Food Security, Welfare and Partial De-Regulation of Parastatals

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Abstract

De-regulation of parastatals is often advocated as a desirable reform, although it is usually opposed by vested interests and by those who perceive that the market can be dominated by a small number of private firms. In practice, however, de-regulation of parastatals has typically been partial in nature. We specify a model for an importing country that can deal with various forms of partial de-regulation. The model allows us to consider the effects of partial de-regulation on food security, on the re-distributional welfare effects and on aggregate welfare. We show that, although a completely de-regulated market may lead to higher welfare and greater food security even if that private sector which emerges is relatively concentrated, partial de-regulation may not necessarily be desirable. Further, when shocks emanate from domestic or world markets, the implications of these shocks will be contingent on the post-reform characteristics of the domestic market.

Keywords: Parastatals; de-regulation; welfare; food security.

JEL Classification: L32; L33; Q13; Q18

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Introduction

State marketing boards and state trading enterprises, often referred to as parastatals, are market intermediaries that are principally responsible for procurement and distribution, especially of agricultural products. They are widely used by governments in developing countries to achieve a diverse range of aims. These include promoting food security and livelihood security, controlling exports and imports, overcoming market distortions, moderating spot-price risk, retaining flexibility to respond to changes in market conditions and raising revenue for the government (World Bank, 2012). Over recent years, there has been considerable pressure for reform of parastatals from international institutions such as the World Bank and the International Monetary Fund and reform (or at least constraints on their activities) has been made a pre-condition for entry into the World Trade Organization (e.g. China) or for external assistance. General overviews of market reforms in developing countries that involve parastatals can be found in Akiyama *et al*. (2001), Rashid *et al*. (2008) and Ganesh-Kumar *et al.* (2010).

At the same time, there has also been domestic pressure for reform which has arisen from the reported inefficiencies of state marketing and the premise that policy objectives would be better met by limiting the role of parastatals or even removing them altogether[1]. However, there has also been opposition to reform. One source has been the concern that replacing the state monopsony/monopoly with private firms will only result in the same (or more significant) market-distorting effects on suppliers and consumers. Ganesh-Kumar *et al.* (2010), in their review of parastatals across six South-Asian countries also highlight the concerns associated with the exercise of market power by the private sector[2]. Further concerns relate to food security issues, for example, lower self-sufficiency and higher prices that would arise if the parastatal were de-regulated. FAO (2006) assesses the links between reforms and food security and highlights the influence of parastatals in a number of country case studies. A recent study by the World Bank addresses the role of parastatals and the private sector in promoting food security in the context of the recent price spikes (World Bank, 2012).

[1] A recent World Bank study of marketing chains in Asian countries summarises these concerns: "Parastatals are generally inefficient…They do not pursue profit maximising objectives and their management is frequently unable to make them financially self-sustaining. Exacerbating this condition, parastatals frequently capture economic rents, exert monopoly rights and deploy anti-competitive tactics that put private companies at a disadvantage" (World Bank, 2012, p. 20).

[2] Other examples where this issue has arisen include Balat and Proto (2005), McMillan *et al*. (2002) and Wilcox and Abbot (2004).

The academic debate on de-regulation has usually been placed in the context of extreme market structures: either the parastatal and no private firms or private firms and no parastatal. In practice, however, de-regulation has often been much more partial than that reflected in the literature. Instead of observing the widespread removal of the state, all that is often witnessed is only a diminished role for it and only a limited involvement by the private sector either in certain segments of the market or in co-existence with the state. Prominent examples of parastatals that have undergone partial reform and with more (but limited) competition from private firms include state enterprises in China, Indonesia, India, Mexico and the Philippines. Rashid *et al*. (2007, 2008) provide several examples of this phenomenon across the six Asian countries that they review (Bangladesh, India, Indonesia, Pakistan, the Philippines and Vietnam). In some cases, they found that reform had allowed the private sector to play a more significant role in domestic procurement and distribution but the state marketing board had retained control over imports and exports. In cases where de-regulation had occurred, it had been later reversed. More recently, despite the debate that centred on the activities of the Food Corporation of India, the recent passing of the National Food Security Act in 2013 essentially extends the role that the main parastatal will play in terms of domestic procurement and distribution of subsidised food to the poorest. A further complication to understanding the economic effects of the reform package arises where the parastatal is removed from a segment of the market, only to be replaced by some other form of government intervention, such as a floor price in the domestic procurement market and/or tariffs on imports.

In this paper, we construct a framework that allows us formally to analyse complete and partial de-regulation of state marketing in importing, developing countries. While we can compare the private sector only case with the parastatal only case, of more relevance given the motivation above is to characterise partial de-regulation. In the framework we set out, partial de-regulation can arise in a number of ways and we employ the framework to highlight the issues involved and the potential outcomes from such partial (as well as complete) de-regulation. These issues include, improving the efficiency of state procurement and distribution (Ganesh-Kumar *et al.* (2010) noted that the inefficiency of parastatals has been one of their main characteristics); changing the objectives of the parastatal such that the re-distributive bias towards consumers or producers that characterises the policy environment in many developing countries is reduced. If the private sector is also given a partial role, we wish to be able to identify which aspects of its involvement are likely to matter most. In addition, reflecting concerns relating to the role of private firms, we can explore the extent to which the degree of competition between private firms improves upon the various metrics used to evaluate the reform process. Specifically, given the food security context in which the debate on parastatal de-regulation arises, we address the nature of parastatal reforms as they

relate to food security metrics; in the open economy model which we apply here and where the combinations of parastatal/private firm permutations relate to domestic and import procurement and distribution, these food security metrics relate to domestic procurement as distinct from overall availability and to the impact of price shocks which may arise from these alternative sources[3].

Evaluating partial de-regulation of parastatals is challenging since we are essentially comparing outcomes across a potentially large number of configurations of market structure including accounting for possible changes in the parastatal's objectives and relative efficiency. Combining these issues with a variety of food security metrics (e.g. domestic procurement versus total availability; the impact of price shocks from alternative sources on domestic producers and consumers), gives rise to a large number of combinations to interpret; while this may hinder some clear insights, it is arguably necessary given the reality of parastatal reform and the sensitivities around which the de-regulation debate takes place in many developing countries. However, the main challenge is that for a large number of the examples we focus on, we are essentially comparing outcomes across different market structures. For some examples of de-regulation, the nature of de-regulation relates to a specific market structure: i.e. in the case of keeping the parastatal in place but changing its objectives or improving efficiency, this characterisation is relatively straightforward to derive the implications for food security. But since many of the examples of parastatal de-regulation involve changing the segments in which the parastatal functions (e.g. a specific source of procurement) and allowing it to co-exist with private firms in distribution, necessitates that we are comparing outcomes (relating to food security metrics) across different permutations of market structure.

We therefore proceed in a number of ways. First, we set out an open economy framework with alternative sources of procurement where a relatively inefficient parastatal can potentially co-exist with private firms and where the parastatal's pay-off function can differ from the private firm pay-off function. By setting out the most extensive form of parastatal/private firm co-existence, we can subsequently change market structure by excluding parastatal/private firm from different segments of the market. With the parastatal/private firms being intermediaries in this set-up, we also allow for the potential buying and/or selling power within different characterisations of the market. Given the

[3] Various food security metrics may be politically-motivated and have less appeal from an economist's perspective. For example, self-sufficiency is often a metric that many countries refer to. Such metrics may also be inconsistent with other metrics. For example, total availability may be inconsistent with self-sufficiency. We remain neutral over these alternatives and report an array of metrics to assess the implications of (partial) de-regulation.

number of combinations, we work with linear functional forms: while within any given market structure, we can derive specific insights with respect to the different metrics through the use of general functional forms, these are of less use in comparing outcomes across different characterisations of market structure. This then requires us to employ simulations with assumed parameters (that feasibly characterise a 'typical' agricultural market) to provide some insights. As well as comparing outcomes across a number of food security metrics, we also ask how competitive the private firm (or private firm/parastatal combination) case would have to be to improve upon the parastatal-only case. Our second tack is to we calibrate the model to a case study of the rice market in Indonesia. This is an appropriate example since the use of the parastatal in Indonesia in promoting food security has changed over time both in terms of changing objectives and the role of the private sector.

