Acreage response of paddy in Malaysia

Vlivy působící na výměru rýžových polí v Malajsii

(John) Yeong-Sheng TEY, Suryani DARHAM, Aswani Farhana MOHD NOH, Nurjihan IDRIS

Institute of Agricultural and Food Policy Studies, Universiti Putra Malaysia, Selangor, Malaysia

Abstract: This study investigated the relative impacts of various factors on acreage response of paddy by analyzing time series data of 1961–2007 via first difference logarithmic functional form of linear Nerlovian expectation model. It is apparent that future paddy price can be identical like previous year. Farmers, therefore, do not have additional incentives to adjust to desired paddy planted area. This scenario is further illustrated by farmers' inelastic response to government supports (incentives). Paddy planted area is not likely to be responsive to the incentives. Paddy price is found associated with higher production cost and may result in a shrink of paddy planted area in Malaysia. All the emerging findings from this study provide an important message for an imperative need to correct paddy related policies so as to reduce the distortions and increase economic efficiency.

Key words: paddy, adjustment coefficient, expectation coefficient, Nerlovian expectation model

Abstrakt: Studie zkoumá relativní dopady různých faktorů na změny výměry rýžových polí prostřednictvím analýzy časových řad let 1961–2007 s využitím první diference logaritmické funkce lineárního Nerlovova modelu očekávání. Je zřejmé, že budoucí ceny rýže mohou být identické s cenami předchozího roku. Farmáři pak nemají dostatečné pobídky k přizpůsobení výměry pěstebních ploch. Tento scénář dále ukazuje neelastickou reakci farmářů na vládní podpory (pobídky). Osevní plochy nereagují s mírou pravděpodobnosti na pobídky. Ceny rýže podle zjištění asociují s vyššími produkčními náklady a jejich výsledkem může být pokles pěstebních ploch rýže v Malajsii. Všechna zjištění vyplývající z této studie poskytují významný impuls imperativní potřeby ekonomické politiky zaměřené tak, aby se maximálně omezila selhání a zvýšila se ekonomická efektivnost.

Klíčová slova: rýžová pole, koeficient přizpůsobení, koeficient očekávání, Nerlovův model očekávání

In the context of a developing country, economic growth is coupled with the relative decline of the agriculture gross domestic product (GDP) share. This is partly the result of the demand of non-agricultural goods that increases faster than agricultural goods, as well as the post-farm gate economic activities which are not taken into account of the agricultuel GDP share. Misunderstanding of the diminishing share of agriculture in GDP has bred many doctrines. Agricultural industry indeed is an embedded pillar of support for other important industries through its value-addable surpluses.

Realizing its contribution and importance, Malaysia has elected to relook into agricultural industry. The utmost policy is to increase domestic paddy production and hereafter the rice production to feed the growing demand for rice. Tey et al. (2008) estimated that the expenditure elasticity of rice was 0.9001 in 2004/05. The vital need to increase rice production was addressed in the Third National Agricultural Policy (1998–2010) where eight granary areas were designated as permanent paddy producing areas to realize a minimum self-sufficiency level (SSL) for rice of 65 per cent. It was further emphasized in the Eighth Malaysian Plan (2001–2005) and the Ninth Malaysian Plan (2006–2010) to achieve rice SSL of 72 per cent and 90 per cent by 2005 and 2010 respectively.

The increase in paddy production can be done in the short/medium term by expanding the acreage of the planted area or in long term by increasing yield or improving efficiency of conversion from paddy to rice. Either way is promising to boost the domestic paddy production. However, the increase in paddy yield has been offset by the diminishing paddy planted area in Malaysia, despite of increasing rice prices and the generous economic incentives which have been given out on the per hectare basis. Hence, this study aims to investigate the relative impacts of various factors on the acreage response of paddy in Malaysia, particularly in view of the importance to shed off the dependence on rice imports.

Next section provides a better overview of the Malaysia's paddy and rice situation and is followed by a discussion on a theoretical framework underlying the foundation of the acreage response of paddy to various factors followed by the specification and estimation procedure of a response model. Estimation results with elasticity estimates for various factors will be presented and discussed to bring conclusions for policy implications to paddy and rice industry in Malaysia.

