21*	1.56	3.52*	1.34	0.57	1.55*
22	2.98*	2.34*	3.15*	1.65*	3.41*	1.35	0.55	1.60*
23	2.84*	2.26*	3.08*	1.74*	3.29*	1.36	0.54	1.65*
24	2.71*	2.19*	3.01*	1.83*	3.19*	1.36	0.53	1.70*
25	2.59*	2.11*	2.94*	1.90*	3.08*	1.36	0.52	1.74*
26	2.47*	2.03*	2.87*	1.97*	2.97*	1.36	0.52	1.78*
27	2.36*	1.96*	2.79*	2.03*	2.87*	1.36	0.52	1.81*
28	2.26*	1.88*	2.72*	2.09*	2.77*	1.35	0.52	1.83*
29	2.17*	1.80*	2.64*	2.14*	2.67*	1.35	0.53	1.86*
30	2.09*	1.73*	2.57*	2.18*	2.57*	1.34	0.54	1.87*
31	2.01*	1.66*	2.50*	2.22*	2.48*	1.33	0.54	1.89*
32	1.93*	1.59*	2.43*	2.25*	2.40*	1.33	0.55	1.90*
33	1.87*	1.51*	2.36*	2.27*	2.32*	1.32	0.57	1.90*
34	1.81*	1.46*	2.29*	2.29*	2.24*	1.30	0.58	1.90*
35	1.75*	1.40*	2.22*	2.30*	2.17*	1.30	0.59	1.90*
36	1.67*	1.34	2.16*	2.31*	2.10*	1.29	0.61	1.90*
37	1.65*	1.29	2.10*	2.32*	2.03*	1.27	0.62	1.89*
38	1.60*	1.24	2.03*	2.32*	1.97*	1.26	0.64	1.88*
39	1.56	1.19	1.98*	2.31*	1.92*	1.25	0.65	1.87*
40	1.52	1.14	1.92*	2.30*	1.86*	1.24	0.66	1.86*
41	1.49	1.10	1.87*	2.29*	1.81	1.23	0.68	1.84*
42	1.46	1.06	1.81	2.28*	1.77	1.22	0.69	1.82*
43	1.43	1.02	1.76	2.26*	1.72	1.20	0.70	1.81*
44	1.40	0.99	1.72	2.24*	1.68	1.19	0.71	1.78*
45	1.37	0.96	1.67	2.22*	1.64	1.18	0.73	1.76*
46	1.35	0.93	1.63	2.19*	1.61	1.17	0.74	1.74*
47	1.33	0.90	1.59	2.17*	1.57	1.16	0.75	1.72*
48	1.30	0.87	1.55	2.14*	1.54	1.15	0.76	1.70*
49	1.28	0.85	1.51	2.11*	1.51	1.14	0.77	1.67*
50	1.26	0.83	1.47	2.08*	1.49	1.13	0.78	1.64*
51	1.25	0.81	1.44	2.05*	1.46	1.12	0.79	1.62*
52	1.23	0.79	1.40	2.02*	1.44	1.11	0.79	1.60*

* Indicates significance at α=0.05 using Monte-Carlo integration analysis. Explanation of variables: SBY=Surabaya, UPG=Ujung Pandang, DPS=Denpasar, BMS=Banjarmasin, JKT=Jakarta, PLB=Palembang, MED=Medan, MND=Menado.

Table 2: Responses to a One-Standard Deviation Shock in Ujung Pandang Rice Prices