To summarize the key insights that arises from the analysis: there is no guarantee that food security will improve with de-regulation, the specific outcome depending on the food security metric used, the 'starting point' for the de-regulation process and the specific characterisation of parastatal de-regulation. Introducing private sector competition does not necessarily guarantee improvements in food security or welfare as we move from one second-best situation to another; however, the extent of competition does not need to be substantial to improve food security and welfare relative to the parastatal case.

The paper is organised as follows. In Section 1, we report on the theoretical literature upon which we base our modelling approach. In Section 2, we outline the basis of the framework also allows us to highlight how the alternative characterisation of market structure and use this framework to explore the impact of de-regulation using alternative food security metrics These food security metrics relate to different sources of procurement and total availability; in Section 3, we focus on a different dimension of food security namely the price transmission effects that arise in partially de-regulated markets due to supply shocks. In Section 4, we calibrate the model to the Indonesian rice market and relate the de-regulation process to the framework outlined in previous sections. In Section 5, we summarize the main insights and offer some overall policy conclusions.

1. Related Theoretical Literature

There is an extensive literature in which the liberalisation of regulated industries and privatisation in general is assessed. A summary can be found in Armstrong and Sappington (2006), Megginson and Netter (2001) and Shirley and Walsh (2000), among others. This literature is of interest insofar as the focus on the differences in the objective functions of private and public firms, and the relative efficiency of the private sector, carry over to the

issue of parastatal reform. This literature also relates to research on the role of the public firm and, by extension, where the public firm may co-exist with private firms, i.e. mixed oligopoly. Early work on this issue as with the literature on privatisation essentially assumed a closed economy framework (see Cremer *et al.* (1989), de Fraja and Delbono (1989), and de Fraja and Delbono (1990)). More recently, the literature on mixed oligopoly has been extended to an open economy framework. The open economy perspective can investigate a number of questions including the role for trade policy when the public firm competes with (private) foreign firms (for example, Fjell and Pal (1996), (Pal and White, 1998), Chao and Yu (2006)), and the possibility of using privatisation as a strategic tool (Bárcena-Ruiz and Garzón (2005)). Fjell and Heywood (2006) consider the possibility of the public firm playing Stackelberg in an open economy context, the main justification for this being that in privatised sectors, the previously dominant public firm may still retain a "first mover" advantage. A further issue of relevance is the possibility of partial privatisation. This of often framed in terms of the ownership share of a public entity (Bennett and Maw (2000, 2003), Matsamura, (1998) and Sun *et al*. (2005)) are examples addressing this issue [4].

While this literature is informative (insofar as the differences in the pay-off functions are highlighted as well as the relative inefficiency of public firms), there are important differences when addressing the issue of de-regulation of parastatals in the food sector. The first is to recognize that the parastatal's role is as an intermediary with a direct link between distribution and procurement. By emphasising the existence of procurement (i.e., from farmers), there is scope for market distortions in both procurement and distribution (i.e., private firms could exert monopsony as well as monopoly power), thus reflecting some of the concerns about de-regulation of parastatals in many developing countries (see Ganesh-Kumar *et al.,* (2010) noted above). Second, in an open economy framework, there are two sources of procurement (domestic supplies and imports), and where the parastatal (or in the de-regulated framework, private firms) decides how much to procure from import markets[5]. Third, with farmers existing more formally in this framework, the asymmetry in the pay-off function of the parastatal should reflect farmers' welfare as well as consumer surplus and profits[6]. Moreover, reflecting concerns about food security and the potential bias of government agricultural policy, the parastatal's welfare function should allow for possible bias (or otherwise) towards one of these constituent groups. Therefore, while the theory on the public firm in an open

[4] In the open economy context, partial privatisation may involve foreign enterprises taking an ownership share in the public firm; Wang and Chen (2011) provide an overview of these issues.
[5] Note this is different from the open economy, mixed oligopoly case where the public firm competes with foreign private firms in distribution only but where the nature of openness relates to different entities.
[6] Consumer surplus and profits are the typical arguments in the pay-off functions in the literature on public firms.

economy framework is informative, in analysing parastatals and food security, the framework required is quite different.

It is in this context that we consider de-regulation of the parastatal. However, partial de-regulation could occur even while retaining the parastatal as a single entity through changing the bias in the pay-off function or by improving its relative efficiency. However, more extensive forms of partial de-regulation can be characterised where private firms or the parastatal can co-exist in some or all segments of the market. This is different from the shared ownership perspective noted above and allows for a wide range of alternatives where the relatively inefficient parastatal with a potentially biased pay-off can co-exist with private firms in both distribution and across different sources of procurement. As noted in the Introduction, where partial de-regulation of parastatals has occurred in developing countries, it has often involved amendments to market structure (perhaps together with a change in the objectives of the parastatal) of this type. More specifically, 'partial de-regulation' can relate to amendments to market structure in specific or all segments of the markets and/or amendments to the pay-off function and the relative efficiency of the parastatal. It is this combination of (limited) private sector competition, market foreclosure and the potential exercise or otherwise of market power in some segments of the market that results in there being no guarantee that food security will improve.

2. Theoretical Model

There are many challenges in analysing the links between parastatal de-regulation and food security in a formal framework. First, while acknowledging there are several dimensions to the food security issue (relating to accessibility, availability and exposure to shocks) there are several metrics relating to these issues. These include the total availability (the sum of domestically procured and imported commodities), livelihood security of domestic suppliers, self-sufficiency, and the effects of domestic and world market price shocks on consumer and producer prices. Second, there is a wide range of configurations that relate to the role of the parastatal as an intermediary and, by extension, the role of the parastatal in a partially de-regulated environment. Even if we deal with the two extremes of the parastatal as the single market entity through to the case where private intermediaries are solely responsible for domestic procurement and imports as well as distribution, there a number of matters to deal with. For example, partial de-regulation could involve retaining the role of the parastatal as the single market participant but changing its objectives or improving its efficiency. If there is full de-regulation, where private firms procure both domestically and from the world market, the effects on food security will depend on the initial characterisation of the parastatal; even though it was the sole market intermediary, the effect on consumers will depend on the

characterisation of its pay-off function. Further, reflecting the concern about market power post de-regulation, the matter of how competitive the post de-regulated case needs to be to ensure an improved outcome has to be addressed. Extending the possibilities to the partially de-regulated case significantly increases the number of possibilities to compare with the parastatal only case, again allowing for the broad range of food security metrics that have to be accounted for.

There is, therefore, a considerable challenge for theoretical modelling to address the links between parastatal de-regulation and food security outcomes. While some insights can be more readily gained when dealing with partial reforms for a given market structure (e.g., re-focussing the objectives of the parastatal or improving its efficiency but retaining the parastatal as the single market participant), this becomes more difficult as we address de-regulation that involves a change in the structure of markets. We deal with these challenges in a number of ways. First, we provide a general characterisation of the open-economy case where the parastatal and private firms could co-exist in all segments of the market. Second, by excluding private firms or the parastatal from certain segments of the market, we can characterise different permutations of de-regulation. We use linear functional forms to aid the transparency in this case in order to tie down the principal characterisations of complete and partial de-regulation and how they may relate to aspects of food security.

Framework

We assume a typical country that produces a basic food commodity which is homogeneous with respect to imports. We take this economy to be 'large' to allow for the possibility of terms of trade effects. The model is one of market intermediaries that may procure from domestic producers and from exporters. These market intermediaries may be private firms or a parastatal or both, depending on the market structure that the government determines.

Let the domestic inverse demand function be:

$$p = a - b(Q_d^{pr} + Q_m^{pr} + Q_d^s + Q_m^s) \quad (1)$$

the inverse domestic supply function be:

$$p_d = f + k(Q_d^{pr} + Q_d^s) \quad (2)$$

and the inverse import supply function be:

$$p_m = F + K(Q_m^{pr} + Q_m^s) \quad (3)$$

where: Q_d^{pr} is domestic procurement by private firms; Q_m^{pr} is import procurement by private firms; Q_d^s is domestic procurement by the parastatal; Q_m^s is import procurement by the parastatal; with $p(0) > p_d(0)$ and $p(0) > p_m(0)$.

The objective function of the representative private firm is:

$$\pi^{pr} = \pi_d^{pr} + \pi_m^{pr} \tag{4}$$

We assume Cournot competition amongst these firms. This seems the natural structure to choose because of our focus on food security as measured by quantity rather than by price.

