Rice Mountain: Assessment of the Thai rice pledging program

Risti Permani and David Vanzetti
The University of Adelaide and Australian National University

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Abstract

The Thai Government introduced a generous price support program for paddy rice in 2011. The policy terminated in mid-2014 with the dismissal of the democratically elected Prime Minister, Ms Yingluck Shinawatra. There is an interest in understanding the welfare effects of the policy given the ongoing civil suit put against the former Prime Minister and the large stocks that remain. This study therefore analyses the welfare effects of various Thai rice policy options using a ten-region, dynamic, stochastic, partial equilibrium model of world rice trade. It finds that while the Thai policy was effective in supporting the incomes of rice producers in the short run, the burden imposed on taxpayers and consumers seems difficult to justify.

Keywords: Thailand, rice, stocks, trade, welfare effect

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1. Introduction

To win electoral support, the Thai Government has provided market price support to paddy rice producers. Between 2004 and 2014, Thailand implemented 11 subsidy schemes covering 15 harvests. The most significant was implemented by Prime Minister Shinawatra in 2011 when the price premium was about 50 per cent above the going market rate. The Government also reduced exports and built up stocks in an effort to push up world prices. This scheme was discontinued in May 2014 when the Government was dismissed.

Thailand’s Finance Ministry has estimated the total losses at around 700 billion baht (around US$21.5 billion which more than three quarters of these losses (i.e. 536 billion baht or $16.5 billion) occurred since 2011 (Bangkok Post 2015). Many believe, however, that there is the lack of transparency in the process of obtaining this estimate. Getting the right estimate is crucial given the civil suit brought against the former PM. In early 2015, the National Anti-Corruption Commission (NACC) formally asked the Finance Ministry to file a civil suit demanding compensation from Ms Shinawatra for negligence in her government’s rice pledging scheme. The demanded compensation would depend on total losses resulting from the policy highlighting the importance of reviewing methods to get estimates of the policy’s welfare effects.

Substantial losses from the policy were not a surprise. The pledging scheme sparked debate over strategies to achieve food security particularly in the Asian region. A standard buffer stock scheme normally involves governments purchasing and stockpiling a commodity when prices are low and selling it when prices are high. By this means, the Government not only stabilises prices but also makes a speculative profit if the price difference is sufficient to cover the cost of storage. However, the Thai policies seemed to have been aimed at raising world prices by temporarily removing supply from the world market. The former PM
Shinawatra was accused of attempting “to manipulate the world’s rice market by buying up supplies” (Murdoch 2013).

The Government’s rice pledging scheme was to pay as much as 50 per cent above the market price without limit on the amount of stocks. This made the Thai Government the largest buyer of rice. When the program was first launched in 2011, the top price at which the government bought rice from the country’s farmers was 15,000 Baht, about $486 a tonne, for white rice; and up to 20,000 Baht for fragrant paddy rice. That was about 50 per cent higher than the going market price at the time. In the second year of the program, the Thai Government was outlaying an additional $7.8 billion to fund the program with the hope that it could recoup this expenditure by selling the grain at an inflated price. Data suggest, however, world price of rice showed no significant increase between 2011 and 2012. Thailand’s decision to restrict its rice exports did not obviously boost the world price (Figure 1). The price level in September 2011 was $616 per tonne but since then it has trended downwards, and is currently around $400. Whilst this could mean that the global rice market has been quite competitive where even a major exporter is not a price maker, the insignificant effect of the policy on the global price may be due to other factors.

The timing of Thailand being edged out of its top exporter position for the first time in three decades was simultaneous with India needing to unload stocks accumulated during a four-year ban on non-Basmati exports (Larson 2013). Indonesia also bought less rice from Thailand due to higher domestic output (Russell 2013). Furthermore, the Philippines’ commitment to import rice from Thailand was constrained by the passing of the importation burden onto the private sector. Thailand is also facing increased competition with Vietnam (Lakkakula et al. 2015). The private sector in Philippines preferred to import rice from Vietnam due to its lower price (Manila Bulletin 2013).
Thailand’s weakening contribution to the global rice market had been happening years before the launch of the pledging scheme. In the past two decades, Thailand’s share of the global rice market has been generally declining and relatively volatile (Figure 2). In contrast, the contribution of other major rice exporters such as Vietnam and India has been gradually increasing since late 1980s. In 2010, just one year before the rice pledging scheme was first launched, Thailand contributed one-third of the global rice exports, whilst Vietnam and India contributed 20 per cent and 8 per cent, respectively (USDA 2015). These relatively small differences between Thailand’s and other major competitors’ world export shares would suggest that Thailand would not be able to increase world prices by a significant amount.

Nonetheless, many argue that the main reason why the rice pledging scheme was implemented in the first place was more politically motivated rather than aimed at enhancing food security. First, there was no evidence that the policy stimulated more local production. The Thai policy implemented in 2011/12 appears to have had little impact on area harvested and production (Column (ii) of Table 1). The increase in area is a modest 3 per cent but the consequent increase in production is negligible. However, it is clear that exports were reduced, from 10.6 million tonne in 2010/11 to 6.9 million tonne the following year, and ending stocks rose from 5.6 million tonne to 9.3 million tonne. Stocks rose even further in 2012/13, to 12.8 million tonne, but were reduced after that. By February 2015 stocks had fallen further to an estimated 9.6 million tonne. This is around one year’s consumption, well above the pre-pledging level of 5.6 million tonne. Given its insignificant effect on food security as well as local production, according to Russell (2013), the policy was merely seen as the former PM Shinawatra’s ‘vote winner’. She won power in July 2011 with a promise of generous subsidies to rice farmers.

Regardless of the rationale behind the design of the policy, this controversial policy seems to bring back an already heated debate on the role of governments in grain storage and potential
volatility in the world grain market, which could be a result of speculative actions of major producers such as Thailand. Governments’ interventions in stockholding are normally justified, as in other areas, by the existence of market failure, for example when the private sector has inadequate resources to handle risk, is poorly informed or subject to inappropriate regulatory or political constraints. That is not obviously the case in this instance.