Week	SBY	UPG	DPS	BMS	JKT	PLB	MED	MND
1	0.00	7.69*	0.37	0.45	0.18	-0.30	0.04	0.29
2	0.26	5.27*	0.30	0.73	0.85*	-0.30	0.09	0.45*
3	0.16	5.35*	0.18	1.09*	0.70	-0.64	0.33	0.53*
4	0.05	4.83*	0.21	1.35*	0.66	0.46	0.47	0.64*
5	-0.07	4.48*	0.18	1.57*	0.58	0.15	0.58	0.72*
6	-0.18	4.12*	0.14	1.75*	0.49	0.25	0.67	0.78*
7	-0.28	3.78*	0.10	1.90*	0.41	0.33	0.75	0.84*
8	-0.36	3.47*	0.06	2.02*	0.34	0.41	0.83	0.88*
9	-0.43	3.18*	0.02	2.11*	0.27	0.47	0.89	0.91*
10	-0.49	2.91*	-0.02	2.17*	0.21	0.53	0.95	0.93*
11	-0.53	2.66*	-0.06	2.22*	0.16	0.59	1.01	0.95*
12	-0.57	2.43*	-0.09	2.24*	0.11	0.64	1.06	0.95*
13	-0.59	2.22*	-0.13	2.25*	0.07	0.69	1.11	0.95*
14	-0.61	2.02*	-0.17	2.24*	0.03	0.73	1.15	0.94*
15	-0.61	1.84*	-0.20	2.22*	-0.01	0.76	1.19	0.93*
16	-0.61	1.68*	-0.22	2.19*	-0.01	0.80	1.23	0.92*
17	-0.61	1.53*	-0.25	2.14*	-0.03	0.83	1.26	0.90
18	-0.60	1.40*	-0.26	2.09*	-0.04	0.85	1.28	0.87
19	-0.59	1.28*	-0.28	2.03*	-0.05	0.88	1.30	0.85
20	-0.57	1.17	-0.30	1.97*	-0.05	0.90	1.32	0.82
21	-0.55	1.07	-0.31	1.90*	-0.05	0.92	1.34	0.79
22	-0.53	0.98	-0.31	1.83*	-0.05	0.94	1.35	0.76
23	-0.50	0.90	-0.32	1.75*	-0.04	0.96	1.36	0.73
24	-0.48	0.83	-0.32	1.68*	-0.03	0.97	1.37	0.70
25	-0.45	0.76	-0.32	1.60	-0.02	0.98	1.37	0.67
26	-0.42	0.71	-0.32	1.52	-0.01	0.99	1.38	0.64
27	-0.39	0.66	-0.32	1.44	0.00	1.00	1.38	0.61
28	-0.36	0.62	-0.31	1.36	0.02	1.02	1.38	0.58
29	-0.34	0.58	-0.31	1.29	0.03	1.02	1.37	0.55
30	-0.31	0.55	-0.31	1.21	0.05	1.03	1.37	0.52
31	-0.28	0.52	-0.30	1.14	0.07	1.04	1.36	0.50
32	-0.25	0.49	-0.29	1.07	0.09	1.05	1.35	0.47
33	-0.23	0.47	-0.27	1.00	0.11	1.05	1.34	0.45
34	-0.20	0.45	-0.25	0.93	0.13	1.06	1.33	0.43
35	-0.18	0.44	-0.24	0.87	0.15	1.06	1.32	0.40
36	-0.15	0.43	-0.23	0.81	0.16	1.06	1.30	0.38
37	-0.13	0.42	-0.21	0.75	0.18	1.07	1.29	0.36
38	-0.11	0.41	-0.19	0.70	0.20	1.07	1.28	0.35
39	-0.09	0.40	-0.18	0.64	0.22	1.07	1.27	0.33
40	-0.07	0.40	-0.16	0.59	0.23	1.08	1.25	0.32
41	-0.05	0.40	-0.15	0.55	0.25	1.08	1.24	0.30
42	-0.03	0.39	-0.13	0.50	0.27	1.08	1.22	0.29
43	-0.15	0.39	-0.12	0.46	0.28	1.08	1.20	0.28
44	0.01	0.39	-0.10	0.42	0.30	1.08	1.19	0.27
45	0.02	0.39	-0.09	0.39	0.31	1.08	1.17	0.26
46	0.03	0.39	-0.07	0.35	0.32	1.08	1.16	0.25
47	0.04	0.39	-0.05	0.32	0.33	1.08	1.14	0.24
48	0.05	0.39	-0.04	0.29	0.34	1.08	1.13	0.24
49	0.07	0.39	-0.03	0.27	0.36	1.08	1.11	0.23
50	0.08	0.39	-0.01	0.24	0.37	1.07	1.09	0.23
51	0.09	0.40	0.00	0.22	0.37	1.07	1.08	0.23
52	0.10	0.40	0.01	0.20	0.38	1.07	1.07	0.22

* Indicates significance at α=0.05 using Monte-Carlo integration analysis. Explanation of variables: SBY=Surabaya, UPG=Ujung Pandang, DPS=Denpasar, BMS=Banjarmasin, JKT=Jakarta, PLB=Palembang, MED=Medan, MND=Menado.