The objective function of the parastatal is:

$$W = \alpha_c CS + \alpha_p PS + \pi_d^s + \pi_m^s \tag{5}$$

where: $\alpha_c \geq 0$ is the weight given to consumer surplus relative to that on profit; and $\alpha_p \geq 0$ is the relative weight given to producer surplus relative to profits. The parastatal may be relatively inefficient when compared with a private firm. This inefficiency is introduced through increasing the procurement cost such that in equation (2), p_d is replaced with λp_d, and in equation (3) p_m is replaced with λp_m, where $\lambda \geq 1$.

The FOCs for the representative Cournot firm are:

$$(a-f)-(b+k)(n+1)q_d^{pr} - b(n+1)q_m^{pr} - (b+k)Q_d^s - bQ_m^s = 0 \tag{6}$$

$$(a-F)-b(n+1)q_d^{pr} - (b+K)(n+1)q_m^{pr} - bQ_d^s - (b+K)Q_m^s = 0 \tag{7}$$

The FOCs for the parastatal which may be inefficient relative the private firm are:

$$(a-\lambda f)-n[b(1-\alpha_c)+k(\lambda-\alpha_p)]q_d^{pr} - nb(1-\alpha_c)q_m^{pr} - [b(2-\alpha_c)+k(2\lambda-\alpha_p)]Q_d^s - b(2-\alpha_c)Q_m^s = 0 \tag{8}$$

$$(a-\lambda F)-nb(1-\alpha_c)q_d^{pr} - n[b(1-\alpha_c)+\lambda K]q_m^{pr} - b(2-\alpha_c)Q_d^s - [b(2-\alpha_c)+2\lambda K]Q_m^s = 0 \tag{9}$$

Multiplying through equations (6) and (7) by the number of private firms, *n*, and consolidating the resulting equations with equations (8) and (9) gives:[7]

[7] We assume in this specification that the private firms and the parastatal act as Cournot competitors. It is possible to modify the model to account for the possibility that the private firms would act as quantity followers to the parastatal's leadership. We do not pursue this possibility here.

$$\begin{bmatrix} (n+1)(b+k) & (n+1)b & n(b+k) & nb \\ (n+1)b & (n+1)(b+K) & bn & n(b+K) \\ b(1-\alpha_c)+k(\lambda-\alpha_p) & b(1-\alpha_c) & b(2-\alpha_c)+k(2\lambda-\alpha_p) & b(2-\alpha_c) \\ b(1-\alpha_c) & b(1-\alpha_c)+\lambda K & b(2-\alpha_c) & b(2-\alpha_c)+2\lambda K \end{bmatrix} \begin{bmatrix} Q_d^{pr} \\ Q_m^{pr} \\ Q_d^s \\ Q_m^s \end{bmatrix} = \begin{bmatrix} n(a-f) \\ n(a-F) \\ a-\lambda f \\ a-\lambda F \end{bmatrix} \quad (10)$$

Exclusion of private firms or the parastatal from a segment of the procurement market is achieved by eliminating the relevant row and column of the matrix and the corresponding row of the right-hand side vector. The resulting solutions to the equations will then be different for each choice of exclusion, if any. With such discrete changes in market structure it is not straightforward to determine the effects of such changes on the quantities available for consumption. Allowing for either one, two or three exclusions, there are 14 possible market structures (${}^4C_1 + {}^4C_2 + {}^4C_3$), not all of which are of importance from an empirical viewpoint. There are, however, even more possibilities. These depend on combinations involving values of $(\lambda, \alpha_p, \alpha_c \text{ and } n)$, thus making a ranking of all possible structures impracticable, particularly because, with the exception of *n*, these parameters are real valued.

Consider initially two extreme cases. If the parastatal has exclusive rights over domestic procurement and imports, then the market structure becomes

$$\begin{bmatrix} b(2-\alpha_c)+k(2\lambda-\alpha_p) & b(2-\alpha_c) \\ b(2-\alpha_c) & b(2-\alpha_c)+2\lambda K \end{bmatrix} \begin{bmatrix} Q_d^s \\ Q_m^s \end{bmatrix} = \begin{bmatrix} a-\lambda f \\ a-\lambda F \end{bmatrix} \quad (11)$$

At the other extreme, if there is no parastatal and only *n* private firms, the market structure becomes

$$\begin{bmatrix} (n+1)(b+k) & (n+1)b \\ (n+1)b & (n+1)(b+K) \end{bmatrix} \begin{bmatrix} Q_d^{pr} \\ Q_m^{pr} \end{bmatrix} = \begin{bmatrix} n(a-f) \\ n(a-F) \end{bmatrix} \quad (12)$$

The only comparison of even these two market structures that permits direct results is where the parastatal is efficient ($\lambda = 1$) and it maximises profit ($\alpha_c = \alpha_p = 0$) (equation (11)) and where the number of private firms is 1 (equation (12)). In this case, the parastatal and the monopsony/monopoly are equally efficient, they have the same objective function and the market structures are identical. Thus, the optimal quantities procured from both segments of the market are the same.

In sum, identifying the effects of de-regulation in the context of a given market structure is relatively straightforward i.e. for any given exclusion to (10) above; the issue however becomes more complex when we are compare outcomes across combination of exclusions in (10) above. We tackle these issues separately below.

(i) Reforming the Parastatal: Exclusive Rights in All Market Segments

Take the market structure as given and focus on the reform to the parastatal. The most obvious starting point for this is where the parastatal alone exists. With the parastatal having exclusive rights over domestic procurement and imports, we can re-write (10) as:

$$\begin{bmatrix} b(2-\alpha_c)+k(2\lambda-\alpha_p) & b(2-\alpha_c) \\ b(2-\alpha_c) & b(2-\alpha_c)+2\lambda K \end{bmatrix}\begin{bmatrix} Q_d^s \\ Q_m^s \end{bmatrix}=\begin{bmatrix} a-\lambda f \\ a-\lambda F \end{bmatrix} \tag{13}$$

For the present, assuming food security relates to quantities from different sources and total quantities available, the direction of change in the optimal quantities from solving equation (13) can be determined for the parameters of interest, namely,$\lambda, \alpha_c, and\ \alpha_p$. From equation (13), totally differentiate it to get:

$$\begin{aligned}[b(2-\alpha_c)+k(2\lambda-\alpha_p]dQ_d^s+b(2-\alpha_c)dQ_m^s &= -(f+2kQ_d^s)d\lambda+b(Q_d^s+Q_m^s)d\alpha_c+kQ_d^s d\alpha_p \\ &= -r_1 d\lambda+r_2 d\alpha_c+r_3 d\alpha_p\end{aligned} \tag{14}$$

and

$$\begin{aligned}b(2-\alpha_c)dQ_d^s+[b(2-\alpha_c)+2\lambda K]dQ_m^s &= -(F+2KQ_m^s)d\lambda+b(Q_d^s+Q_m^s)d\alpha_c \\ &= -r_4 d\lambda+r_2 d\alpha_c\end{aligned} \tag{15}$$

Consolidating equations (14) and (15) gives:

$$\begin{bmatrix} b(2-\alpha_c)+k(2\lambda-\alpha_p) & b(2-\alpha_c) \\ b(2-\alpha_c) & b(2-\alpha_c)+2\lambda K \end{bmatrix}\begin{bmatrix} dQ_d^s \\ dQ_m^s \end{bmatrix}=\begin{bmatrix} -r_1 d\lambda+r_2 d\alpha_c+r_3 d\alpha_p \\ -r_4 d\lambda+r_2 d\alpha_c \end{bmatrix} \tag{16}$$

where the determinant of the matrix, Δ, can be shown to be strictly positive.