Trade is often seen as a means of stabilising domestic prices. However, when exporters imposed restrictions on trade, as happened in 2008, importers were naturally reluctant to rely on international markets and may seek to ensure supplies by holding their own stocks. This is especially so in a thin market such as rice markets where trade is a small proportion of global production. Related issues to the debate include whether a regional or national approach or the provision of credit or other costs subsidies are more effective in ensuring stable food prices and supply. In eight of the past 13 years, global grain consumption has exceeded production leading to a significant drop in reserves (Larson 2013). In 2012, according to FAO statistics, global rice production is only slightly above total consumption whilst the available stocks would only cover 81 days of consumption. Given the importance of food security, governments’ role in grain storage is understandable but holding excessive stocks may not be the most efficient policy option.

Despite exhaustive media coverage, to the authors’ knowledge, there has not been any empirical study demonstrating the welfare effects of the Thai rice pledging scheme. The most relevant study is by Warr (2014a). Whilst his study provides important insights into the impacts of (unilateral) elimination of trade barriers including to agricultural commodities, it assumes that the rice pledging policy effects on the rates of protection to be ‘temporary’ (Warr 2014a). Therefore, the simulation results presented in Warr (2014a) do not specifically present the welfare effects of the rice pledging scheme.
Given the above background, this study, therefore, aims at investigating the welfare effects of various Thai rice policy options including the pledging scheme and selling-off strategies. Using 2010 as the base year, in particular, it employs a dynamic, stochastic, ten-region, partial equilibrium model of world rice trade. Despite its limitations, the use of a partial equilibrium model allows a first estimate of the impacts of policy changes and provides a useful tool for policy analysis using timely data. The analysis is to identify the separate impacts of the domestic price rise and the build-up of stocks, and then to examine options to draw down the stocks and to support farmers using a direct support mechanism not linked to production.

Comparing various policy scenarios, this study finds that a combination of pledging scheme and stock purchase without immediate stock release would result in the biggest loss. The welfare loss would decrease as the government sold-off its stock and be minimised if it were done within one year. This, however, would influence the global markets as competing exporters might perceive this move as a ‘price war’. For the Asian region, it would lead to lower food costs and, therefore, lower inflation which is highly sensitive to food prices.

The remainder of the paper is organised as follows. Section 2 reviews rice policies in Thailand. Section 3 defines datasets and an analytic framework. Section 4 presents simulation results. Section 5 concludes.

2. Rice policies in Thailand

The rice economies in Asia were traditionally characterised by a high degree of government intervention in production, export and internal distribution (Wong 1978). Many Asian countries have been concerned about food security and improving productivity to reduce import dependence. Some would then translate the policy to a self-sufficiency program. For
Thailand, the concerns have been more about stabilising food prices for consumers rather than supporting producers (Warr 2008).

A review of rice policies until 1973 suggests that most policies being used were trade policies and “unlike most importing countries, the government of Thailand never tried to influence prices by influencing production” (Siamwalla 1975). In the past, the impacts of various government rice policies varied considerably. However, as suggested by Siamwalla (1975), “the government generally was more successful in decreasing rice prices than in increasing them” and benefiting urban consumers more when prices were high compared with their effects on the farmers who “were completely unprotected when prices were low” (page 246). As an illustration, the export premium, a fee to be paid as a price for obtaining an export license and in effect an export tax, became the major instrument of government intervention since the abolishment of government’s monopoly in rice export (Wong 1978). Since the removal of the export tax in 1986, however, Thailand’s rice exports have been neither protected nor subsidised to any significant extent (Warr 2008).

Thailand still experiences fluctuations in its production although the general trend in rice production has been positive (Figure 3). Domestic production has been well-above the level required to meet domestic demand as indicated by a widening gap between production and consumption (Figure 3). This production gap partly reflects decreasing income elasticities for rice. In Thailand, income elasticities have even turned negative, from 0.237 in 1961 decreasing to -0.437 in 1985 (Ito et al. 1989). This reflects dietary transformation in Thailand which, as in many other Asian countries, implies higher demand for animal-based sources of protein such as beef, fish and dairy (Beghin 2006). However, as demonstrated by Figure 2, increased exports from newer exporting countries such as India and Vietnam mean that the increased Thai rice export volume does not necessarily imply an increase in its global export share.
Prior to the implementation of the rice pledging scheme, what is unusual about Thailand was that government interventions seldom occurred in agricultural commodity markets (Warr 2008). Instead, cash transfers to village organisations and subsidised loan schemes not linked to agricultural production and rural infrastructure development were the main intervention instruments (Warr 2008). Unfortunately, these transfers and loans were not able to raise the productivity of rural people or help them diversify their economic activities out of agriculture. This condition might have been seen by the former PM Shinawatra as a rationale for designing a policy to improve rice smallholders’ welfare.

The rice pledging scheme was costly. The costs of pledging, storage, milling and operating and interest were paid by the government. Under the program, registered farmers could deliver paddy to designated millers. Data vary between sources, but it is estimated that there were between 800 and 2,000 millers across the country who joined the program (The World Bank 2012; Thai PBS 2013). Participating farmers received a receipt from the millers, which they would then take to the Bank for Agriculture and Agricultural Cooperatives (BAAC) to claim a payment (The World Bank 2012). The payment would depend on the grade and moisture of the paddy as determined by the millers. Millers were hired by the government to mill the pledged paddy and deliver the milled rice to the government within seven days. Due to limited capacity of the Government’s public storage, they were also hired to store the milled rice.

Looking at the farm-gate price, there seemed to be some rationale for the government to increase the floor price. The average cost of rice farming was estimated at between 5,000 and 6,000 baht per tonne, according to the Thai Agriculturist Association, and a margin of 3,000 baht per tonne could not cover “interest payments, labour costs, land rental payments and the rising cost of living” (Jikkham and Bunyamanee 2013). According to FAO data, the average farm gate price was 11,600 baht per tonne in 2010, but in the rainy season the price can
decrease to 9,000 baht per tonne due to humidity (Jikkham and Bunyamanee 2013). These price effects of quality have been reported as a source of tension between rice millers, buyers and producers.

3. An analytic framework

3.1 The model

In this sub-section, a simple theoretical model is set up to illustrate the welfare effects of public stockpiling. The features of the model are the following.

Demand and supply equations in each region \( i \) are specified as follows:

\begin{align}
D_i &= \alpha_i P_d^i \beta_i \\
S_i &= \gamma_i E(P_d^i) \delta_i + \mu_i
\end{align}

In this study, it is defined that \( i = 1, \ldots, 10 \). Ten regions included in the analysis include: China, India, Japan, South Korea, Indonesia, Philippines, Thailand, Vietnam, and two ‘aggregate regions’, namely ‘Rest of ASEAN’ and ‘Rest of World’ (ROW). The ROW is a residual, meaning that the model covers global trade.

