ON THE COMPLEMENTARITY BETWEEN LAND REFORMS AND TRADE REFORMS

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Abstract

The purpose of the paper is to look at the welfare effects of trade in agricultural goods in a less-developed country where the agricultural market is controlled by a handful of large farmers. It is shown that the success of trade reform depends upon the distribution of output between large and small farmers and the success of land reform leading to redistribution from the large to the poor depends on trade reform. In other words, if undertaken in isolation, each reform might lead to a fall in welfare, but if jointly undertaken, they will lead to an increase in welfare. Thus the two reforms are complementary.

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1. Introduction

In recent years, a number of less developed countries are going through a process of economic reforms. Many of these countries are still predominantly agricultural and an important agenda in their list of reforms is to open up the economy to international trade in agricultural goods. The WTO has also insisted on freer trade in agricultural commodities among its member countries. All this has made free agricultural trade among nations a very important policy issue in recent years. More so, because the current trade practices in agricultural goods in the world is far from free. It is but natural that debates and controversies would crop up around the question of costs and benefits of a freer agricultural trade. Indeed, a considerable literature has developed addressing this policy question. But very few of the existing papers written on the subject address the problem in terms of a formal model. The purpose of the present paper is to fill up this gap.

While doing so, our focus remains restricted to less developed agricultural countries. In many of these countries, the agricultural market is controlled by a handful of large sellers. True, a large number of small sellers also coexist in the market and true, the *total* output produced by the small sellers is not insignificant. But the small sellers do not have the power to hold stocks for long. So each year, they are compelled to sell most of their stocks just after the harvest. As a result, every year, barring a few busy months just after the harvest, the market is controlled by the large sellers. We model international trade in agricultural goods in this background.

What are the nature of reforms people are talking about for these backward agricultural sectors? Indeed, what kind of restrictions are imposed on international trade? The existing restrictions are in the form of export and import quotas, tariffs, restrictions on future trading, restriction on private holding of stocks and canalization of exports and imports, i.e. international trade only through government agencies (see Pursell and Gulati (1995) for a detailed account of the restrictions imposed on Indian agriculture). The reformists are in favour of removing these restrictions and move on to free international trade. In this paper, we examine, theoretically, the desirability of free trade over autarky as well as trade with government restrictions.

In fact, there is yet another type of reform, viz. land reform, which some economists have been talking about for a much longer in the context of these backward agricultural countries. The effect of land reform is to redistribute output from the large to the smaller farmers. Surprisingly, the proponents of economic liberalization have seldom talked about this more fundamental reform. But at least in some quarters it is accepted that the success of liberalization depends to a large extent on certain social reforms, including redistribution of land (see, for example, Lipton (1995)). The history of Europe, Japan and that of the newly industrialized countries of South East Asia seems to support this view. Our paper provides a theoretical justification of this view. In particular, we show that free trade is better than autarky or restricted trade only if the distribution of output between the small and the large sellers is sufficiently in favour of the former.

We also show that the success of land reform, in its turn, depends on trade reform. We show in particular, that under autarky redistribution leads to a welfare loss and hence is costly. If, on the other hand, the economy is opened to international trade, free or restricted, the welfare cost associated with land reforms under autarky simply vanishes. So, if the primary aim is to implement redistribution within the agricultural sector, it is better to have the economy open to international trade. Thus the purpose of the paper is to show that the two reforms are, to a large extent, *complementary.*

2.1 The Environment

We consider the market for a single agricultural good. Output is seasonal and is obtained at discrete points in time. These discrete points are identified with the harvest. The time interval, which lies between two consecutive harvests, is denoted by [0,T]. We focus our attention on this time interval. Though production is discrete, consumption is continuous. To meet continuous consumption, output has to be stored from one harvest to another. Thus, storage is a very important activity in the present model.

There are three types of agents operating in the market: large sellers, small sellers and consumers. Both large and small sellers own some stocks at the initial time point 0. The problem of each seller is to decide upon the optimal sequence of sales from these stocks over the interval [0,T] so as to maximize profits. There are two differences between the large and the small sellers. First, a large seller is able to affect the market price through his sales decision. Thus each large seller enjoys oligopolistic market power. Each small seller, on the other hand, is a price taker. Second, the large and small sellers differ according to their storage costs. For a large seller, storage cost is in the nature of a fixed cost. Once this fixed cost is incurred, a large seller is able to store as much stock as he wishes at zero additional cost. In other words, for a large seller, the average cost of storage falls as the quantity of stocks goes up. Therefore, the large sellers are specialized traders who invest money to acquire large storehouses with excess capacity. On the contrary, the small sellers incur storage costs per unit of stocks stored per unit of time. Moreover, this per unit storage cost is increasing in the total amount of stocks stored. Thus, the small sellers have a rising marginal cost of storage with zero fixed cost and the large sellers have a zero marginal cost of storage with a positive fixed cost. We assume that there is a large number of small sellers and n large sellers in the market.