Using Cramer's Rule, the comparative statics associated with λ are obtained as:

$$dQ_d^s/d\lambda=[-b(2-\alpha_c)(f+2kQ_d^s-F-2KQ_m^s)-2r_1\lambda K]/\Delta$$

$$dQ_m^s/d\lambda=[b(2-\alpha_c)(-f-2kQ_d^s+F+2KQ_m^s)-r_4 k(2\lambda-\alpha_p)]/\Delta$$

The term in the second set of brackets in both equations is the difference between the marginal outlays of the parastatal from domestic and import procurement which, from the first-order conditions, has to be zero. Therefore, with $\Delta>0$:

$$dQ_d^s/d\lambda=-2r_1\lambda K/\Delta<0 \tag{17}$$

$$dQ_m^s/d\lambda=-r_4 k(2\lambda-\alpha_p)/\Delta<0 \tag{18}$$

Repeating the exercise for the consumer bias gives:

$$dQ_d^s / d\alpha_c = 2r_2\lambda K / \Delta > 0 \quad (19)$$

$$dQ_m^s / d\alpha_c = r_2 k(2\lambda - \alpha_p) / \Delta > 0 \quad (20)$$

For the producer bias:

$$dQ_d^s / d\alpha_p = r_3[b(2-\alpha_c) + 2\lambda K] / \Delta > 0 \quad (21)$$

$$dQ_m^s / d\alpha_p = -r_3 b(2-\alpha_c) / \Delta < 0 \quad (22)$$

and the net change in the total availability is:

$$dQ_d^s / d\alpha_p + dQ_m^s / d\alpha_p = 2r_3\lambda K / \Delta > 0 \quad (23)$$

(ii) Parastatal Co-Exists with Private Firms

Again, we focus on the case where we reform the role of the parastatal but this time, the parastatal co-exists with private firms. In the most obvious cases, assume that the parastatal has exclusive rights over imports and the private firms are responsible for domestic procurement but private firms and the parastatal compete directly on the procurement market. In this case, (10) can be re-written as:

$$\begin{bmatrix} (n+1)(b+k) & nb \\ b(1-\alpha_c) & b(2-\alpha_c)+2\lambda K \end{bmatrix} \begin{bmatrix} Q_d^{pr} \\ Q_m^s \end{bmatrix} = \begin{bmatrix} n(a-f) \\ a-\lambda F \end{bmatrix} \quad (24)$$

We can derive the effects of reforming the practices of the parastatal above (though noting that in this case, α_p does not feature while the competitiveness in the domestic procurement market (as given by n) does. We summarise these effects on food security metrics and compare them with the parastatal only case in Table 1.

Table 1: Reforming the Practices of the Parastatal for Given Market Structures

	$d\lambda$	$d\alpha_c$	$d\alpha_p$	dn
		Parastatal only		
Q_d^s	–	+	+	
Q_m^s	–	+	–	
$Q_d^s + Q_m^s$	–	+	+	
		Importing Parastatal/Private Firms in Domestic Procurement		
Q_d^{pr}	+	–		+
Q_m^s	–	+		–
$Q_d^s + Q_m^s$	–	+		+

There are a couple of observations that can be construed from Table 1. First, the effects of reform to the parastatal are context-specific. For example, removing the bias towards consumers in the parastatal pay-off function will reduce food security by any metric (total availability or domestic procurement) if the parastatal is the sole intermediary on the market. However, the same reforms will reduce total availability when the parastatal co-exists with private firms but at the same time, if domestic procurement is the (politically-motivated) food security metric, then food security will increase. Differences also arise across these two cases when considering the effect of improving the relative efficiency of the parastatal. The comparison also serves to that the assessment of reforms also depends on the food security metric employed. Finally, increasing competition which matters in the second case shown above, will improve food security by both metrics with the mechanism being that the increase in domestic procurement outweighing the (negative) import effect though leading to an overall increase in total quantities available.

Changing Market Structure

The above discussion relates to the case where the parastatal is reformed by changing objectives and/or improving efficiency but the characteristics of market structure are given. But parastatal de-regulation may involve a change in market structure with some involvement of the private sector, with possible co-existence with the parastatal in procurement segments or with the parastatal having some exclusive rights in procurement through to the complete case of complete removal of the parastatal. These outcomes are embedded in (10). In this sub-section, we address what impact changes in market structure make to food security.

The insights are less transparent than those that could be derived as above when market structure was taken as given. To focus on this, we take one indicator of food security, domestic procurement (though total availability could also have been chosen), to compare outcomes for different permutations of market structure. As we show below, the comparisons are not very transparent in detailing outcomes, so we limit the discussion to three comparisons: the parastatal only case, the private firm only case and the case where the parastatal has exclusive rights in the procurement of imports but the private firms procure domestically. Other permutations are possible from (10).

Using (8) and with the exclusions applying to Q_d^{pr} and Q_m^{pr} in (10), the change in domestic procurement with the private sector compared with the parastatal only case, is given by:

$$Q_d^p - Q_d^{pr} = \left(\frac{(n+1)}{\Delta^p}\right)[(b+k)(a-F) - b(a-f)]$$
$$-\left\{\frac{(a-\lambda F)\left[b(2-\alpha_c) + k\left(2\lambda - \alpha_p\right)\right] - (a-\lambda f)[b(2-\alpha_c) + 2\lambda K]}{\Delta^{pr}}\right\} \gtreqless 0 \quad (25)$$

The outcome from (25) is ambiguous but it is clear what is will depend on: first, how competitive the private sector is likely to be. From (10) it can be shown that $dQ_d^p/dn > 0$ i.e. the greater the number of competing firms, domestic procurement will increase. Second, it will depend on the initial characterisation of the parastatal. For example, if we had initially a consumer or producer biased pay-off function for the parastatal, de-regulation would reduce domestic procurement (from Table 1, $dQ_d^p/-d\alpha_c < 0$ and $dQ_d^p/-d\alpha_p < 0$). Hence, we have two offsetting effects from de-regulation that involves a change in market structure and it is not clear from (25) which will dominate.

Consider partial de-regulation with this time keeping the parastatal in place but giving it exclusive rights to import only, the private sector allowed to procure domestically and both the parastatal and private firms compete in distribution. Again with the food security metric being domestic procurement and using (13) and (25), the change in domestic procurement resulting from partial de-regulation is given by:

$$Q_d^m - Q_d^{pr} = \frac{n}{\Delta^m}\{[b(2-\alpha_c) + 2\lambda K](a-f) - b(a-\lambda F)\}$$
$$-\left\{\frac{(a-\lambda F)[b(2-\alpha_c)+2\lambda K] - (a-\lambda f)b(2-\alpha_c)}{\Delta^{pr}}\right\} \gtreqless 0 \quad (26)$$

There are several points to note from (26). First, as with complete de-regulation, the starting points matter in terms of the initial characterisation of the pay-off function of the parastatal. Second, the potential effect on domestic procurement will depend on how competitive the domestic procurement market is likely to be; from Table 1, we would anticipate that the more competitive this market is, domestic procurement rises. Third, the effect of increased competition is now different from the solely private firm case as the effect of increasing n now interacts with the characterisation of the parastatal which has exclusive rights over imports. Taken together, contingent on 'starting points' and what the partially de-regulated market involves, there is no guarantee that partial de-regulation would increase this food security metric. Finally, the ambiguity would be exacerbated if, in the process of changing market structure, there were also changes to the functioning of the parastatal through changing the pay-off function and the relative efficiency. By way of example, we know from Table 1 that the effect of changing the bias in the pay-off function ($d\alpha_c$) or improving the

efficiency of the parastatal ($d\lambda$) impacts in different ways due to the nature of the exclusive rights that apply to the parastatal in the partially de-regulated case.

Equations (25) and (26) indicate that, even for apparently straightforward comparisons of changes in market structure for one food security metric, there is no guarantee that food security would improve and that, while we can determine the factors that will likely determine the final outcome, there are no clear insights from (25) and (26) that food security will improve. This ambiguity intensifies when we consider other permutations of partial de-regulation from (10) and alternative food security metrics. To shed further light on these issues, we therefore turn to a numerical exercise.