Table 3: Responses to a One-Standard Deviation Shock in Jakarta Rice Prices

Week	SBY	UPG	DPS	BMS	JKT	PLB	MED	MND
1	0.00	0.00	0.00	0.00	7.06*	0.16	0.54*	0.15
2	1.05*	0.20	0.56*	0.74*	7.27*	0.71*	0.98*	0.12
3	1.38*	0.63*	0.63*	0.73*	6.91*	0.93*	1.16*	0.22
4	1.46*	0.78*	0.59	0.81	6.43*	1.03*	0.12*	0.42
5	1.43*	0.92*	0.49	0.87	5.92*	1.08*	1.00*	0.54*
6	1.37*	1.01*	0.39	0.94	5.43*	1.11*	0.87	0.64*
7	1.30*	1.07*	0.30	1.02	4.97*	1.12*	0.75	0.74*
8	1.23*	1.12*	0.22	1.10	4.55*	1.13*	0.64	0.83*
9	1.16	1.16*	0.15	1.18	4.17*	1.13	0.56	0.91*
10	1.09	1.18*	0.08	1.26	3.82*	1.13	0.49	0.98*
11	1.03	1.19*	0.04	1.34*	3.51*	1.13	0.44	1.05*
12	0.98	1.19*	-0.00	1.41*	3.22*	1.12	0.40	1.11*
13	0.93	1.18	-0.03	1.48*	2.96*	1.12	0.38	1.16*
14	0.89	1.17	-0.05	1.54*	2.73*	1.12	0.36	1.20*
15	0.86	1.16	-0.07	1.60*	2.52*	1.11	0.35	1.24*
16	0.82	1.14	-0.08	1.66*	2.33*	1.10	0.35	1.27*
17	0.79	1.12	-0.09	1.71*	2.17*	1.09	0.36	1.30*
18	0.77	1.09	-0.09	1.75*	2.01*	1.08	0.37	1.32*
19	0.75	1.07	-0.09	1.78*	1.88*	1.07	0.39	1.34*
20	0.73	1.04	-0.09	1.81*	1.76*	1.06	0.41	1.35*
21	0.71	1.01	-0.09	1.84*	1.65	1.05	0.43	1.36*
22	0.70	0.99	-0.08	1.86*	1.55	1.04	0.45	1.36*
23	0.69	0.96	-0.07	1.87*	1.46	1.03	0.47	1.37*
24	0.68	0.94	-0.06	1.88*	1.39	1.02	0.50	1.36*
25	0.67	0.91	-0.05	1.88*	1.32	1.01	0.52	1.36*
26	0.67	0.89	-0.03	1.88*	1.26	1.01	0.55	1.35*
27	0.66	0.97	-0.02	1.88*	1.21	1.00	0.57	1.34*
28	0.66	0.84	-0.03	1.87*	1.16	0.99	0.60	1.33*
29	0.66	0.82	0.01	1.86*	1.12	0.98	0.62	1.31*
30	0.65	0.80	0.03	1.84*	1.08	0.98	0.64	1.30*
31	0.65	0.78	0.04	1.82*	1.05	0.97	0.66	1.29*
32	0.65	0.77	0.06	1.80*	1.02	0.96	0.68	1.27*
33	0.65	0.75	0.08	1.78*	0.99	0.96	0.70	1.25*
34	0.65	0.73	0.09	1.76*	0.97	0.95	0.72	1.23*
35	0.65	0.72	0.11	1.73*	0.95	0.95	0.74	1.21*
36	0.65	0.71	0.13	1.71*	0.94	0.95	0.75	1.19*
37	0.65	0.70	0.14	1.68*	0.93	0.95	0.77	1.17*
38	0.65	0.69	0.16	1.65*	0.91	0.94	0.78	1.15*
39	0.65	0.68	0.18	1.62*	0.90	0.94	0.79	1.13*
40	0.65	0.67	0.19	1.59*	0.89	0.94	0.80	1.11
41	0.65	0.66	0.21	1.56*	0.88	0.93	0.81	1.09
42	0.65	0.65	0.22	1.53*	0.88	0.93	0.82	1.07
43	0.65	0.64	0.23	1.49*	0.87	0.93	0.83	1.05
44	0.65	0.63	0.25	1.46*	0.86	0.93	0.83	1.04
45	0.64	0.63	0.26	1.43*	0.86	0.92	0.84	1.01
46	0.64	0.62	0.27	1.40*	0.85	0.92	0.84	0.99
47	0.64	0.62	0.28	1.37	0.85	0.92	0.85	0.98
48	0.64	0.61	0.29	1.34	0.85	0.92	0.85	0.96
49	0.64	0.61	0.30	1.31	0.84	0.92	0.85	0.95
50	0.63	0.60	0.32	1.28	0.84	0.92	0.85	0.93
51	0.63	0.59	0.33	1.25	0.83	0.92	0.85	0.91
52	0.63	0.59	0.34	1.22	0.83	0.91	0.85	0.90

* Indicates significance at α=0.05 using Monte-Carlo integration analysis. Explanation of variables: SBY=Surabaya, UPG=Ujung Pandang, DPS=Denpasar, BMS=Banjarmasin, JKT=Jakarta, PLB=Palembang, MED=Medan, MND=Menado.