BACKGROUND

There has been a series of changes precipitated by the hike in petroleum prices coupled with the unfolding World Food Crisis, particularly the tripling of Thai rice prices and followed by the major exporting rice prices in 2008. Being a net importer of rice, Malaysia with SSL of about 72% was caught in the tension of food security like other developing nations. This is because rice has an important bearing not only for the fulfillment of consumption, particularly concerning food security of poor consumers in the country, who depend solely on rice as a calorie provider, but also as the source of raw materials for '*mee hun*' (vermicelli) mills and other end-use products.

As stepping up of on-going efforts, a bulk of new packages to increase rice production was introduced in the National Food Security Policy and the 7-Point Action Plan to tackle the rice crisis. In view of the gap to achieve her target by 2010, the rice SSL target was re-determined to be 86 per cent in the Mid-term Review of the Ninth Malaysian Plan.

In the wake of all these, it is pretty clear that there is an urgent need to boost rice production or supply response. Due to the urgency, the ideal immediate deed is to expand the acreage of paddy planted area in Malaysia. Under such circumstances, farmers in other countries may have to worry about production costs, but not in Malaysia. The Malaysian government has devoted a splendid funding (incentives/subsidies) to encourage the expansion of paddy cultivation. To name a few, it comprises funding for:

1. Irrigation Infrastructure and Drainage Development Program
2. Irrigation Infrastructure and Drainage Maintenance Program
3. Land Levelling Program
4. Farm Mechanization Program.

Instead of increasing rice prices and all the economic incentives mentioned above, the statistics and the trend of paddy planted area suggest that there is no or minimal acreage response of paddy in Malaysia. The trend of the paddy planted area can be clearly seen in Figure 1. After the independence of the country in 1957, the acreage of rice has increased steadily up to its peak at 766 000 hectares in 1972 and started to decrease gradually to 711 000 hectares in 1981. It

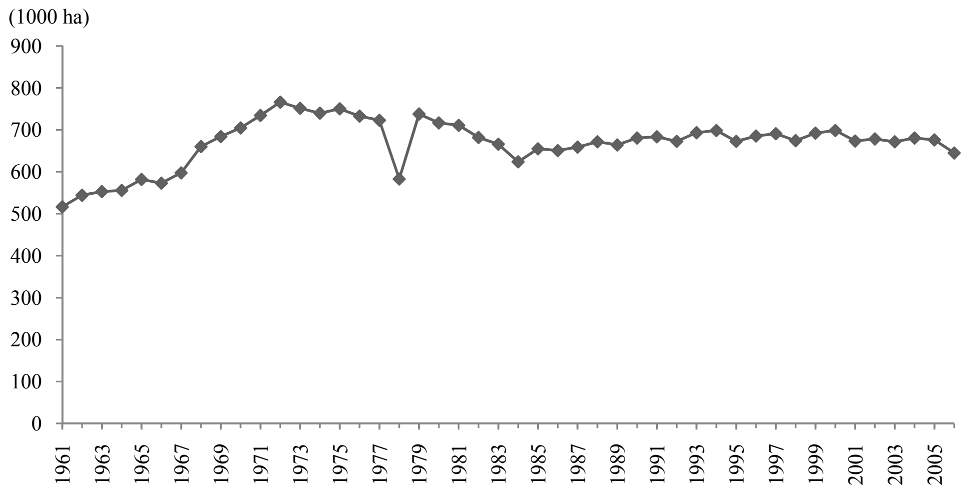

Figure 1. Paddy planted area ('000 ha) in Malaysia, 1961–2007

Source: IRRI (2008)

then has been stable within the range of 640 000 to 700 000 hectares. Some economists suggest that this is a result of land competition for production of more profitable commodities, mainly oil palm and rubber. However, given that there is no direct competition for land as soil requirements for paddy and other major commodities are different, it is rather a diversion of investment for more profitable crops.

METHODOLOGY

In view of the need to increase rice production for meeting the targets spelled out in the various agricultural policies, the methodology in this section is elected to rationalize the application of acreage (supply) response function like those applied in the previous studies (Mahmood et al. 2007; Mythili 2001 and 2008; Nosheen and Iqbal 2008).