Numerical Example

We choose parameter values to characterise a 'typical' agricultural market with inelastic demand, inelastic domestic supply and where there are the potential for terms of trade effects with respect to imports but where the elasticity of the import supply function is greater than the domestic supply function. The equations that correspond to (1)-(3) above are given by:

$$p = 10 - 0.5(Q_d^{pr} + Q_m^{pr} + Q_d^s + Q_m^s);\ p_d = -1 + 0.5(Q_d^{pr} + Q_d^s);\ \text{and}\ p_m = 2 + 1.25(Q_m^{pr} + Q_m^s)$$

With the use of the numerical example, we can provide a comparison across different characterisations of parastatal de-regulation as outlined above as well as more complex characterisations of market structure[8]. Moreover, noting that there are different means of gauging food security, we can provide a comparison across different indicators including total availability and exposure to world markets. Again, acknowledging the large number of permutations of market structure that can characterise partial de-regulation, we limit the comparison to a limited number of cases which are summarised in Table 2 below: (i) alternative characterisations of the parastatal (Case A: (a)-(g)); (ii) the parastatal has exclusive rights with regard to imports and the private firms characterise domestic procurement (Case B); (iii) the parastatal co-exists with private firms in both import procurement and domestic procurement markets (Case C); and (iv) the private firm only case. For the moment, we confine the comparisons involving private firms to *n=1* so that we are isolating the impact of the nature of the parastatal pay-off function, the asymmetry in this pay-off function with the private firm and the impact of exclusive rights in specific procurement segments of the market. Note that the first and last rows of Table 2 represent the case where the parastatal

[8] These parameter values relate to a 'typical' agricultural market; in this context, it should be noted that none of the insights we detail below is contingent on the parameter values chosen.

only case is identical to the private firm (monopoly) case (see equations (11) and (12)); here we have a relatively efficient parastatal with exclusive rights in both segments of the market with profit maximising pay-off function which is identical to a profit maximising monopolist-monopsonist. We explore the impact of increasing the number of private firms below.

Table 2: Characterisation of Alternative Market Structures

Case	**Description of the market structure**	**Parameter values** $(\lambda, \alpha_c, \alpha_p)$, n
A(a)	an efficient, profit-maximising parastatal with exclusive rights to procure in both segments	(1, 0, 0), 0
A(b)	as in Case 1(a) but the parastatal is inefficient	(1.25, 0, 0), 0
A(c)	as in Case 1(a) but the parastatal is consumer-biased	(1, 1, 0), 0
A(d)	as in Case 1(a) but the parastatal is producer-biased	(1, 0, 1), 0
A(e)	as in Case 1(a) but the parastatal maximises social welfare	(1, 1, 1), 0
A(f)	as in Case 1(e) but the parastatal is inefficient	(1.25, 1, 1), 0
A(g)	imports are banned and the parastatal procures only from the domestic market	(1.25, 1, 1), 0
B	the parastatal has exclusive rights to import and private firms have exclusive rights to domestic procurement	(1, 0, 0), 1
C	the parastatal and private firms compete in both procurement markets	(1.25, 1, 1), 1
D	there are only private firms	1

In Table 3, we provide the numerical outcomes for different food security metrics: domestic procurement, imports, self-sufficiency and total availability. The way to interpret the entries in this table, is that starting from any permutation of Case A, the outcomes to any other characterisation of Case A or to Cases B and C represent partial de-regulation. The move to Case D represents complete de-regulation with a private firm replacing the parastatal.

Take, by way of a starting point, the case where we had a consumer biased (and relatively efficient) parastatal; the consumer bias is consistent with bias of agricultural policies in many developing countries in recent years where food was subsidised and farmers taxed. If reform involved a re-orientation of the pay-off function, say towards the interests of producers (i.e. we move from Case A(c) to Case A (d), then domestic procurement increases, as we would expect from the above comparative statics. However, while self-sufficiency increases, total availability falls. These changes keep market structure the same; as we move from any of the Case A scenarios to Cases B to D, market structure involves some changes which, as we

know from the above, is difficult to interpret from direct comparisons of the closed form outcomes.

Starting again at Case A(c) and moving to Case B (exclusive rights for the parastatal over imports and a private firm in domestic procurement) shows that two metrics of food security exhibit a decline (domestic procurement and total availability) while self-sufficiency rises. The main point here is that it is not necessarily the case that removing the parastatal from a segment of the market will improve food security improvements, at least by some metrics. However, allowing private firms to compete in both procurement segments of the market (i.e. where there are no exclusive rights in procurement), improves upon the exclusive rights case (compare Case C outcome with Case B) but does not improve upon the parastatal/consumer biased only case. Moving to the private firm only case leads to the least best outcome with the exception of maintaining the parastatal/relatively inefficient case.

Table 3: Food Security Metrics for a Selection of Market Structures

	Q_d	Q_m	Self-Sufficiency (%)	Q_T
Case A(a)	5.083	0.833	86	5.917
Case A (b)	4.698	0.679	87	5.377
Case A (c)	6.824	1.529	82	8.353
Case A (d)	7.176	0.235	97	7.412
Case A (e)	10.545	0.909	92	11.454
Case A (f)	8.650	0.876	91	9.526
Case A (g)	9.000	-	100	9.000
Case B	5.111	1.556	77	6.667
Case C	6.778	1.111	86	7.889
Case D	5.083	0.833	86	5.917

Clearly, we can generate different comparisons by taking a different starting point but the above serves to illustrate three main points: (i) 'starting points' matter specifically the characterisation of the parastatal; (ii) partial or even full de-regulation will not necessarily improve food security outcomes but it will depend on the starting point and the nature of the

partial de-regulation and (c) alternative food security metrics can lead to different interpretations of the desirability of the outcomes.

In the private firm examples above, we constrained the number of private firms to 1 in order to highlight the changes due to asymmetry in the pay-off functions, the relative inefficiency of the parastatal and the changes in market structure. A relevant question that arises from equations (25) and (26), and reflecting a concern about parastatal reform in developing countries, is how intensive would private firm competition would have to be (with or without the parastatal presence) to improve upon the parastatal only case? We address this with reference to Figures 1 and 2 below. In Figure 1, we focus on total availability and compare this with the private sector only case (i.e. complete de-regulation). Each of the horizontal lines highlights total availability for the parastatal only case and corresponds with Cases A(a)-(f) above. The outcomes for the parastatl-only are obviously invariant to the number of *n* firms which is designated along the horizontal axis. As you can see, with the exception of the welfare maximising parastatal, only a small number of private firms is required to 'beat' the parastatal only case. Again starting points matter and even a private sector duopoly could improve upon several of the characterisations of the parastatal only case. The only case where the private sector does not improve upon is the welfare maximising parastatal case. The reason for this is that in an open economy context, the welfare maximising parastatal takes into account the terms of trade effect with respect to the procurement of imports.

In Figure 2, we explore the same exercise but this time considering examples of partial de-regulation. To keep the comparisons manageable, the parastatal-only characterisation is the consumer biased/relatively inefficient case (Case A (c) above) and where the co-existence of the parastatal is assumed to maintain these characteristics. The overall message is the same: only a small number of private firms is required to improve upon the parastatal only case. Note, however, total availability is greater when private firms co-exist with the parastatal (for this characterisation) and it improves upon the private firm only case even with the same number of firms. This is due to the pro-competitive nature of the parastatal pay-off function (despite its relative inefficiency). In sum, even though the simulations suggest that you do not need a lot of competition to improve upon outcomes, it is not necessarily the case that removing the parastatal altogether would be the best option.

Figure 1: Total Availability Under Different Market Structures

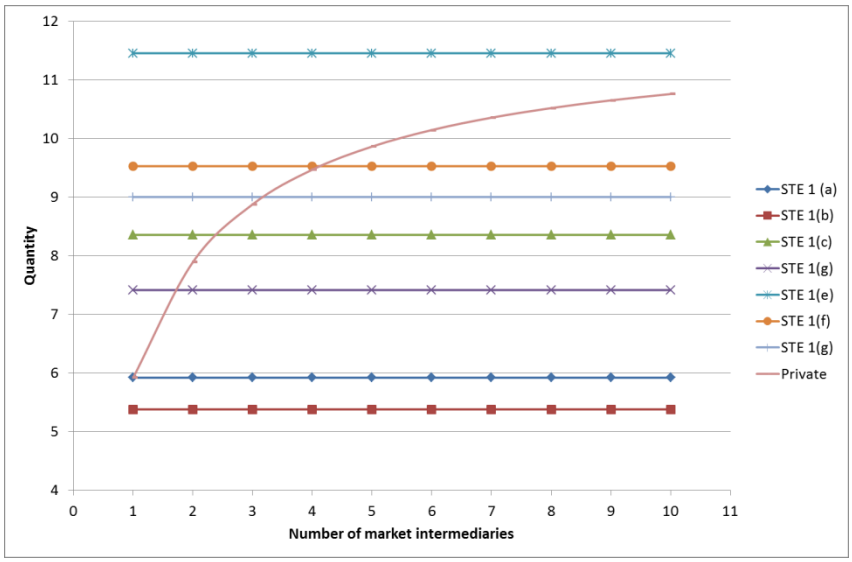
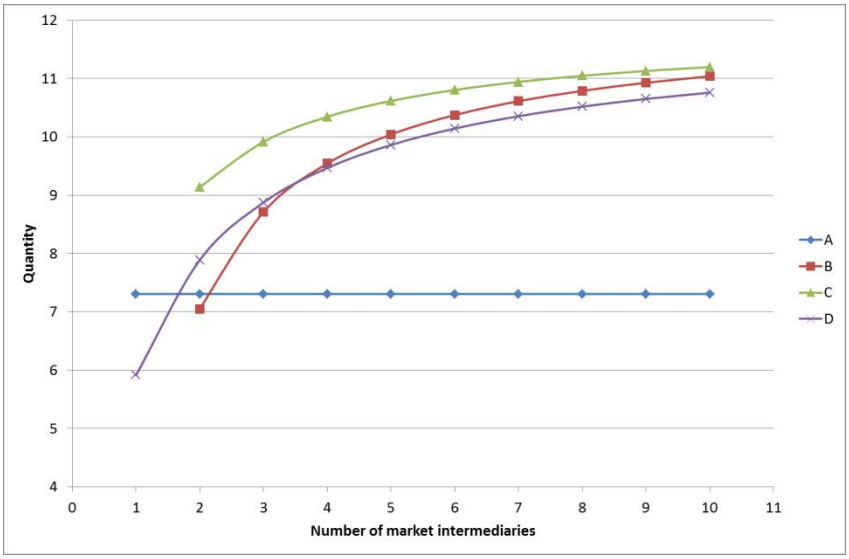