A further important difference between the large and the small sellers will *follow* from our analysis. It will be shown below that the large sellers can sometimes *buy* stocks from the market for future sales; the small sellers, however, will be selling stocks at all points in time. Thus we shall show that it is only the large sellers who can engage themselves in intertemporal trade (i.e. buying cheap at one point in time and selling at another future point in time).

As compared to the sellers, the consumers are passive in this model. They do not, by assumption, hold any stock for future consumption. They buy and consume at the same instant. At any point in time they have a demand curve which is assumed to be linear and uniform across time. The inverse demand function takes the form

$$(2.1) \qquad p(t) = a - q(t)$$

where $p(t)$ is the price of the good and $q(t)$ is the quantity demanded at time t. Let $y(t)$ be market sales (market purchase, if $y(t)$ is negative) by the large sellers and $z(t)$ be market sales by the small sellers at time t. Then demand-supply equality at time point t implies that $q(t) = y(t) + z(t)$. Consequently, equation (2.1) may be written as

(2.1A) $$p(t) = a - \{y(t) + z(t)\}$$

The sellers take (2.1A) as given while maximizing their profits.

2.2 The Large Sellers' Problem

A large seller maximizes his intertemporal profits by choosing his sequence of sales (and purchases) *given* the sequence of sales of the small sellers, the sequence of sales of the other large sellers and the demand equation (2.1A). Formally, a large seller's problem is to

(2.2) $$\max \int_0^T p(t) y_i(t) dt \; - \; k_i$$

$$\text{subject to } X_i(0) = X_i, \;\; X_i(T) = 0$$

$$\text{where } y_i(t) = -\dot{X}_i(t)$$

In the above maximization problem, $X_i(t)$ denotes stocks held by the *i*th large seller at time t. His initial stocks are X_i and his terminal stocks are zero. Sales at any t are denoted by $y_i(t)$ which is equal to the fall in stocks at t. If $y_i(t)$ is negative, then it is interpreted as purchase. k_i denotes the fixed cost of storage of the *i*th large seller. Since these fixed costs are not going to play any role in the subsequent analysis, we assume that $k_i = 0 \forall i$. For simplicity, we also assume that the initial stock X_i is the same for all *i*.

Each large trader chooses his sequence of sales (or purchases) $\{y_i(t)\}$ to maximize profits. The first order conditions, given by the Euler equations are

$$\dot{m}_i(t) = 0 \text{ for } i = 1,2,\ldots n. \tag{2.3}$$

Here $m_i(t)$ denotes marginal revenue of the ith large seller at time t. Using the demand equation (2.1A) we can solve (2.3) simultaneously for all i to obtain

$$\dot{y}_i(t) = -\frac{\dot{z}(t)}{n+1} \tag{2.4}$$

$$\dot{y}(t) = -\dot{z}(t)\frac{n}{n+1} \tag{2.5}$$

$$\dot{p}(t) = -\frac{\dot{z}(t)}{n+1} \tag{2.6}$$

A few comments on the maximization and the consequent solutions are now in order. First, a large seller chooses his sequence of sales and purchases $\{y_i(t)\}$ to maximize (2.2). We confine our attention to the case where the path of purchase and sales is *precommitted.* In other words, the *i*th large seller chooses his optimal path at time 0 and sticks to this path for the entire interval of time. We could alternatively assume that the seller is able to revise his optimal path at any point in time in future. This, however, would not change the solutions (see Sarkar (1993) for a formal argument).

Secondly, as is clear from equations (2.4)-(2.5), the rate of change in optimal sales and purchases of the *i*th large seller is independent of the sales or purchases of the other large sellers. The rate of change depends only on the rate of change in the market arrival of stocks from the small sellers and the *number* of large sellers in the market. The latter variable *n* is inversely related to the degree of monopoly in the market.