Table 4: Responses to a One-Standard Deviation Shock in Denpasar Rice Prices

Week	SBY	UPG	DPS	BMS	JKT	PLB	MED	MND
1	0.00	0.00	6.48*	-0.22	-0.05	0.27	0.05	0.05
2	0.43	0.68*	6.50*	-0.99*	0.72	0.55	0.10	0.04
3	0.63*	0.37	6.38*	-0.85	0.92*	0.65	0.18	0.02
4	0.66*	0.34	6.10*	-0.83	0.91*	0.69	0.21	0.05
5	0.65	0.22	5.82*	-0.82	0.88*	0.68	0.20	0.07
6	0.61	0.13	5.53*	-0.80	0.82	0.67	0.16	0.09
7	0.57	0.04	5.25*	-0.79	0.77	0.65	0.11	0.11
8	0.54	-0.04	4.98*	-0.78	0.71	0.63	0.07	0.12
9	0.51	-0.01	4.73*	-0.76	0.66	0.60	0.02	0.13
10	0.48	-0.18	4.48*	-0.75	0.61	0.57	-0.01	0.14
11	0.46	-0.24	4.25*	-0.74	0.56	0.54	-0.05	0.15
12	0.44	-0.29	4.04*	-0.73	0.52	0.51	-0.08	0.16
13	0.42	-0.33	3.83*	-0.72	0.48	0.48	-0.11	0.16
14	0.41	-0.37	3.64*	-0.71	0.44	0.45	-0.14	0.16
15	0.40	-0.40	3.45*	-0.70	0.41	0.42	-0.17	0.17
16	0.39	-0.42	3.28*	-0.69	0.38	0.39	-0.19	0.17
17	0.38	-0.44	3.11*	-0.67	0.35	0.36	-0.21	0.17
18	0.38	-0.46	2.96*	-0.66	0.33	0.33	-0.23	0.17
19	0.38	-0.47	2.81*	-0.65	0.31	0.30	-0.25	0.17
20	0.37	-0.48	2.67*	-0.64	0.29	0.27	-0.27	0.16
21	0.37	-0.49	2.54*	-0.62	0.27	0.24	-0.28	0.16
22	0.37	-0.49	2.42*	-0.61	0.26	0.22	-0.29	0.16
23	0.37	-0.49	2.30*	-0.60	0.24	0.19	-0.31	0.16
24	0.37	-0.49	2.19*	-0.58	0.23	0.16	-0.32	0.15
25	0.37	-0.48	2.09*	-0.57	0.22	0.14	-0.33	0.15
26	0.37	-0.48	1.99*	-0.55	0.21	0.11	-0.34	0.15
27	0.36	-0.47	1.90*	-0.54	0.20	0.09	-0.34	0.15
28	0.36	-0.46	1.81*	-0.52	0.20	0.07	-0.35	0.14
29	0.36	-0.45	1.73	-0.51	0.19	0.05	-0.36	0.14
30	0.36	-0.44	1.65	-0.49	0.18	0.03	-0.36	0.14
31	0.36	-0.43	1.57	-0.47	0.18	0.01	-0.37	0.14
32	0.36	-0.42	1.50	-0.46	0.17	-0.01	-0.37	0.13
33	0.36	-0.41	1.43	-0.44	0.17	-0.03	-0.38	0.13
34	0.36	-0.40	1.37	-0.42	0.16	-0.05	-0.38	0.13
35	0.35	-0.39	1.31	-0.40	0.16	-0.07	-0.38	0.13
36	0.35	-0.37	1.25	-0.39	0.16	-0.08	-0.38	0.12
37	0.35	-0.36	1.20	-0.37	0.15	-0.10	-0.39	0.12
38	0.34	-0.35	1.15	-0.35	0.15	-0.11	-0.39	0.12
39	0.34	-0.34	1.10	-0.34	0.15	-0.12	-0.39	0.12
40	0.33	-0.33	1.05	-0.32	0.14	-0.14	-0.39	0.11
41	0.33	-0.31	1.01	-0.30	0.14	-0.15	-0.39	0.11
42	0.32	-0.30	0.96	-0.28	0.14	-0.16	-0.39	0.11
43	0.32	-0.29	0.92	-0.27	0.13	-0.17	-0.39	0.11
44	0.31	-0.28	0.87	-0.25	0.13	-0.18	-0.39	0.11
45	0.31	-0.27	0.85	-0.24	0.13	-0.19	-0.39	0.11
46	0.30	-0.26	0.81	-0.22	0.12	-0.20	-0.39	0.11
47	0.30	-0.25	0.78	-0.20	0.12	-0.21	-0.39	0.10
48	0.29	-0.24	0.75	-0.19	0.11	-0.22	-0.39	0.10
49	0.28	-0.23	0.72	-0.17	0.11	-0.23	-0.38	0.10
50	0.28	-0.22	0.69	-0.16	0.11	-0.23	-0.38	0.10
51	0.27	-0.22	0.66	-0.15	0.10	-0.24	-0.38	0.09
52	0.26	-0.21	0.63	-0.13	0.09	-0.25	-0.37	0.09

* Indicates significance at α=0.05 using Monte-Carlo integration analysis. Explanation of variables: SBY=Surabaya, UPG=Ujung Pandang, DPS=Denpasar, BMS=Banjarmasin, JKT=Jakarta, PLB=Palembang, MED=Medan, MND=Menado.