Equation (1) specifies a non-linear, non-stochastic domestic demand function. \( D_i \) is annual consumption in region \( i \). The supply function is specified by Equation (2). It includes additive stochastic shocks \( \mu_i \) which follow a logistic distribution. \( S_i \) is annual production, \( P_d^i \) is the domestic price, \( E \) is the expectations operator. \( \alpha_i, \beta_i, \gamma_i, \delta_i \) are constant parameters and

\(^2\) Time subscripts are dispensed with except where it is necessary to avoid confusion.

\(^3\) These additive stochastic supply-side shocks are based on observed annual variations in production from a linear trend since 1961. The shocks appear to be positively related to production in some regions but negatively in others. For simplicity an additive rather than multiplicative specification was chosen. The logistic distribution has longer tails than a normal distribution and allows for more extreme shocks. The covariance between regions is taken into account when generating the shocks. Shocks which have their origin in the demand side are ignored, although from the perspective of a single country, changes in demand in other countries are transmitted to the domestic market.
\( \mu_i \) a stochastic parameter reflecting uncertainty in annual production. Demand and supply curves are assumed to be non-linear so as to capture observed responses such as to large shocks on prices where consumption does not fall proportionally as much as it does for smaller price shocks.

The model is dynamic in the sense that periods are linked by the formation of price expectations and carry-over of stocks between periods. Expected prices are assumed to be based on prices in the three previous periods, with greater weight being given to the more recent period.

\[
E(P^d_i) = \omega_1 P^d_{i(t-1)} + \omega_2 P^d_{i(t-2)} + \omega_3 P^d_{i(t-3)}
\]

where \( \omega_1 + \omega_2 + \omega_3 = 1 \) and \( \omega_1 > \omega_2 > \omega_3 \).

The price linkage equation is:

\[
P^d_i = \phi_i + \theta_i P_w
\]

Domestic prices are linked to world prices, \( P_w \), as defined in Equation (4) through two components, namely \( \phi_i \) and \( \theta_i \). First, \( \phi_i \) represents a shift component unrelated to the world price, such as a specific tariff, a variable levy, transport costs and so on. The term \( \theta_i \) represents the direct relationship between domestic and world prices, and can be interpreted as a transmission elasticity. For \( \theta_i < 1 \), domestic prices are insulated from and fluctuate less than world prices. A negative value would imply that domestic prices move opposite to world prices. Under free trade, \( \phi_i = 0 \) (excluding transport costs and other margins) and \( \theta_i = 1 \).

These parameters should be seen as capturing the effects of a range of policies, although this is an admittedly crude (linear) specification. Where consumers are taxed or subsidised, it is possible to specify different consumer price linkages.
Public and private stock functions are modelled separately as it is assumed that they are based on different objectives, for example price stabilisation (buy and sell bands) and commercial incentives (expected price gains outweigh storage costs) respectively. Commercial stocks can be determined by using the arbitrage relationship requiring the expected increase in buying and subsequent selling prices equate to the cost of storage at the margin. Agents carryover stocks if they expect their profits on resale to more than covers the storage costs, including interest, spoilage and the cost of operating the physical facilities. For simplicity, an approximation suggested by a previous study is used here (Tweeten 1989). The change in the quantity of private stocks is some proportion of the difference between current and expected prices, where the proportion is equivalent to 1 minus the ratio of storage costs to equilibrium price. This term is multiplied by the slope of the supply equation to convert prices into quantities. Private stockholders are assumed to base their expectation of future prices in a similar fashion to producers, on a weighted average of prices in the current and previous two years. Private stocks cannot become negative.

Private ending stocks ($EPS_i$) depend on opening stocks ($OPS_i$) and prices and quantities as follows:

\[
EPS_i = \rho_i \left( E\left( P_i^d \right) - P_i^d \right) + OPS_i
\]

where

\[
\rho_i = \frac{(1-f_i-g_i)\delta_i S_i}{P_i^d}
\]

$f_i$ is the real rate of interest and $g_i$ is the physical costs of storage including depreciation. This function implies that as prices rise or supply falls, the demand for stocks falls. In years of poor production, prices will rise and stocks will be run down.
Government stocks are modelled as a price band. The change in government stocks at the end of each period is:

\[
EGS_i - OGS_i = \lambda_i \left( p_i^{dmin} - p_i^d \right) \quad \text{if } p_i^d < p_i^{dmin}
\]

\[
= \lambda_i \left( p_i^{dmax} - p_i^d \right) \quad \text{if } p_i^d > p_i^{dmax}
\]

\[
= 0 \quad \text{if } p_i^{dmin} < p_i^d < p_i^{dmax}
\]

where \( p_i^{dmin} \) and \( p_i^{dmax} \) are the lower and upper limits of the band and \( \lambda_i \) is the responsiveness of the government agency when the limits are breached. A capacity constraint limits the carryover of government stocks in each country to a user specified percentage above the historic maximum.

The market clearing equation i.e. Equation (8) requires that each period global supply equals the sum of the change in private and government stocks and global demand, and that global imports equal global exports:

\[
\sum D_i + \left[ (\Sigma OPS_i + \Sigma OGS_i) - (\Sigma EPS_i + \Sigma EGS_i) \right] - \Sigma S_i = 0
\]

Various welfare measures are then derived from these results. The values for a baseline and alternative simulations are compared to assess the impact of a specific policy change. The non-linear specification requires that consumer and producer surplus measures be calculated by integration. Consumer surplus is the area above the price line bounded by the demand curve and the vertical axis in a standard demand and supply diagram. For a constant elasticity function, \( \alpha_i, p_i^d \beta_i \) as used here, the demand curve does not reach the vertical axis, and thus the level of consumer surplus is not defined. The approach taken here is to calculate the change in consumer surplus (\( CS_i \)) from the baseline. A similar line of reasoning applies to producer surplus (\( PS_i \)). The change in surplus is thus:

\[
CS_i = \int_{p_0}^{p'} Di(t) dt
\]
where $P_0$ and $P'$ refer to the baseline and new domestic prices in each region, respectively.