Acreage (supply) response can be broadly analyzed by a supply function derived from a profit-maximizing framework and the Nerlovian expectation model. The first approach requires detailed information on all the input prices which are difficult to obtain in Malaysia. The second approach of Nerlove (1958) is more plausible to provide the insight of both the speed and level of adjustment of the actual acreage toward the desired acreage via adjustment coefficient, short run and long run elasticities. To ease the estimation of the elasticities, a logarithmic functional form of the linear Nerlovian expectation model can be expressed as:

$$Q_t^* = \alpha + \beta P_t^* + \gamma Z_t + U_t \qquad (1)$$

where:
Q_t^* = desired paddy planted area
P_t^* = expected normal paddy price
Z_t = denotes other exogenous factors
U_t = a disturbance term.

Since the desired paddy planted area is unobservable, it is assumed to be based on its lag and can be formed as

$$Q_t^* = Q_{t-1} + \gamma(Q_{t-1} - Q_{t-1}^*) \qquad 0 < \lambda \leq 1 \qquad (2)$$

where γ is coefficient of area adjustment.

Similarly, the expected paddy price is unobservable. It is assumed to be based on its lag and can be formed as:

$$P_t^* = P_{t-1} + \delta(P_{t-1} - P_{t-1}^*) \qquad 0 < \delta \leq 1 \qquad (3)$$

where δ is coefficient of expectation.

By substituting equations (2) and (3) into (1), the structural form of Nerlovian expectation model can be specified as:

$$Q_t = \beta_0\gamma\delta + \beta_1\gamma\delta P_{t-1} + [(1-\gamma) + (1-\delta)]Q_{t-1} -$$
$$-(1-\delta)(1-\gamma)Q_{t-2} + [\delta U_t - \delta(1-\gamma)U_{t-1}] \qquad (4)$$

The reduced form of the logarithmic linear equation of a distributed lag model with lagged dependent variables appearing as independent variables is:

$$Q_t = \alpha_0 + \alpha_1 P_{t-1} + \alpha_2 Q_{t-1} + a_2 Q_{t-2} + u_t \qquad (5)$$

where:

$$\alpha_0 = \beta\gamma\delta \qquad (6)$$
$$\alpha_1 = \beta_1\gamma\delta \qquad (7)$$
$$\alpha_2 = (1-\gamma) + (1-\delta) \qquad (8)$$
$$a_3 = -(1-\delta)(1-\gamma) \qquad (9)$$
$$u_t = \delta U_t - \delta(1-\gamma)\, U_{t-1} \qquad (10)$$

By taking the subsidy in Malaysian paddy cultivation in a particular year (like Salassi 1995), as well as yield in the previous year into account (like those in Mahmood et al. 2007; Nosheen and Iqbal 2008), the extended logarithmic functional form of equation can be specified as follows:

$$Q_t = \alpha_0 + \alpha_1 P_{t-1} + \alpha_2 Q_{t-1} + a_3 Q_{t-2} + \alpha_4 Y_{t-1} + \alpha_5 S_t \qquad (11)$$

where:
Y_{t-1} = lagged paddy yield
S_t = government support
other explanatory variables are as described earlier.

With the specification of equation (11), the data (1961–2007) for the identified variables was collected from the IRRI (2008). The whole set of the data was then verified by using stationary tests. This exercise was to correct the unit root problem, which is normally related to the autocorrelation issue. The autocorrelation was handled by the first difference form of generalized least squares (GLS) technique.

A preliminary GLS test was conducted and found that the variable, Q_{t-2}, is not statistically significant. It was dropped to improve the performance of the model. Hence, the final estimated logarithmic functional form of equation was:

$$Q_t = \alpha_0 + \alpha_1 P_{t-1} + \alpha_2 Q_{t-1} + a_3 Y_{t-1} + \alpha_4 S_t \qquad (12)$$

Subtraction of the coefficient of the lagged one paddy planted area from one would yield an adjustment coefficient, γ. The area adjustment coefficient indicates the pace of adjustment between the desired and the actual paddy planted area in the previous year.

It can then be used to produce the long run price elasticity by dividing the short run price elasticity over the adjustment coefficient. The adjustment coefficient can also be used to produce expectation coefficient, δ, from equation (8), where

$$\delta = 2 - \alpha_2 - \gamma \quad (13)$$

Nosheen and Iqbal (2008) explain that if δ approaches 0, there is no difference between this year's expected price and the last year actual price; if δ = 1, the expected price is identical to the last year actual price.