Figure 2: Total Procurement with Partially-De-regulated Market Structures



Note:
A: an inefficient, consumer-biased parastatal has exclusive rights in both procurement markets
B: *m* private firms are excluded from importing and an inefficient, consumer-biased parastatal is excluded from domestic procurement
C: *m* private firms compete for procurement and sales with an inefficient, consumer-biased parastatal and there are no exclusions
D: *m* private firms only

3. Supply Shocks and Price Transmission

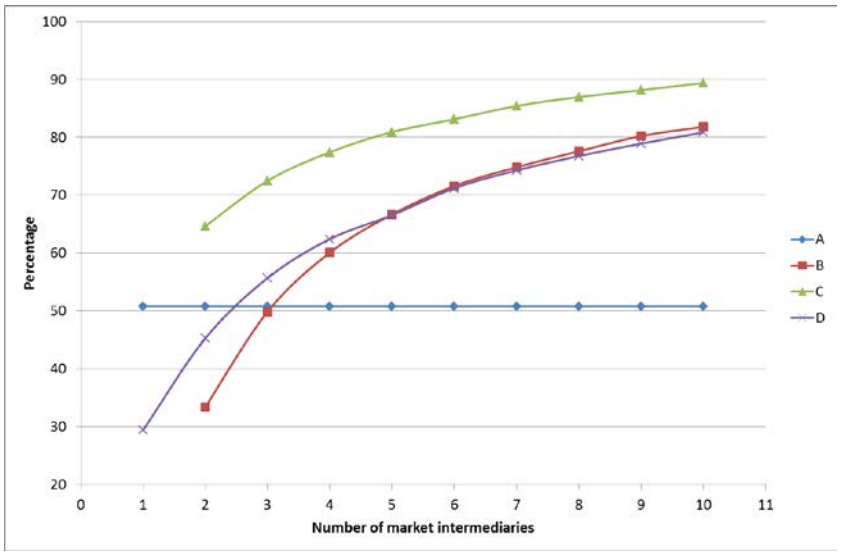
Another dimension of food security is the impact of supply shocks and how domestic prices change in response to these shocks. This issue of price transmission and the impact of market structure on the price transmission process is a common concern in addressing economic policy changes. Usually the focus on the interaction of market structure and price transmission takes the market structure as given but, as above, we focus on how changes in

market structure involving partial de-regulation of the parastatal can impact on that outcome. However, the framework we employ here provides further insights into this issue. First, since we have an open economy model with also domestic procurement, we are able to separately identify the impact of domestic and world supply shocks. Further, since the food security aspect relates to both consumers and producers, we can also differentiate the effect between these two groups.

Again observing that there are many permutations of market structure that can arise with partial de-regulation from (10), we confine the discussion here to the three characterisations of market structure that we focussed on above: the parastatal only; the parastatal with exclusive import rights co-existing with private firms who source domestically; and the private firm only case. In Table 4, we provide details of the price transmission effects for these alternative characterisations of market structure. As was the case when we were addressing other food security metrics, the insights from the explicit solutions are not informative particularly in attempting to compare these effects across different characterisations of the market and, as before, we turn to numerical simulations. But three general observations arise from Table 4: (i) the price transmission effect will depend on the source of the supply shock; (ii) the price transmission effect on consumers will differ from that on producers; (iii) partial or complete de-regulation will affect each of these outcomes. The direction and extent of these differences in price transmission effects can be obtained from the numerical exercise.

Figures 3 and 4 provide results of different sources of supply shocks and the effect on consumer prices when market structure varies. We convert the price transmission into percentage changes to allow for more direct comparison between market structures. On the horizontal axis, we detail the number of private firms which may exist or co-exist with the parastatal following partial de-regulation. From Figure 3, we see that-for a reasonably small number of private firms-the parastatal only case has a lower degree of price transmission; to the extent that negative supply shocks are undesirable, consumers have more 'protection' from these shocks in the presence of the parastatal. The market structure that leads to the highest level of price transmission is the case when the private sector co-exists with the parastatal; in this case, the private firm effect is exacerbated by the presence of the consumer-biased parastatal which implies an outcome even more competitive than with the equivalent number of private firms (i.e. *n* private firms plus the parastatal).

Figure 3: Percentage Price Pass-Through from a Domestic Supply Shock



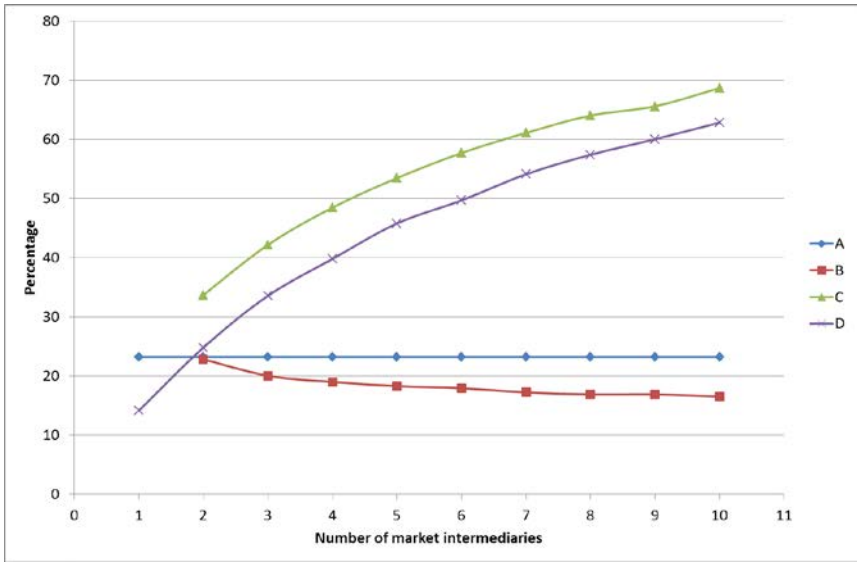
Note: The definitions of the structures are given in Figure 2.

In Figure 4, we have the same market structure cases but this time the source of the shock relates to import supply shocks. There are two general points to note. First, for the 'same' supply shock, the price transmission effect is lower which can be observed by comparing the vertical axes across both figures. For example, in the parastatal only case, the domestic supply shock lead to a price transmission effect of around 50 per cent; for the import supply shock, the price transmission effect is around 20 per cent. Moreover, while it is commonly asserted that more competitive markets lead to a higher level of price transmission (which is generally substantiated from Figures 3 and 4), the one exception to this is where we have an import supply shock and the private firms are excluded from importing. In this case, more private firms dilute the price transmission effect; the rationale for this is that as we increase the number of private firms that can procure domestically, this reduces the reliance on imports which in turn reduces the exposure to import supply shocks.