Government revenue ($GR_i$) is the difference in prices times the level of imports, the excess of demand over supply, plus gains or losses from holding stocks. Domestic governments may not capture all of the rent accruing from policies that drive a wedge between domestic and world prices, as assumed here. They may incur losses through subsidies on exports. Governments also make a net storage gain from buying stocks at a low price and selling at a higher price. Storage costs must be deducted from this.

(12) \[ GR_i = (P_i^d - P_w)(D_i - S_i) + EGS_{it}(P_{it} - P_{i(t-1)}) - c_i EGS_{it} \]

where $c_i$ is the marginal cost of storage.

Competitive private stockholders in each region are also assumed to make normal profits ($NSG_i$) which just offset the cost of storage:

(13) \[ NSG_i = c_i EPS_{it} \]

Welfare in each region $i$ ($W_i$) in each period is the sum of the four components:

(14) \[ W_i = CS_i + PS_i + GR_i + NSG_i \]

### 3.2 The simple analytics of welfare effects

As a simple illustration, this sub-section presents simple analytics of a floor price scheme.

The main effects of a floor price for rice are shown in Figure 4. The left hand side panel shows the quantity of output ($Q_{s1}$) of which $Q_{d1}$ is consumed domestically and ($Q_{s1} - Q_{d1}$) is exported at world price $P_{w1}$. Thailand’s exports equal Rest of the World (ROW) imports i.e. ($Q_{wd1} - Q_{ws1}$), as shown in the right hand side panel.

(i) A floor price policy
Suppose the Thailand government decides to implement a floor price policy. The policy raises domestic prices from $P_{w1}$ to $P_d$. The exportable surplus rises to $(Q_{s2} - Q_{d2})$. In the absence of a change in stocks, the world price falls from $P_{w1}$ to $P_{w2}$ for the market to clear. Thus, ROW imports increase to $(Q_{wd2} - Q_{ws2})$. In such a scenario, there will be transfers from domestic consumers to local price producers i.e. Area B. Consumer surplus decreases from Area $(A + B)$ to Area $A$, while producer surpluses increase from Area $D$ to Area $(B + C + D)$.

(ii) Public stockpiling

Now suppose that the Thai government decides to purchase additional surplus made during the implementation of a floor price policy. For simplicity, let us assume that there is no private stock (i.e. $EPS_t = 0$). The stock expenditure (or a negative value of the government revenue) can be defined as:

\[ GR = -P_d EGR = P_d (m(Q_{s2} - Q_{d2})) \]

Where $m$ is the share of exportable surplus purchased by the government to build its stock and $0 \leq m \leq 1$. Let us define $m = f(\rho_t)$ and the first derivative $m_\rho > 0$, where $\rho_t$ is a function of region $i$’s initial level of stocks, real interest rates and storage costs as defined in Equation (7).

Table 2 presents the summary of the welfare effects when the policy is firstly launched. Hence, there is no storage cost and no revenue from selling off its stock. The welfare effects of the floor price combined with government stock purchase depends on $m$.

In an extreme case, the government stops the exports and purchase all exportable surplus expecting the world price to increase. In such a case, $m = 1$ and $GR = -P_d (Q_{s2} - Q_{d2})$, shown in Figure 4. The government might choose $m$ between 0 and 1 such that the world price increases. Obviously, even if this is possible, it would have to be done by a sufficiently
large exporting country. To reduce its exports, the country must store the additional production plus the reduction in exports.

\[(16) \quad EGR = m(Qs_2 - Q_{d2}) > (Q_{s1} - Q_{d1}) + (Q_{d1} - Q_{d2})\]

Or, \(\frac{Q_{s1} - Q_{d1}}{Q_{s2} - Q_{d2}} > (1 - m)\)

Note that the right hand side is the share of additional supplies being supplied to ROW at price \(P_d\). This inequality simply means that exports to ROW i.e. \((1 - m)(Q_{s2} - Q_{d2})\) must be lower than the initial level of exports \((Q_{s1} - Q_{d1})\).

Under most conditions, a floor price scheme coupled with public stockholding is unlikely to be welfare enhancing although they may be politically attractive. However, welfare may increase if the policy coincides with a global price shortage or if restricting exports causes a panic, as appeared to be the case in 2008. The next sub-section explains a partial equilibrium analysis to predict the welfare effects.

### 3.3. The data

This study uses data from various online databases (FAO 2013; USDA 2015). Base period quantity and price data for the ten regions are shown in Table 3. The year 2010 is selected as the base year, the most recent for which price, quantity and policy data are available and reasonably representative of important recent developments like bio-fuels. In particular, this choice avoids the turmoil of 2008.

In 2010, global rice production was dominated by China producing one third of the global supply, which more than maintained a policy of self-sufficiency (defined by the government as production in excess of 95 per cent of consumption), with production similar to consumption at 135 million tonnes. Given their high rice consumption, most Asian countries including China and Thailand maintained a relatively large amount of rice stocks with an aim
of price and supply stabilisation. It has been argued that “a low and declining level of stocks has added to the price rise” (OECD 2008). In 2010, whilst China consumed nearly all of its domestic rice production, Thailand exported about a half of its production (20 million tonnes) to the global market, i.e. 10 million tonnes. Total domestic consumption is 10 million tonnes and the level of stocks was about a half of it at 5 million tonnes in 2010. Prices

The model is calibrated around a world indicator milled rice price (Thai 5 per cent broken) of US$520 per tonne. Domestic prices are based on world prices plus the applied import tariffs. These tend to be well above the paddy prices received by producers because rice is milled before it is traded.

Producer prices in countries in the South East Asia region, for example Indonesia and Philippines, seem to have followed Thai prices for much of the past three decades, according to historical data reported by the FAO (Figure 5). This implies that price transmission is relatively high, at least on an annual basis, and that Thai prices will have a direct effect on world prices.

Base period parameters and policy data

The parameters of the model are shown in Table 4. Note that elasticity of demand, elasticity of supply, transmission elasticity and storage costs in Table 4 represent parameters $\beta_i$, $\delta_i$, $\theta_i$ and $g_i$ as defined in sub-section 3.1, respectively. The key issue is the responsiveness of foreign suppliers. Unless the build-up of stocks in Thailand led to a decrease in global supply, or there was simultaneously a significant production shortfall, the policy was unlikely to succeed. Foreign supply depends on the transmission elasticity and the supply elasticity, and the responsiveness to private and public stockholders to world price movements. In fact, these transmission elasticities are not particularly high for India (0.77) and Vietnam (0.58), the major competing exporters, although the elasticity of supply for India appears higher than
other countries. Still, a ten per cent change in the world price would generate an increase of production in India of 2.7 per cent according to these elasticities. This might suggest that the increase in Indian and Vietnamese rice exports to the world market might not necessarily be driven by decreases in Thai rice exports. As previously noted, their domestic policy and production level might have driven the change in exports.