Table 5: Responses to a One-Standard Deviation Shock in Palembang Rice Prices

Week	SBY	UPG	DPS	BMS	JKT	PLB	MED	MND
1	0.00	0.00	0.00	0.00	0.00	5.41*	0.33	0.10
2	0.22	0.74*	0.65*	-0.14	0.70*	5.56*	0.72*	0.18
3	0.47	0.69*	0.95*	-0.16	1.04*	5.49*	0.92*	0.26
4	0.58	0.75*	1.08*	-0.16	1.16*	5.38*	1.07*	0.33
5	0.63	0.76*	1.17*	-0.17	1.24*	5.24*	1.16*	0.41
6	0.66	0.77*	1.23*	-0.16	1.29*	5.11*	1.22*	0.48*
7	0.68	0.78*	1.28*	-0.16	1.33*	4.97*	1.27*	0.55*
8	0.70	0.78*	1.32*	-0.15	1.36*	4.84*	1.31*	0.61*
9	0.72	0.78*	1.36*	-0.13	1.38*	4.71*	1.34*	0.67*
10	0.74	0.79	1.38*	-0.12	1.40*	4.60*	1.38*	0.72*
11	0.76	0.79	1.41*	-0.09	1.42*	4.48*	1.41*	0.77*
12	0.78	0.79	1.43*	-0.07	1.43*	4.37*	1.44*	0.81*
13	0.79	0.79	1.44*	-0.05	1.44*	4.27*	1.47*	0.86*
14	0.81	0.80	1.45*	-0.03	1.45*	4.17*	1.49*	0.90*
15	0.83	0.80	1.46*	-0.01	1.46*	4.07*	1.52*	0.93*
16	0.85	0.80	1.47*	0.02	1.47*	3.98*	1.54*	0.96*
17	0.87	0.81	1.48*	0.05	1.48*	3.89*	1.56*	0.99*
18	0.89	0.81	1.48*	0.08	1.49*	3.81*	1.58*	1.02*
19	0.91	0.82	1.48*	0.11	1.49*	3.73*	1.60*	1.05*
20	0.93	0.82	1.48*	0.13	1.50*	3.65*	1.62*	1.07*
21	0.95	0.83	1.48*	0.16	1.51	3.57*	1.63*	1.09*
22	0.97	0.83	1.48	0.19	1.51	3.51*	1.65*	1.11*
23	0.98	0.84	1.48	0.21	1.52	3.44*	1.66*	1.13*
24	1.00	0.84	1.48	0.24	1.52	3.38*	1.67*	1.14*
25	1.02	0.85	1.47	0.27	1.53	3.31*	1.68*	1.15*
26	1.03	0.86	1.47	0.29	1.53	3.25*	1.69*	1.17*
27	1.05	0.86	1.47	0.31	1.54	3.20*	1.70	1.18*
28	1.06	0.87	1.46	0.34	1.54	3.14*	1.70	1.19*
29	1.07	0.87	1.46	0.36	1.55	3.09*	1.71	1.19*
30	1.08	0.88	1.45	0.38	1.55	3.04*	1.71	1.20*
31	1.10	0.89	1.45	0.41	1.56	2.99*	1.72	1.21*
32	1.11	0.89	1.45	0.43	1.56	2.95*	1.72	1.21*
33	1.11	0.90	1.44	0.45	1.56	2.90*	1.72	1.22*
34	1.12	0.90	1.43	0.47	1.57	2.86*	1.73	1.22*
35	1.13	0.91	1.43	0.49	1.57	2.82*	1.73	1.23*
36	1.14	0.92	1.42	0.51	1.57	2.78*	1.72	1.23*
37	1.14	0.92	1.42	0.53	1.57	2.74*	1.72	1.23*
38	1.15	0.93	1.41	0.55	1.57	2.71*	1.72	1.23*
39	1.16	0.93	1.41	0.56	1.57	2.67*	1.72	1.23*
40	1.16	0.94	1.40	0.58	1.58	2.64*	1.72	1.23*
41	1.16	0.94	1.39	0.60	1.58	2.60*	1.71	1.23*
42	1.16	0.94	1.39	0.61	1.58	2.57*	1.71	1.23*
43	1.17	0.95	1.38	0.63	1.58	2.54*	1.71	1.23*
44	1.17	0.95	1.37	0.64	1.57	2.51*	1.70	1.23*
45	1.17	0.95	1.36	0.66	1.57	2.48*	1.70	1.23*
46	1.17	0.96	1.36	0.67	1.57	2.46*	1.69	1.23
47	1.17	0.96	1.35	0.68	1.57	2.43*	1.68	1.23
48	1.17	0.96	1.34	0.70	1.57	2.40*	1.68	1.22
49	1.17	0.96	1.33	0.71	1.56	2.38*	1.67	1.22
50	1.16	0.96	1.32	0.72	1.56	2.36*	1.66	1.22
51	1.16	0.96	1.32	0.73	1.55	2.33*	1.65	1.21
52	1.16	0.96	1.31	0.74	1.55	2.31*	1.65	1.21

[*] Indicates significance at $\alpha=0.05$ using Monte-Carlo integration analysis. Explanation of variables: SBY=Surabaya, UPG=Ujung Pandang, DPS=Denpasar, BMS=Banjarmasin, JKT=Jakarta, PLB=Palembang, MED=Medan, MND=Menado.