Table 3: Price Transmission Effects due to Alternative Supply Shocks

	Parastatal Only	
	Domestic Supply Shock	**Import Supply Shock**
Consumer Prices	$\frac{2bK\lambda^2}{[b(2-\alpha_c)+2\lambda K][b(2-\alpha_c)+k(2\lambda-\alpha_p)-b^2(2-\alpha_c)^2}$	$\frac{bk(2\lambda-\alpha_p)}{[b(2-\alpha_c)+2\lambda K][b(2-\alpha_c)+k(2\lambda-\alpha_p)-b^2(2-\alpha_c)^2}$
Producer Prices	$1-\frac{\lambda k[b(2-\alpha_c)+2\lambda K}{[b(2-\alpha_c)+2\lambda K][b(2-\alpha_c)+k(2\lambda-\alpha_p)-b^2(2-\alpha_c)^2}$	$\frac{bk\lambda(2-\alpha_c)}{[b(2-\alpha_c)+2\lambda K][b(2-\alpha_c)+k(2\lambda-\alpha_p)-b^2(2-\alpha_c)^2}$
Parastatal with Import Rights Coexisting with Private Sector		
	Domestic Supply Shock	**Import Supply Shock**
Consumer Prices	$\frac{nb[b+2\lambda K]}{[b(2-\alpha_c)+2\lambda K][(n+1)(b+k)-nb^2(1-\alpha_c)}$	$\frac{b[b+k(1+\lambda n)]}{[b(2-\alpha_c)+2\lambda K][(n+1)(b+k)-nb^2(1-\alpha_c)}$
Producer Prices	$1-\frac{kn[b(2-\alpha_c)+2\lambda K}{[b(2-\alpha_c)+2\lambda K][(n+1)(b+k)-nb^2(1-\alpha_c)}$	$\frac{n\lambda b}{[b(2-\alpha_c)+2\lambda K][(n+1)(b+k)-nb^2(1-\alpha_c)}$
	Private Firms Only	
	Domestic Supply Shock	Import Supply Shock
Consumer Prices	$\frac{nbK}{(n+1)[(b+k)(b+K)-b^2}$	$\frac{nbk}{(n+1)[(b+k)(b+K)-b^2}$
Producer Prices	$1-\frac{nk(b+K)}{(n+1)[(b+k)(b+K)-b^2}$	$\frac{nb}{(n+1)[(b+k)(b+K)-b^2}$

Figure 4: Percentage Price Pass-Through from an Import Supply Shock



Note: The definitions of the structures are given in Figure 2

Clearly we could produce a large number of figures detailing price transmission effects, yet Figures 3 and 4 establish the main points: first as you de-regulate parastatals and change market structures, the price transmission outcomes will vary; second, to the extent that lower degrees of price transmission are preferable when you are concerned with food security issues, there is no guarantee that de-regulation will improve this food security metric.

4. The Effects of Partial De-regulation: the Case of Rice in Indonesia

In Section 3, we have shown that food security for consumers depends fundamentally on a combination of market structure and the objectives of the parastatal. We have also shown that the effects of de-regulation on food security depend on the starting point, i.e., the nature of the policy bias and the market structure. We now apply these insights to a real parastatal and show why the changes in market structure and policy objectives, even when designed to increase food and livelihood security, may not achieve the desired outcomes. We also consider in more detail the relationship between policy biases and market structure on the livelihood security of domestic suppliers to the market intermediaries.

Background

As noted in the Introduction there are many examples of partial de-regulation of parastatals in developing countries, for example in China, India, Indonesia, and the Philippines, where the role of the parastatal has changed with the agricultural policy reforms that have had the aim of

promoting food security. We focus here on the Indonesian rice market where BULOG continues to play a dominant role. BULOG states that its vision is to ensure "sufficient, secure and accessible food for people" (BULOG, 2013).

There are of course a number of factors and policy initiatives that can influence a country's overall food security but, as the World Bank has noted, BULOG "remains one of the most important institutions for ensuring food security in Indonesia" (World Bank, 2005).[9] What makes the role of BULOG in the Indonesian rice market of special interest for our analysis of parastatals is that, over the years, it has undergone a series of partial reforms. The original impetus for these reforms was the Asian financial crisis where one of the conditions for the bailout fund from the IMF was substantial reforms to BULOG, although BULOG retained its dominant status with regard to imports of rice.

Three distinct periods can be identified which differ with respect to policy bias and market structure. First, the period 1967 to 1998 when BULOG maintained domestic rice prices close to parity with world market prices and it did not display any particular policy bias in favour of either consumers or producers. We represent this as the policy bias with $\alpha_c = \alpha_p = 1$. Second, is the period 1998-2004 when the policy changed to representing a bias towards producers. This change caused a rise in domestic rice prices above world market levels. We represent the change policy bias with $\alpha_p = 1$ and $\alpha_c = 0.75$. Third is the period since 2004 when the objective became one of greater 'commercially-orientation'. We represent this situation with $\alpha_c = \alpha_p = 0.5$. We assume in all these cases that BULOG is relatively inefficient and we set $\lambda = 1.25$. In each of the three periods, the parastatal competes with one private firm. Thus, any differences in the results across the three periods are not due to differences in *n* or to differences in the inefficiency of the parastatal but to differences in policy objectives and market structure.

Coincident with the changes in objectives, the role of the private sector also changed. In the first and third periods it was confined to procuring in the domestic market and excluded from importing, while in the second, it was allowed to procure imports as well. At the same time a specific tariff on imports of rice of $40 per tonne was imposed on the private sector. This

[9] A more general discussion of Indonesian agricultural policy can be found in OECD (2012) including the role of BULOG. Note that, while BULOG has other functions, including maintaining stocks and the management of the RASKIN programme, which involves distributing subsidised rice to the poor, the focus here is with respect to the partial de-regulation associated with changes in market structure and objectives. Yongekura (2005) also provides a discussion on the role of BULOG, while Warr and Yusuf (2013) investigate the link between rice prices and poverty using a CGE model of Indonesia.

pattern of partial de-regulation and re-regulation fits with aspects of the characterisation of partial de-regulation outlined above rather than with the total de-regulation that has been a large part of the policy debate on parastatals.

We can refer back to equation (10) to characterise the policy bias and market structure of these three periods. For the pre-1998 period, we have:

$$\begin{bmatrix} 2(b+k) & (b+k) & b \\ 0.25k & b+1.5k & b \\ 0 & b & b+2.5K \end{bmatrix} \begin{bmatrix} Q_d^{priv} \\ Q_d^{ps} \\ Q_m^{ps} \end{bmatrix} = \begin{bmatrix} a-f \\ a-1.25f \\ a-1.25F \end{bmatrix} \tag{27}$$

for the period 1998-2004 we have:

$$\begin{bmatrix} 2(b+k) & 2b & (b+k) & b \\ 2b & 2(b+K) & b & (b+K) \\ 0.25b+0.25k & 0.25b & 1.25b+1.5k & 1.25b \\ 0.25b & 0.25b+1.25K & 1.25b & 1.25b+2.5K \end{bmatrix} \begin{bmatrix} Q_d^{priv} \\ Q_m^{priv} \\ Q_d^{s} \\ Q_m^{s} \end{bmatrix} = \begin{bmatrix} a-f \\ a-F-t \\ a-1.25f \\ a-1.25F \end{bmatrix} \tag{28}$$

and for the period post-2004 we have[10]:

$$\begin{bmatrix} 2(b+k) & (b+k) & b \\ 0.5b+0.75k & 1.5b+2.0k & 1.5b \\ 0.5b & 1.5b & 1.5b+2.5K \end{bmatrix} \begin{bmatrix} Q_d^{priv} \\ Q_d^{s} \\ Q_m^{s} \end{bmatrix} = \begin{bmatrix} a-f \\ a-1.25f \\ a-1.25F \end{bmatrix} \tag{29}$$

where the values for $(\lambda, \alpha_p, \alpha_c \; and \; n)$ have been substituted.

Calibration

We use data from the Indonesian rice market to calibrate equations (1) to (3). The data relate to 2009-11 and are reported in the Appendix together with the values of the calibrated parameters. In selling rice in the domestic market, BULOG mixes domestic and imported rice and thus we continue to treat rice as homogeneous. The results of simulating the three market structures and policy objectives are reported in Table 4.