Another important parameter is the Thailand elasticity of demand, as this determines the response of consumers to price shocks. A high elasticity, such as -0.4 in India, means consumers respond to higher prices by reducing consumption, and there is less change in domestic prices than would be the case with a lower elasticity. If there is no response, all the adjustment to the production shock occurs in prices rather than quantities.

Storage costs

The costs of storage include interest on the value of the stocks, the interest and depreciation of the physical storage facilities, the variable costs required to keep the rice at appropriate moisture content and an allowance for possible spoilage and, perhaps, theft. According to Vanzetti (1998), annual storage costs in developed countries are assumed to be 5 per cent of current price, to reflect real interest charges, plus 10 per cent of baseline prices to represent physical storage costs. Costs in developing countries tend to be higher (at 17 per cent) than in the developed countries because of the lack of good quality storage facilities, the lower quality training received by storage personnel and the higher temperatures in tropical countries that encourage insect pests.

According to the World Bank (2012, p.19) which uses information from the National Rice Policy Committee, in the 2011/2012 Paddy Pledging Program the total costs of operating, storage, milling and interest were 33 billion Baht for approximately 21 million tonne produced in the main and second crop. This implies around 1571 Baht per tonne was spent on
operating, storage, milling and interest. This is about 10 per cent of the pledged price (i.e. 15,000 Baht) or 15 per cent of the domestic market rice which was between 9,000 and 10,000 Baht. Therefore, we assume here that total storage costs in Thailand are 17 per cent which includes about 5 per cent interest rates and 12 per cent physical storage costs. This is consistent with the average warehouse rent which is around 160-190 Baht (or about $6) per square metre per month.

The average cost of storage at about 17 per cent of domestic market price is quite similar to the costs of storage in other developing countries. Government storage costs are assumed to be similar to private costs. Governments might have lower costs because of economies of scale, lower borrowing costs, or lower insurance costs, but on the other hand costs may be higher, given that governments are holding stocks for reasons other than speculative profits, such as producer income support. In addition, spoilage is likely to increase the longer the grain is held. After two years the cost of storage may increase significantly for this reason. This is not taken into account here. In the model used here, government storage levels are not dependent on the costs of its storage.

*Government stockholding*

Governments hold stocks when they believe the private sector is not adequately performing the social or political economy role. Since the private sector responds to expected prices, governments typically buy stock when there is insufficient profit to encourage private storage.

The Thai rice pledging program offered a unique case of public-private relationships in the rice sector. By design, there seemed to be a deliberate goal to offer a higher price in order to crowd out the private rice dealers. As previously mentioned, under the Program, the Government hired between 800 and 2,000 millers across Thailand to mill and store the milled
rice. The total domestic rice storage capacity was reported to be around 23 million tonnes in 2011 (Samudro 2012).

As the Thai government did not restrict the amount of rice allowed to be pledged, the government would have to increasingly rely on private warehouses. In October 2012, it was reported that 95 per cent of government warehouses were full and several rice millers refused to buy rice from farmers because of insufficient storage, whilst earlier the Commerce Minister said that the government could store up to 20 million tonnes of rice (Oryza 2012). This represents nearly 90 per cent of total production in that year. However, if the government continued to build up its rice stocks; increasing reliance on private warehouses would be expected to increase the cost of storage by up to 15 per cent.

Figure 6 suggests that rice stocks as a percentage of national production reached over 70 per cent in 2013. With over 17 million tonnes of rice being stored in both government and private warehouses, on average the stock had increased at about 5 million tonnes per annum between 2011 and 2013. This figure is used in simulations in this study. Figure 7 shows that this 5 million tonnes stock accumulation per annum is a significant increase compared with stock accumulation in years preceding the launch of the rice pledging scheme. However, further investigation suggests that the figure seems to be relatively moderate compared with what the government might have actually purchased between 2011 and 2013.

*Expectations*

In most cases producers must make their planting decisions before they know the season’s price. The price they expect to receive is assumed here to be a combination of past prices, weighted to place prominence on the more recent values. In general, the faster producers respond to a shock, the more stable prices become. On the other hand, lagged effects reduce the magnitude and increase the duration of a one-off shock by spreading its impact. In this
analysis, the weights are assumed the same for all countries and all periods at 0.6, 0.3 and 0.1 for one, two and three period lags respectively. This assumption is somewhat at odds with the Government announcing a fixed price, say 15,000 Baht. At issue is whether producers believed the Government at planting time. Towards the end of the program in early 2014, there was some debate, for example, about reducing the price to 12,000 Baht.

3.4. Implementing the model

The partial equilibrium analysis is conducted using Microsoft Excel. The Excel Solver finds a solution to the optimisation problem. The non-linearities in the model require that it is solved numerically. Initially, a world reference price is postulated. The world price plus region-specific trade costs determine domestic prices, which in turn generate levels of domestic production, consumption and changes in private and public stocks. Trade flows are then calculated. If global exports do not equal global imports, the world price is adjusted until equilibrium is reached. Finally, the welfare effects as defined in sub-section 3.1 are measured.

Several scenarios of the international rice market are presented and compared with the baseline. The Baseline represents the base simulation in which all regions apply the policies current in 2010.

We run the baseline for 1000 iterations without any policy change but with prices and quantities responding to observed supply side shocks. In the baseline, world prices range from $191 to $1079 with a standard deviation of $121 around the mean of $520 per tonne. In any given year, the probability of the world price rising 50 per cent is three per cent (29 in 1000). Under this assumption, the Thai Government would have been lucky if prices had risen enough to cover the 50 per cent premium paid to producers. There is almost no chance it would be sustained over several years.
In Scenario A, the study simulates the pledging scheme where the price received by Thai farmers increases by 50 per cent compared with the market price. This provides estimates of the effects of the current rice pledging program in the absence of stockholding.