Table 6: Responses to a One-Standard Deviation Shock in Medan Rice Prices

Week	SBY	UPG	DPS	BMS	JKT	PLB	MED	MND
1	0.00	0.00	0.00	0.00	0.00	0.00	5.87*	-0.03
2	0.64*	0.37	0.52*	-0.15	0.49	0.36	6.66*	-0.05
3	0.95*	0.61*	0.70*	-0.40	0.87*	0.65*	6.71*	-0.16
4	1.08*	0.78*	0.78*	-0.59	1.10*	0.88*	6.57*	-0.27
5	1.13*	0.93*	0.82*	-0.77	1.27*	1.06*	6.36*	-0.36
6	1.15*	1.05*	0.84*	-0.93*	1.39*	1.23*	6.12*	-0.43
7	1.15*	1.15*	0.86	-1.07*	1.49*	1.38*	5.88*	-0.49
8	1.13*	1.25*	0.86	-1.18*	1.57*	1.51*	5.65*	-0.54
9	1.11*	1.33*	0.87	-1.27*	1.63*	1.64*	5.43*	-0.57
10	1.08	1.40*	0.88	-1.35*	1.68*	1.76*	5.21*	-0.59
11	1.04	1.46*	0.88	-1.41*	1.72*	1.87*	5.00*	-0.60
12	1.01	1.51*	0.88	-1.45*	1.75*	1.97*	4.81*	-0.60
13	0.97	1.55*	0.88	-1.48*	1.77*	2.06*	4.62*	-0.59
14	0.93	1.59*	0.88	-1.49*	1.77*	2.14*	4.45*	-0.57
15	0.89	1.62*	0.88	-1.50	1.78*	2.22*	4.28*	-0.55
16	0.85	1.64*	0.88	-1.50	1.77*	2.29*	4.13*	-0.53
17	0.81	1.65*	0.88	-1.49	1.76*	2.36*	3.98*	-0.50
18	0.78	1.66*	0.87	-1.47	1.75*	2.42*	3.84*	-0.47
19	0.74	1.66*	0.87	-1.44	1.73	2.47*	3.71*	-0.43
20	0.71	1.66*	0.87	-1.41	1.71	2.52*	3.59*	-0.40
21	0.67	1.65*	0.86	-1.38	1.68	2.56*	3.47*	-0.36
22	0.64	1.64*	0.85	-1.34	1.66	2.60*	3.37*	-0.32
23	0.61	1.63*	0.85	-1.29	1.63	2.63*	3.27*	-0.28
24	0.58	1.61*	0.84	-1.25	1.60	2.66*	3.17*	-0.23
25	0.56	1.59*	0.83	-1.20	1.57	2.69*	3.08*	-0.19
26	0.53	1.57*	0.83	-1.15	1.54	2.71*	3.00*	-0.15
27	0.51	1.55*	0.82	-1.11	1.51	2.72*	2.93*	-0.11
28	0.49	1.53*	0.81	-1.06	1.49	2.74*	2.85*	-0.07
29	0.48	1.50*	0.80	-1.01	1.46	2.75*	2.79*	-0.02
30	0.46	1.48*	0.79	-0.95	1.43	2.76*	2.73*	0.01
31	0.45	1.45*	0.79	-0.91	1.41	2.76*	2.67*	0.05
32	0.44	1.43	0.78	-0.86	1.38	2.76*	2.61*	0.09
33	0.43	1.40	0.78	-0.81	1.36	2.77*	2.56*	0.12
34	0.43	1.37	0.77	-0.76	1.33	2.76*	2.51*	0.16
35	0.42	1.35	0.77	-0.71	1.31	2.76*	2.47*	0.19
36	0.42	1.32	0.76	-0.67	1.29	2.76*	2.43*	0.22
37	0.42	1.30	0.76	-0.63	1.27	2.75*	2.39*	0.26
38	0.42	1.27	0.76	-0.59	1.55	2.74*	2.35*	0.28
39	0.42	1.25	0.75	-0.55	1.24	2.73*	2.32*	0.31
40	0.42	1.23	0.75	-0.51	1.22	2.72*	2.29*	0.34
41	0.42	1.20	0.75	-0.47	1.21	2.71*	2.26*	0.37
42	0.43	1.18	0.74	-0.43	1.20	2.70*	2.23*	0.39
43	0.43	1.16	0.74	-0.40	1.19	2.68*	2.20*	0.41
44	0.44	1.14	0.74	-0.36	1.18	2.67*	2.17*	0.43
45	0.44	1.12	0.74	-0.33	1.17	2.65*	2.15*	0.45
46	0.45	1.11	0.74	-0.30	1.16	2.64*	2.13*	0.48
47	0.46	1.10	0.74	-0.27	1.15	2.62*	2.10*	0.49
48	0.47	1.07	0.74	-0.24	1.15	2.61*	2.08*	0.51
49	0.47	1.06	0.74	-0.21	1.14	2.59*	2.06	0.53
50	0.48	1.04	0.74	-0.18	1.14	2.58*	2.04	0.54
51	0.49	1.03	0.74	-0.16	1.13	2.56*	2.02	0.56
52	0.50	1.01	0.75	-0.13	1.13	2.54*	2.00	0.57

* Indicates significance at α=0.05 using Monte-Carlo integration analysis. Explanation of variables: SBY=Surabaya, UPG=Ujung Pandang, DPS=Denpasar, BMS=Banjarmasin, JKT=Jakarta, PLB=Palembang, MED=Medan, MND=Menado.