Results

Food security, measured by total availability, declines with successive partial de-regulations because of the interaction between market structure and the policy bias of BULOG. This decline in food security has been caused in large part by the fall in domestic procurement, which in the second period appears inconsistent with the change in policy bias toward producers. Recall from Table 1 that domestic procurement increases with each policy weight. However, overall procurement is more sensitive to the weight on consumers and it has fallen

[10] For a short period in 2008, the private sector was also allowed to import but this changed once again in June 2008. We therefore assume monopsony control over imports in this period. Note also we could include a domestic floor price, given that this was part of the reformed policy since 1998 (i.e., by replacing f with $\overline{f}$). However, for the price and quantity data used in the calibration this floor price (Rupiahs 2560) is not binding and we exclude it here.

from 1.0 to 0.75 to 0.5 over the subsequent two periods. Therefore, although there was a decline in domestic procurement and in the total quantity available, domestic procurement, as a share of total procurement, increased from the first to the second period causing self-sufficiency to increase from 97.4 per cent to 99.3 per cent. Part of this increase can be explained by the fall in imports procured by BULOG in the second period that exceeded the new imports by the private firm. In contrast, in the third period self-sufficiency falls because of the increase in imports by BULOG.

Livelihood security, measured by producer surplus, falls with each partial de-regulation because domestic procurement falls and with it the price received by rice farmers. A similar pattern is shown by consumer surplus. As total procurement falls, the consumer price increases and consumer surplus falls. Despite the decrease in both surplus measures, overall social welfare remains essentially unchanged. It does so because the level of profits achieved by the private firm and BULOG increases. However, if livelihood and food security are the real objectives sought by partial de-regulation, then it is undesirable that neither has been achieved.

These undesirable outcomes from partial de-regulation, which are inconsistent with the government's policy objectives, are exacerbated when the effects of the transmission of supply shocks are noted. The size of the producer price shock increases with each successive partial de-regulation regardless of the source of the shock. On the other hand, producer surplus increases with each successive de-regulation if the shock is domestic but not to the same extent if it is from the import market. In contrast, the size of the consumer price shock diminishes with each successive de-regulation and the consumer surplus shock remains largely unchanged. While the absolute size of the shock to the intercept in each inverse supply was identical, the results were not. In general, the size of the percentage changes were about ten times larger when the shock occurred in the domestic market than when it occurred in the import market. This outcome may have substantial and damaging implications if a policy of self-sufficiency is pursued.

Table 4: Effects of the Partial De-Regulation of BULOG

	Episodes of Partial De-regulation [a]		
Food Security Metric	*pre-1998*	*1998-2004*	*post-2004*
Total Availability (m.m.t) [b]	72.1	65.6	58.4
Domestic Procurement (m.m.t)	70.3	64.7	57.1
Import Procurement (m.m.t)	1.8	1.0	1.3
Self-sufficiency (%)	97.4	99.3	97.8
Agg. welfare (Rs tril.)	1489	1490	1457
PS (Rs tril.)	208	167	118
CS (Rs tril.)	1249	1035	819
Effect of Domestic Supply Shocks [c]:	(%)	(%)	(%)
-producer prices	4.7	5.5	7.6
-producer welfare	1.8	2.3	4.2
-consumer prices	3.8	2.1	1.4
-consumer welfare	-1.2	-1.2	-1.2
Effect of Import Supply Shocks [d]:	(%)	(%)	(%)
-producer prices	0.4	0.6	0.6
-producer welfare	0.5	0.8	0.8
-consumer prices	0.4	0.3	0.2
-consumer welfare	-0.1	-0.1	-0.1

Note: [a] In the period pre-1998, the parastatal is welfare maximising ($\alpha_c = \alpha_p = 1$), it has exclusive rights to import and it competes for domestic procurement with the private sector.
In the period 1998-2004, the parastatal has a bias towards producers ($\alpha_c = 0.75, \alpha_p = 1$) and it competes with the private sector for procurement in both markets.
In the period post-2004, the parastatal has greater commercial orientation ($\alpha_c = \alpha_p = 0.5$) but the market structure is the same as that in the period pre-1998.
[b] Any discrepancy between total availability and the sum of domestic and import procurement is rounding error.
[c] the domestic supply shock is an increase in the intercept (*f*) of 250,000
[d] the import supply shock is an increase in the intercept (*F*) of 250,000

To the extent that producers and consumers are sensitive to commodity price shocks, the forms of the partial de-regulation undertaken by the Indonesian government that have been simulated, appear to have negative consequences. The level of producer surplus falls and it becomes more sensitive to supply shocks as partial de-regulation has proceeded. For consumers, the outcome is more ambiguous. While the level of consumer surplus decreases as de-regulation proceeded, the sensitivity to supply shocks also decreased.

The theoretical framework that has been developed sheds light on how partial de-regulation can be evaluated in a formal and consistent manner when the government's objectives are to improve livelihood and food security. The simulations provide insights into why the intended policy goals were not achieved despite the changes in policy biases and market structure. There are a variety of factors that influence food security and the framework developed isolates the characteristics of market reforms that explain the outcomes. Several observations can be made: (i) food security, as measured by aggregate quantity, changes with the change in the objectives of the parastatal even although self-sufficiency may be relatively unchanged; (ii) even although social welfare may not change much, there are substantive distributional effects; and (iii) the effect of commodity price shocks is contingent on where they arise and it can differ significantly between consumers and producers; and (iv) de-regulation can have a significant influence on the magnitude of price transmissions and the welfare changes that arise from them.

5. Summary and Conclusions

There is a wide-ranging debate on the use of parastatals and the likely impact, both positive and negative, of reform, with concerns expressed about the effects on consumers and producers and on food security. Most of the evidence has been case-study based with no formal framework to inform the debate. Any assessment is complicated by the fact that reform of parastatals may be partial in nature involving changes in its objectives or the parastatal being limited to operating in certain segments of the market. Moreover, many of the concerns about de-regulation have centred around the potential for a limited number of private firms to dominate the market when the role of the parastatal has been reduced.

In this paper, we have presented a framework in which alternative characterisations of the de-regulation process can be analysed. The effects of a parastatal in its various forms is compared with those of a private sector benchmark that can be varied in size in order to capture how differences in the characterisations may influence the results and the policy conclusions to be drawn from them. The framework is general enough to allow for differences in the markets in which the parastatal competes, for alternative definitions of its objective function, to allow for the relative inefficiency of parastatals and for the introduction of other instruments of government policy.

The results show that the outcome of the process of partial de-regulation does not necessarily lead to an improvement in either food security or welfare but, instead, may diminish either or both. However, care needs to be taken with the market structure that is used as the point of

comparison – whether it is total de-regulation or only partial de-regulation. The policy conclusions to be drawn depend upon the initial characterisation of the parastatal, the extent of its inefficiency, the precise nature of de-regulation, the number of private firms, the use of alternative government instruments and the variables used in the measurement of that comparison. In general, in the context of a second best world, there is no guarantee that partial reform will necessarily be desirable. The results obtained from the calibrated example of the Indonesian rice market amply reinforce this outcome.

The overall aim of using this framework is to provide insights into the de-regulation of parastatals that moves beyond the case-study commentaries that generally characterise this debate. But there is clearly scope for more research on this issue, including alternative characterisations of the parastatal's pay-off function, accounting for price volatility more comprehensively, characterising the interaction between private firms and the parastatal in different ways and accounting for dynamics, including storage. A successful outcome to such a research agenda would establish more informed insights into the links between market reforms and food security.

Appendix: Data and Calibrated Parameters – Indonesian Rice Market, 2009-11

Variables	Data
P_1 (Rupiahs/metric tonne)	8,018,590
P_2 (Rupiahs/metric tonne)	8,018,590
Q_1 (metric tonnes)	65,541,729
Q_2 (metric tonnes)	1,229,510
Domestic Supply Price (Rupiahs/metric tonne)	3,527,060
World Price (Rupiahs/metric tonne) [a]	3,778,397
Demand Elasticity	0.25
Domestic Supply Elasticity	0.5
World Supply Elasticity	5
α_p	1.25
α_c	0.75

Calibrated Parameters	Calibrated Values
a	40,092,950
b	0.48036
f	-352,706
k	0.10763
F	3,022,718
K	0.61462

Source: Taken from the *Statistical Yearbook of Indonesia*, various years except for the price of imported rice which was obtained from the World Bank Commodity Price Data (Pink Sheet) (April 2013).

Note: *a* the price of imported rice is for Rice, Thai A.1 converted from US$ to Rupiahs at the average exchange rate for 2009-11 of Rupiahs 9,700: $US.

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