Scenario B assumes the pledging scheme as in Scenario A plus the Thai government buying five million tonnes over each of three years. It shows the effect of the high domestic price plus the build-up of stocks to maintain world prices. At the end of the third year after the program was launched (i.e. 2013), it is predicted that the government closing stock is at 17.8 million tonnes, quite similar to the actual stock level of 17 to 18 million tonnes in 2013 as reported by various studies (Murdoch 2013; Russell 2013).4

Scenarios C, D and E simulate the government’s strategies for selling stocks. Scenario C assumes the government clears out stockpiles in one year. More specifically, Scenario C defines that the government pledges the rice price, buys five million tonnes over each of three years (as in Scenario B) and finally sells 15 million tonnes in the fourth year after the launch. This scenario is relevant to the discussion in early 2014 on whether the government’s plan to sell about 1 million tonne per month or 12 million tonnes by the end of 2014 is a strategic move (Bangkok Post 2014). Scenarios D and E assume the government clears out stockpiles over three and five years, respectively. This equates to selling five million tonnes per annum and three million tonnes per annum, respectively.

Scenario F assumes that the government provides cash transfers to poor farmers. It examines an alternative policy to support low income farmers through a decoupled payment. This takes into account recommendations from several development agencies including the World Bank. The World Bank (2012) suggests that although only a little more than 10,000 households out of 1.3 million household participating at the pledging scheme were large households, the very

---

4 Stock accumulation by 5 million tonnes per annum is assumed to simplify annual changes in government closing stocks. This should take into account government’s stock sale. Murdoch (2013) reports that the Thai government has bought 36 million tonnes in the first three years of the program but sold a proportion of this.
poor farmers in Thailand were subsistence farmers who did not have excess rice to sell and, therefore, did not benefit from the pledging program. On the other hand, there was a claim that the pledging scheme had motivated farmers to increase the number of crops each year through the use of lower quality paddy with a shorter harvest time. Therefore, a better program to help raise income and productivity of poor farmers might be through better-targeted social assistance such as cash transfers.

4. Simulation results

Table 5 presents the simulation results. Column (i) presents the Baseline (i.e. initial) scenario, whilst Column (ii) presents the results from the pledging scheme (i.e. Scenario A) where the Thai Government is assumed to increase domestic prices by 50 per cent without any other policy changes. Hence, there is no change in Government stocks. After the changes have worked through – there is a three year lag in the formation of producer expectations of domestic prices – production increases 11 per cent and consumption decreases 8 per cent, reflecting the respective elasticities. As a result, the exportable surplus increases 31 per cent and world price is reduced by 3 per cent from the base of $520 to $506 per tonne. There is no virtually no change in the variance of world prices, in this or the remaining scenarios.

The annual welfare effects show the change from the base in consumer surplus, producer surplus and Government expenditure. Rice producers gain, $5.1 billion, at the expense of consumers, $2.3 billion, and taxpayers $3.8 billion as represented by Government expenses. Private stockholders make a speculative gain from selling stocks at high prices. While the main effect is transfers from one group to another, the net effect is a welfare loss for Thailand of $759 million. This is not totally wasted, however, as world prices fall and foreign consumers gain. Foreign producers also lose.
This result sees world prices falling because global supply has increased. This is partly due to
the increase in production, but also because Thai (private) stockholders have drawn down
their stocks in the belief that prices must inevitably fall. Exports increase significantly by 31
per cent. This adds to the problem.

Column (iii) of Table 5 presents Scenario B, which reflects reality more closely. Compared
with Scenario A (i.e. the pledging scheme), output and consumption are hardly affected.
However, exports are reduced by close to the amount of the annual stock purchase. The effect
on world price is to raise it to $527 per tonne, compared with $520 in the baseline and $506
in Scenario A. To this extent the policy is effective in raising prices, but the magnitude (i.e.
1.3 per cent compared with the baseline) is not great. This is because world price depends
on total world production, not only on exports by major exporting countries. Here the model
is consistent with reality. Historically, supply restrictions are almost always offset by an
increase in supply from other countries (Warr 2014b).

In Scenario B, the reduction in Thai exports lifts world prices which flow through to increase
domestic prices. There is the expected effect on producer and consumer surplus. However,
the main cost for the government is the expenditure in acquiring and storing the stocks. This
rises to $4.7 billion. The government also bears a cost of $4.2 billion from speculative loss as
shown by Column (iii) of Table 5. The economy-wide net welfare losses are $5.4 billion.
Whilst the producers gain most from this scheme (i.e. $5.9 billion), about $271 million of this
loss accrues to private stockholders who make speculative gains by selling stocks to the
Government.

While the stock purchase plan (i.e. Scenario B) seems moderately successful in raising world
prices, the question arises as to how to dispose of the stocks. Prices are expected to fall when
the Government sells off the stocks. This is illustrated in Scenarios C, D and E.
The simulated effects of Scenario C are shown in Column (iv) of Table 5. This column only presents the welfare effect in the fourth year after the program was launched. The world price falls to $435, as a result of the large increase in Thai exports onto the world market. Because we assume domestic prices are maintained at 50 per cent above world levels, the impact on producers and consumers are relatively unchanged from Scenario B. One difference is that the Government enhances its revenue by selling the stocks, so the welfare effect in that year is positive. However, this is not a speculative profit. The selling price is below the purchase price and the Government has incurred storage costs of 17 per cent for several years. Finally, we can see that private stockholders move back into the market when the Government exits.

Changes in net welfare effects until 9 years after the program launch are presented in Figure 8. Under Scenario 1 (one year selling-off), the welfare gains in Year 4 can compensate for the welfare losses in Year 5 to Year 9 (i.e. the difference is $425 million) although the magnitude is not significant.

To illustrate the change in producer surplus in more detail, Figure 8 shows that under Scenario C producers receive lower surplus in Year 4 compared with Year 3. However, they quickly recover in the following year.

The welfare effects of Scenarios D and E are presented in Column (v) and (vi) respectively of Table 5, which only show the effects in Year 4. Combined with observations based on Figure 8, the results show a clear pattern that selling off the stock as quickly as possible is the best approach to deal with the mountain of rice already built up due to the pledging scheme. The total welfare loss in Year 4 to Year 9 under Scenario E where the government sells off over five years is $3 billion, much higher than the total loss under Scenario D at $956 million and Scenario C at $425 million. Table 6 presents the cumulative loss over the first nine years after the program launch (i.e. 2010 to 2018).