Table 7: Responses to a One-Standard Deviation Shock in Banjarmasin Rice Prices

Week	SBY	UPG	DPS	BMS	JKT	PLB	MED	MND
1	0.00	0.00	0.00	9.10*	0.17	-0.20	-0.15	0.12
2	-0.01	0.80*	-0.13	7.37*	0.18	-0.39	0.17	0.55*
3	-0.04	0.39	-0.08	7.01*	0.26	-0.37	0.14	0.44*
4	-0.11	0.42	-0.09	6.52*	0.24	-0.36	0.11	0.40*
5	-0.17	0.33	-0.08	6.07*	0.25	-0.35	0.06	0.36
6	-0.23	0.27	-0.09	5.66*	0.23	-0.35	0.02	0.32
7	-0.29	0.21	-0.10	5.27*	0.21	-0.34	-0.03	0.28
8	-0.34	0.16	-0.12	4.90*	0.18	-0.34	-0.07	0.25
9	-0.38	0.10	-0.14	4.57*	0.14	-0.34	-0.11	0.22
10	-0.42	0.05	-0.16	4.25*	0.11	-0.35	-0.15	0.19
11	-0.46	0.01	-0.19	3.96*	0.07	-0.35	-0.19	0.16
12	-0.49	-0.03	-0.21	3.68*	0.03	-0.35	-0.21	0.14
13	-0.51	-0.07	-0.23	3.42*	-0.01	-0.36	-0.24	0.11
14	-0.53	-0.11	-0.26	3.18*	-0.04	-0.36	-0.27	0.09
15	-0.55	-0.15	-0.28	2.96*	-0.08	-0.37	-0.29	0.07
16	-0.57	-0.18	-0.30	2.75*	-0.12	-0.37	-0.31	0.05
17	-0.58	-0.20	-0.32	2.55*	-0.15	-0.38	-0.33	0.03
18	-0.58	-0.24	-0.34	2.37*	-0.19	-0.39	-0.34	0.01
19	-0.59	-0.26	-0.36	2.20*	-0.22	-0.39	-0.36	-0.01
20	-0.59	-0.28	-0.38	2.03*	-0.25	-0.40	-0.37	-0.02
21	-0.59	-0.30	-0.39	1.88*	-0.27	-0.41	-0.38	-0.04
22	-0.59	-0.32	-0.40	1.74*	-0.30	-0.41	-0.39	-0.05
23	-0.59	-0.33	-0.42	1.61*	-0.32	-0.42	-0.39	-0.07
24	-0.59	-0.35	-0.43	1.48*	-0.34	-0.43	-0.40	-0.08
25	-0.58	-0.36	-0.44	1.36*	-0.36	-0.43	-0.41	-0.10
26	-0.57	-0.37	-0.45	1.26	-0.38	-0.44	-0.41	-0.11
27	-0.57	-0.38	-0.46	1.15	-0.39	-0.44	-0.41	-0.13
28	-0.56	-0.38	-0.46	1.06	-0.41	-0.45	-0.41	-0.14
29	-0.55	-0.39	-0.47	0.96	-0.42	-0.45	-0.42	-0.15
30	-0.54	-0.39	-0.47	0.88	-0.43	-0.46	-0.42	-0.16
31	-0.53	-0.39	-0.48	0.80	-0.44	-0.46	-0.42	-0.17
32	-0.53	-0.40	-0.48	0.72	-0.44	-0.47	-0.42	-0.18
33	-0.52	-0.40	-0.48	0.65	-0.45	-0.47	-0.42	-0.19
34	-0.51	-0.40	-0.48	0.58	-0.45	-0.48	-0.42	-0.20
35	-0.50	-0.40	-0.48	0.53	-0.46	-0.48	-0.42	-0.21
36	-0.49	-0.40	-0.48	0.47	-0.46	-0.48	-0.42	-0.22
37	-0.48	-0.39	-0.48	0.42	-0.46	-0.48	-0.42	-0.23
38	-0.47	-0.39	-0.48	0.37	-0.46	-0.49	-0.42	-0.24
39	-0.46	-0.39	-0.47	0.32	-0.46	-0.49	-0.41	-0.25
40	-0.45	-0.38	-0.47	0.27	-0.46	-0.49	-0.41	-0.25
41	-0.44	-0.38	-0.47	0.23	-0.46	-0.49	-0.41	-0.26
42	-0.43	-0.38	-0.46	0.19	-0.46	-0.49	-0.41	-0.26
43	-0.42	-0.37	-0.46	0.16	-0.46	-0.49	-0.41	-0.27
44	-0.41	-0.37	-0.45	0.13	-0.46	-0.50	-0.41	-0.28
45	-0.41	-0.36	-0.45	0.09	-0.45	-0.50	-0.40	-0.28
46	-0.40	-0.36	-0.44	0.07	-0.45	-0.50	-0.40	-0.28
47	-0.39	-0.35	-0.44	0.04	-0.45	-0.50	-0.40	-0.29
48	-0.38	-0.35	-0.43	0.01	-0.45	-0.50	-0.40	-0.29
49	-0.38	-0.34	-0.43	-0.01	-0.44	-0.50	-0.40	-0.29
50	-0.37	-0.33	-0.42	-0.03	-0.44	-0.49	-0.40	-0.30
51	-0.36	-0.33	-0.42	-0.05	-0.43	-0.49	-0.39	-0.30
52	-0.36	-0.32	-0.41	-0.07	-0.43	-0.49	-0.39	-0.30

* Indicates significance at α=0.05 using Monte-Carlo integration analysis. Explanation of variables: SBY=Surabaya, UPG=Ujung Pandang, DPS=Denpasar, BMS=Banjarmasin, JKT=Jakarta, PLB=Palembang, MED=Medan, MND=Menado.