RESULTS

Firstly, stationary tests were conducted using the augmented Dickey-Fuller (ADF) test. From the result of Table 1, it can be clearly seen that most of the computed ADF test-statistics are greater than the critical values (–2.9266 at 5% significant level) at level, they show that the set of data has the unit root problem. However, by the Durbin-Watson statistics those smaller than 2 suggest that there is the autocorrelation problem in the data. Durbin's *h*-test was conducted to confirm the suggestion. As it turned out, there is the first order autocorrelation problem at the 5% significant level. ADF test was then further conducted and found that the unit root problem is corrected at the first difference (*I*(1)). Durbin's *h*-test was also performed and found that the autocorrelation problem was corrected at the 5% significant level.

Following the discussion in the final part of previous section which is supported by the suggestion of the ADF statistics,equation (6) was estimated via GLS. The estimated coefficients in the model are presented

Table 1. Augmented Dickey-Fuller test statistics of unit roots

Variable	Definition	ADF	Durbin-Watson	Durbin's *h*-test
Level				
P	paddy price	–0.3519	1.9956	0.0529
Q	paddy planted area	–3.2627	1.9717	0.4950
Y	yield	–0.8938	1.9109	1.1278
S	government support	–0.8980	2.1065	–1.2704
Critical value [a]		–2.9266		–1.96 or 1.96
First difference				
P	paddy price	–6.6094	2.0198	3.2664
Q	paddy planted area	–9.3732	2.0259	–4.8504
Y	yield	–6.4537	1.9747	–4.7510
S	government support	–6.9758	2.0306	5.3110
Critical value[a]		–2.9281		–1.96 or 1.96

[a]95% confidence level

Table 2. Estimates of the acreage response of paddy in Malaysia, 1961–2007

Variable	Coefficient	*t*-Statistic
Constant	1.2741	(2.9833)***
$\text{LOG}(P_{t-1})$	–0.3036	(–6.5923)***
$\text{LOG}(Q_{t-1})$	0.5223	(6.4813)***
$\text{LOG}(Y_{t-1})$	–0.2449	(–3.1023)***
$\text{LOG}(S_t)$	0.2891	(6.6393)***
AR(1)	–0.3526	(–2.0764)**
R^2	0.8276	
Durbin-Watson	2.1604	

Statistically significant: ***at 1% level and * at 5% level

Table 3. Estimates of adjustment/expectation coefficient, short and long run elasticities

Variable	Adjustment/Expectation coefficient	Short run elasticity	Long run elasticity
Paddy price	1.0000	–0.3036	–0.6355
Paddy planted area	0.4777	0.5223	–
Yield	–	–0.2449	–
Government support	–	0.2891	0.6052

in Table 2. While most of the explanatory variables are statistically significant, they explain about 80% of the variation in the paddy planted area in Malaysian within 1961–2007.

To provide a better insight of the acreage response of paddy, the estimated coefficients were re-stated as short term elasticities to the yield adjustment coefficient and long term elasticities. Table 3 provides the estimates of the adjustment/expectation coefficient, short and long run elasticities of the acreage response of paddy in Malaysia.

The expectation coefficient of paddy price is 1, which means that the expected price is same like the actual price in previous year. This is because there is no efficiency in price transmission on both top-down and down-top approaches resulting from the price control on retail price of 15% broken rice and ceiling prices for other grades by the government. At the ex-farm level, the Paddy Price Subsidy (RM248.10 per ton in 2007) is given as an income support as well as encouragement for farmers to produce more paddies. At the same time, the Guaranteed Minimum Price program (RM650 per ton in 2007) is embedded to kick in if the actual paddy price goes lower than the GMP. These policy interventiosn and incentives indeed hinder the domestic paddy farmers to respond to the market signals.

The area adjustment coefficient of 0.4777 represents that farmers adjust moderately toward the desired paddy planted area. The farmers' adjustment pace is not necessarily a positive response to the underlying changes, rather, it depends on the sign of the estimates of short and long run elasticities which are to be discussed below.