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5 These welfare effects are not discounted.
In the last scenario, this study simulates the welfare effect of a decoupled lump sum payment as shown by Column (vii) of Table 5. This scenario is particularly relevant if the Thai Government’s objective is to help small farmers as such a payment can be targeted to low-income families irrespective of production. The Government could have given the poorest 1.3 million farmers $2,400 each and the total cost would be no more than the costs of storing 30 million tonnes.6

The simulations suggest that the build-up in Thailand’s rice stocks has favoured competing rice producers such as Vietnam and India. Simulation results under Scenario B (not presented here) suggest an increase in Vietnam rice exports of 1 per cent. Thai stocks are taken off the market. This good fortune is only temporary. Exports from Vietnam are likely to fall below baseline levels when Thailand releases its stocks. The simulated export volume is slightly greater than Vietnam’s actual export volume in 2013, which was 6.7 million tonnes.

5. Concluding remarks

This study has provided ex-ante predictions on the extent to which Thai rice policies may have affected the rice sector. By assuming that the government sets the pledged price at 50 per cent above the market rice and purchases 5,000 tonnes per annum, results from this study suggest that the program would cost the government about $11.8 billion in the first three years of program implementation (i.e. 2010-2012) and $15 billion in its first four years of implementation (i.e. 2010-2013). These estimates are quite close to the ones reported by the World Bank. The World Bank (2012) predicted a loss of 1.2 per cent of GDP for the 2012/2013 Program (or based on the Thai GDP at 2013 it equals $11 billion) and, recently, its 2014 East Asia Economic Update quoted an estimate by Thailand’s Ministry of Finance suggesting a loss of 3.8 per cent of GDP (or based on the Thai GDP at 2014 it equals $14.7 billion) (The World Bank 2014).

6 This calculation assumes 20 per cent annual storage costs and a price of $520 per tonne.
The next key question addressed by this study is what the Thai government should do to deal with this mountain of rice. In contrast to minerals and some agricultural products such as wool, the storage of rice not only incurs physical storage and interest costs, but the commodity deteriorates over time, and the rate of spoilage increases exponentially with time. This study therefore investigates whether the Thai government should sell the stocks quickly (for instance, within a year) or more gradually (e.g. three or five years).

Our analysis suggests selling within one year is the best approach, resulting in minimum welfare losses. This is mainly explained by significant storage costs. Selling off Government stocks over one, three and five years results in estimated sector-wide welfare losses of $8 billion, $11.7 billion and $14 billion respectively over a five year period. Over the longer period the price is not depressed so much but the storage costs are greater. Recent news suggested that out of 18 million tonnes of rice stocks that the Thai government accumulated from the pledging scheme, only 10 per cent are of standard quality; about 70 per cent are below-standard and about 20 per cent are unfit for human consumption (Oryza 2014). It is quite clear that the government loss would be even greater for the three-year and five-year scenarios if spoilage were considered.

Recent media reports suggest that Thailand has been doing what it should do to recover, that is offloading its rice from the 17 million tonne stockpiles accumulated during the rice pledging program. The country plans to sell 10 million tonnes in 2015 and 7 million in 2016. This sale has put pressure on global prices especially due to the discounts prices that Thailand offers. In the latest tender, Thailand sold 5 per cent broken rice from its old stocks for $236 to $378 per tonne compared with the price for new crops that was around $415 (Customs Today 2015).

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7 Our estimate does not take account of spoilage over time.
Limitations to the analysis should be noted. First, we have assumed producer prices are based on past prices. This would not be the case if prices were administratively set. This implies farmers would respond more quickly to the announced price changes.

Second, a further assumption is the share of stocks held by private stockholders. In fact, data about private stocks are incomplete. There are no data, for example, about stocks on farms. We also have no data about the possible losses from spoilage.

Third, our study has not been able to address issues with the distribution of the rice pledging scheme. One objective of the rice pledging scheme was to improve the productivity and welfare of smallholders. These universally applied subsidies meant that farmers who were in a position not requiring financial support also received it. In 2013, about 500,000 rice farmers were regarded as wealthy, while 1.3 million farming households were poor (Wangkiat 2013). Moreover, most wealthy farmers earned their income mainly from growing rice, while only 16 per cent of poor paddy farmers earned their income solely from the land implying the scheme tended to benefit the rich more than the poor (Wangkiat 2013). Future studies should look at the impacts of the policy on smallholder producer’s welfare and productivity taking into account farmers’ heterogeneity.

Fourth, the final scenario (i.e. decoupled producer support) simulated in our study illustrates a transfer from taxpayers to producers, with no impact on quantities or prices. We assume away the cost of raising taxes to fund transfers. Admittedly, this cost may be considerable and involve administrative costs and the distortionary effects. This may vary considerably depending on the type of tax. Furthermore, we also assume producers don’t grow more, or less, rice to qualify for the payment. In reality, risk averse farmers may increase production if given a decoupled payment, especially if they expect that future payments may be linked to production. Future studies should review these assumptions to get better understanding of the
welfare effects of a producer support program, that has been getting increased interests from many governments in developing countries.

To summarise, a floor price scheme is not the optimal approach. Whilst current Thailand’s rice sale is now putting pressure on the global market, this should be temporary and would cause less welfare loss to the economy than other strategies. Despite its limitations, the similarity between ex-ante simulation results in this study and the actual figures (i.e. government loss) reported by various sources indicates the validity of the model being applied in this study in predicting future rice public programs.

References
Dissanayake, J. (2012). Transmission of price fluctuations in International markets to domestic markets. Crawford School of Public Policy, Australian National University, Canberra.