Table 8: Responses to a One-Standard Deviation Shock in Menado Rice Prices

Week	SBY	UPG	DPS	BMS	JKT	PLB	MED	MND
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.91*
2	0.05	0.05	-0.55*	0.24	-0.07	0.01	0.29	3.63*
3	0.18	-0.04	-0.56	0.56	-0.12	0.00	0.43	3.51*
4	0.32	-0.01	-0.58	0.76*	-0.11	0.01	0.57	3.38*
5	0.47	0.01	-0.57	0.94*	-0.07	0.02	0.69*	3.26*
6	0.60	0.03	-0.55	1.09*	-0.02	0.04	0.81*	3.14*
7	0.72	0.06	-0.52	1.21*	0.04	0.06	0.92*	3.01*
8	0.83	0.10	-0.48	1.32*	0.12	0.08	1.01*	2.89*
9	0.93	0.14	-0.43	1.40*	0.20	0.11	1.10*	2.77*
10	1.02*	0.19	-0.38	1.47*	0.28	0.13	1.17*	2.66*
11	1.10*	0.24	-0.33	1.52*	0.37	0.16	1.23*	2.55*
12	1.18*	0.29	-0.27	1.56*	0.45	0.19	1.29*	2.44*
13	1.24*	0.34	-0.21	1.59*	0.54	0.22	1.34*	2.34*
14	1.29*	0.40	-0.15	1.61*	0.62	0.26	1.38*	2.24*
15	1.34*	0.45	-0.09	1.62*	0.70	0.29	1.41*	2.15*
16	1.37*	0.50	-0.04	1.63*	0.78	0.32	1.43*	2.07*
17	1.41*	0.55	0.02	1.63*	0.85	0.36	1.45*	1.99*
18	1.43*	0.59	0.07	1.63*	0.92	0.39	1.46*	1.91*
19	1.45*	0.64	0.13	1.62*	0.98	0.43	1.47*	1.84*
20	1.46*	0.68	0.18	1.61*	1.04	0.46	1.47*	1.77*
21	1.47*	0.72	0.22	1.60*	1.09	0.50	1.47*	1.71*
22	1.47*	0.75	0.27	1.59*	1.14	0.53	1.47*	1.65*
23	1.47*	0.79	0.31	1.57*	1.18	0.56	1.47	1.60*
24	1.46*	0.82	0.36	1.56*	1.22	0.59	1.46	1.55*
25	1.45*	0.85	0.39	1.55*	1.25	0.63	1.45	1.50*
26	1.44*	0.87	0.43	1.53*	1.28	0.66	1.44	1.46*
27	1.13	0.89	0.46	1.51*	1.30	0.68	1.43	1.42*
28	1.41	0.91	0.49	1.50*	1.32	0.71	1.41	1.38*
29	1.39	0.93	0.52	1.48*	1.34	0.74	1.40	1.35*
30	1.37	0.94	0.55	1.47*	1.35	0.77	1.38	1.32*
31	1.35	0.95	0.57	1.45*	1.36	0.79	1.36	1.29*
32	1.33	0.96	0.59	1.44*	1.37	0.81	1.35	1.26*
33	1.31	0.97	0.61	1.43*	1.37	0.84	1.33	1.24*
34	1.28	0.97	0.63	1.41	1.37	0.86	1.31	1.22*
35	1.26	0.98	0.64	1.40	1.37	0.88	1.30	1.19*
36	1.23	0.98	0.65	1.38	1.37	0.90	1.28	1.17*
37	1.21	0.98	0.67	1.37	1.36	0.92	1.27	1.16*
38	1.18	0.98	0.67	1.36	1.35	0.93	1.25	1.14*
39	1.16	0.97	0.68	1.34	1.35	0.95	1.23	1.12*
40	1.13	0.97	0.69	1.33	1.34	0.96	1.22	1.11*
41	1.11	0.97	0.70	1.32	1.33	0.98	1.20	1.09*
42	1.09	0.96	0.70	1.30	1.31	0.99	1.19	1.08*
43	1.06	0.95	0.70	1.29	1.30	1.00	1.18	1.07
44	1.04	0.94	0.71	1.28	1.29	1.01	1.16	1.05
45	1.02	0.94	0.71	1.26	1.27	1.02	1.15	1.04
46	0.99	0.93	0.71	1.25	1.26	1.03	1.14	1.03
47	0.97	0.92	0.71	1.24	1.24	1.04	1.13	1.02
48	0.95	0.90	0.71	1.23	1.23	1.05	1.11	1.01
49	0.94	0.88	0.71	1.21	1.21	1.05	1.10	1.00
50	0.92	0.87	0.70	1.20	1.20	1.06	1.09	0.99
51	0.90	0.86	0.70	1.18	1.18	1.07	1.08	0.98
52	0.87	0.84	0.70	1.17	1.17	1.07	1.07	0.97

* Indicates significance at α=0.05 using Monte-Carlo integration analysis. Explanation of variables: SBY=Surabaya, UPG=Ujung Pandang, DPS=Denpasar, BMS=Banjarmasin, JKT=Jakarta, PLB=Palembang, MED=Medan, MND=Menado.