It is generally seen that all eleasticities are not elastic. The negative short run elasticity of the paddy planted area with respect to paddy price (–0.3036) and yield (–0.2449) shows that there is an inverse relationship between them. For example, an increase of 1% in the real paddy price is expected to result in 0.3036% of reduction in the paddy planted area in the short run, *ceteris paribus*. Similarly, the long run price elasticity of –0.6355 also indicates negative relationship between paddy planted area and price.

An increase in paddy price can be attributed to demand or/and supply (production) function. Being a small open economy, demand for rice is fulfilled via domestic production and imports. Hence, the short and long run price elasticities are implications of the supply function. While paddy price in Malaysia is generally stable without a serious hike or ramble, an increase in paddy price is more likely caused by higher production cosst and vice versa.

On the other hand, the short and long run government support elasticities of 0.2891 and 0.6052 imply that a 1% increase in the government support is likely to result in 0.2891 and 0.6052% expansion of the paddy planted area in Malaysia respectively. They also mean that the paddy planted areas are not responsive to such incentives. Nosheen and Iqbal (2008) suggest that such indication is a result of distortion and resulting in the wasteful and inefficient allocation of resources. In fact, an excessive assistance given to Malaysian paddy farmers (Athukorala and Loke 2007) and policy intervention are major distortions.

CONCLUSIONS

Given the importance of rice as a staple food to Malaysians and its economic role, this study investigated the relative impacts of various factors on the acreage response of paddy by analyzing the time series data of 1961–2007 via first difference logarithmic functional form of the linear Nerlovian expectation model. It is apparent that because of the government intervention at both the ex-farm and retail levels, future paddy price can be identical like previous year as long as there are no policy and structural changes. Thus, an increase in paddy price which is associated with higher production cost may result in a shrink of paddy planted area in Malaysia. Furthermore, farmers do not have additional incentives to adjust to the desired paddy planted area. This scenario is further illustrated by the farmers' inelastic response to government supports (incentives). Streaming from here, farmers actually do not show any elastic response to what it supposed to be.

Viewing the above signal inefficiency and misallocation of incentives for paddy farmers, there is an imperative need to correct the paddy related policies so as to reduce the distortions and increase economic efficiency. This is particularly crucial where the era of cheap food has ended and the policy to provide cheap rice to consumers is at the expense of farmers' income and efficiency and government expenses. As paddy price should be responsive to market signals, the local rice prices must be floated (but still allow 15% rice be price controlled to provide safety net for the poor).The increasing demand for rice will be likely to result in a higher paddy price as well as willingness to invest in the expansion of the paddy planted area. If the demand is low, the production surplus could even be exported to other countries where rice has increasingly become an important routine food, e.g. in some African countries. All these efforts will be translated as an improvement the in paddy and rice industry's competitiveness in the domestic, regional, and international markets.

REFERENCES

Athukorala P.C., Loke W.H. (2007): Distortions to agricultural incentives in Malaysia. World Bank's Development Research Group, Agricultural Distortions Working Paper 27.

International Rice Research Institute (2008): IRRI World Rice Statistics. Available at http://beta.irri.org/solutions/index.php?option=com_content&task=view&id=250

Mahmood M.A., Sheik, A.D., Kashif M. (2007): Acreage supply response of rice in Punjab. Journal of Agriculture and Resources, *45*: 231–236.

Mythili G. (2008). Acreage and yield response for major crops in the pre- and post-reform periods in India: A dynamic panel data approach. India Gandhi Institute of Development Research, PP-061.

Nerlove M. (1958): The Dynamics of Supply: Estimation of Farmers' Response to Price. Johns Hopkins Press, Baltimore, MD.

Nosheen M., Iqbal J. (2008): Acreage response of major crops in Pakistan (1970–71 to 2006–07). ARPN Journal of Agricultural and Biological Science, *3*: 55–64.

Salassi M.E. (1995): The responsiveness of U.S. rice acreage to price and production costs. Journal of Agriculture and Applied Economics, *27*: 386–99.

Tey Y.S., Mad Nasir S., Zainalabidin M., Amin Mahir A., Alias R. (2008): Complete demand systems of food in Malaysia. Agricultural Economics – Czech, *54*: 467–475.

Arrived on 27th May 2009

Contact address:

(John) Yeong-Sheng Tey, Institute of Agricultural and Food Policy Studies, Putra Infoport, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
e-mail: tyeong.sheng@gmail.com