Table 1. Thai rice area, production, exports and stocks

<table>
<thead>
<tr>
<th></th>
<th>2010/11 (i)</th>
<th>2011/12 (ii)</th>
<th>2012/13 (iii)</th>
<th>2013/14 (iv)</th>
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<tr>
<td>Area harvested (1000 ha)</td>
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<td>20,460</td>
<td>20,200</td>
<td>20,460</td>
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<td>Exports (kt)</td>
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<td>6,700</td>
<td>8,500</td>
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<td>Ending stocks (kt)</td>
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<td>9,330</td>
<td>12,808</td>
<td>11,724</td>
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<td>Domestic consumption (kt)</td>
<td>10,300</td>
<td>10,400</td>
<td>10,600</td>
<td>10,875</td>
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Table 2. Welfare effects of floor price and public stockpiling

<table>
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<th>Initial conditions</th>
<th>Floor price and public stockpiling</th>
<th>Change</th>
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</thead>
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<tr>
<td>Consumer surplus</td>
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<td>$A$</td>
<td>$-B$</td>
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<td>Producer surplus</td>
<td>$D$</td>
<td>$(B + C + D)$</td>
<td>$(B + C)$</td>
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<td>Government revenue</td>
<td>0</td>
<td>$-GR = -P_d * m(Q_s2 - Q_d2)$</td>
<td>$-GR$</td>
</tr>
<tr>
<td>National welfare</td>
<td>$(A + B + D)$</td>
<td>$(A + B + C + D) - GR$</td>
<td>$(C - GR)$</td>
</tr>
</tbody>
</table>

Source: Authors’ compilations

Table 3. Milled rice baseline data (2010)

<table>
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<tr>
<th></th>
<th>Production kt</th>
<th>Imports kt</th>
<th>Exports kt</th>
<th>Consumption kt</th>
<th>Ending stocks kt</th>
<th>Prices $/t</th>
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<td>540</td>
<td>500</td>
<td>135,000</td>
<td>42,574</td>
<td>775</td>
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<td>India</td>
<td>95,980</td>
<td>-</td>
<td>2,774</td>
<td>90,206</td>
<td>23,500</td>
<td>936</td>
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<td>Japan</td>
<td>7,720</td>
<td>676</td>
<td>200</td>
<td>8,200</td>
<td>2,689</td>
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<td>546</td>
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<td>-</td>
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<td>10,300</td>
<td>5,615</td>
<td>567</td>
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<td>500</td>
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<td>19,400</td>
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<td>Rest of World</td>
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Table 4. Rice baseline parameters

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<th>Country</th>
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<th>Elasticity of supply</th>
<th>Transmission elasticity</th>
<th>Storage costs</th>
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<td>0.18</td>
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<td>Japan</td>
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<td>1.70</td>
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<td>0.76</td>
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Source: (Vanzetti 1998; UNCTAD 2007; Dissanayake 2012; FAPRI 2014)
Table 5. Simulation results for Thailand

<table>
<thead>
<tr>
<th>Scenario</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
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<tr>
<td></td>
<td>Baseline</td>
<td>Pledging scheme</td>
<td>Pledging scheme + Stock purchase Over 3 years (5000 kt pa in Year 1-3)</td>
<td>Pledging scheme + 3-year stock purchase+ Stock sell-off in one year (15000 kt in Year 4)</td>
<td>Pledging scheme + 3-year stock purchase+ Stock sell-off in three years (5000 kt in Year 4-6)</td>
<td>Pledging scheme + 3-year stock purchase+ Stock sell-off in five years (3000 kt in Year 4-8)</td>
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<tr>
<td>(i)</td>
<td>(ii)</td>
<td>(iii)</td>
<td>(iv)</td>
<td>(v)</td>
<td>(vi)</td>
<td>(vii)</td>
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<tr>
<td>I. Main indicators</td>
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<tr>
<td>Output</td>
<td>kt 20,262</td>
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<td>22,744</td>
<td>22,970</td>
<td>22,970</td>
<td>22,970</td>
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<td>Consumption</td>
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<td>9,343</td>
<td>9,774</td>
<td>9,552</td>
<td>9,510</td>
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<td>Exports</td>
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<td>8,401</td>
<td>26,869</td>
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<td>0</td>
<td>1,327</td>
<td>688</td>
<td>558</td>
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<td>Closing stocks - government</td>
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<td>12,808</td>
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<td>Domestic price</td>
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<td>837</td>
<td>699</td>
<td>766</td>
<td>780</td>
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<td>506</td>
<td>527</td>
<td>435</td>
<td>480</td>
<td>489</td>
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<tr>
<td>Change in consumer surplus (A)</td>
<td>$m -2,351</td>
<td>-2,646</td>
<td>-1,326</td>
<td>-1,975</td>
<td>-2,106</td>
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<td>Change in producer surplus (B)</td>
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<td>Change in Government revenue (C)</td>
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<td>-6,967</td>
<td>-6,284</td>
<td>-6,128</td>
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<td>Private speculative profits (D)</td>
<td>$m 271</td>
<td>271</td>
<td>-657</td>
<td>-257</td>
<td>-165</td>
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<td>Government speculative gains (E)</td>
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<td>Net welfare (A+B+C+D+E)</td>
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<td>4</td>
<td>4</td>
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Source: Model simulations. ‘kt’ means kilo tonnes; ‘$/t’ means ‘$/tonne’; ‘$m’ means millions of dollar.
<table>
<thead>
<tr>
<th>Number of years since the program launch</th>
<th>Year</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Pledging scheme + 3-year stock purchase+ Stock sell-off in one year (15000 kt in Year 4)</td>
<td>Pledging scheme + 3-year stock purchase+ Stock sell-off in three years (5000 kt in Years 4-6)</td>
<td>Pledging scheme + 3-year stock purchase+ Stock sell-off in five years (3000 kt in Years 4-8)</td>
</tr>
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<td>9</td>
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<td>-11.41</td>
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Table 6. Total welfare change
Figure 1. Thai rice price (2003-2014)

Source: IMF (IMF 2014)

Figure 2. Rice export share (1960-2014)

Source: USDA (USDA 2015)
Figure 3. Thai rice production and domestic consumption (1960-2014)

Source: USDA (USDA 2015)

Figure 4. Welfare effects of a floor price
Figure 5. Price transmissions: Producer prices in Thailand, Indonesia and Vietnam (2000-2010)

Source: FAO (FAO 2013)

Figure 6. Thailand stocks (% total production) (1960-2014)

Source: USDA (USDA 2015)
Figure 7. Thailand change in stocks (1960-2014)

Source: USDA (USDA 2015)
Figure 8. Welfare change by different sell-off strategies

Note: Assuming the Thai government purchases 5,000 kilo tonnes of rice in the first three years (2011-2013), the one-year sell-off strategy (top-left graph) means that the government releases 15,000 kilo tonnes of its stocks to return to the baseline level (i.e. 2808 kilo tonnes in 2010); the three-year strategy (top-right graph) is when the government releases 5,000 kilo tonnes per annum over three years to return to the baseline level; and the five-year strategy (bottom graph) is when the government releases 3,000 kilo tonnes per annum over five years.
Figure 9. Change in producer surplus by different sell-off strategies

Note: See note in Figure 8.