Thirdly, from equation (2.6) it follows that the extent of price fluctuations (as represented by the rate of change in price at any t) depends only on the extent of fluctuation in market arrival from the small sellers and the degree of monopoly. In particular, for any given fluctuation in market arrival, the higher the value of n, i.e., the lower the degree of monopoly in the market, the lower is the extent of price fluctuations. We shall have more to say on this point after we compute the equilibrium paths.

2.3 The Small Sellers' Problem

The small sellers are price takers by assumption. A representative small seller maximizes his expected profits by choosing his sequence of sales, given a sequence of expected prices. A small seller has a quadratic cost function of storage given by $\frac{\mu}{2}[H(t)]^2$, where $[H(t)]$ is the stock held at time t and μ is a constant. A small seller's problem is to

(2.7) $$\max \int_0^T [p^e(t)z(t) - \frac{\mu}{2}\{H(t)\}^2]dt$$

subject to $H(0) = H$, $H(T) = 0$

where $z(t) = -\dot{H}(t)$

In words, a small seller maximizes intertemporal profits by choosing his sequence of sales $\{z(t)\}$ given a sequence of expected prices $\{p^e(t)\}$ and given his initial stocks *H*. The Euler equation representing the first order condition is given by

(2.8) $$\dot{p}^e(t) = \mu H(t)$$

From equations (2.4), (2.5), (2.6) and (2.8) we can compute the equilibrium price sequence and the sequence of sales of the large and the small sellers. This is done in the next section.

2.4 Equilibrium under Autarky

Before we proceed to compute the equilibrium sequence of prices and sales, we give a formal definition of equilibrium. An *equilibrium* is defined as a collection $[\{y_i(t)\},\{z(t)\},\{p(t)\}]$ such that the following conditions hold:

(i) $\{y_i(t)\}$ maximizes (2.2) given $\{y_j(t)\}_{i\neq j}$ and $\{z(t)\}$ $\forall i, j$.

(ii) $\{z(t)\}$ maximizes (2.7) given $\{p^e(t)\}$.

(iii) $p^e(t) = p(t) = a - y(t) - z(t)$ $\forall t.$

Condition (iii) implies that in equilibrium price expectations are fulfilled. It also implies that

$(iii)'$ $\dot{p}^e(t) = \dot{p}(t)$ $\forall t.$

Combining condition $(iii)'$ with (2.6) and (2.8) we get

(2.9) $$-\frac{\dot{z}(t)}{n+1} = \mu H(t)$$

Equation (2.9) is a second order differential equation of the form

(2.10) $$\ddot{H}(t) - \beta H(t) = 0$$

where $\ddot{H}(t) = -\dot{z}(t),\ \ \beta = \mu(n+1).$

The general solution of (2.10) is given by

(2.11) $$H(t) = C_1 e^{-\beta t} - C_2 e^{\beta t}$$

The constants C_1, C_2 may be solved from the initial conditions as

(2.12) $$C_1 = \frac{He^{2\beta T}}{e^{2\beta T} - 1}, C_2 = \frac{H}{e^{2\beta T} - 1}$$

It may be verified from (2.11) that $-\dot{H}(t) = z(t) > 0, -\ddot{H}(t) = \dot{z}(t) < 0, -\dddot{H}(t) = \ddot{z}(t) > 0.$ In view of these, the time paths of $z(t), H(t)$ are drawn in figures IA and IB.

Finally, the time paths of $y_i(t), y(t), p(t)$ may be derived from equations (2.4), (2.5) and (2.6) along with the initial conditions. These time paths are

(2.13) $$y_i(t) = \frac{1}{n+1}[\bar{z} - z(t)] + \bar{y}_i$$

(2.14) $$y(t) = \frac{n}{n+1}[\bar{z} - z(t)] + \bar{y}$$

(2.15) $$p(t) = a - \frac{n}{n+1}\bar{z} - \frac{1}{n+1}z(t) - \bar{y}$$

where $\bar{y}_i = \frac{1}{T}\int_0^T y_i(t)dt$, $\bar{y} = \frac{1}{T}\int_0^T y(t)dt$, $\bar{z} = \frac{1}{T}\int_0^T z(t)dt$. Clearly, $\bar{y}_i, \bar{y}, \bar{z}$ are *average* sales. The detailed derivation of equations (2.13)-(2.15) is given in Appendix A. It is clear that once the time path of *z*(*t*) is determined from equation (2.11), the other time paths are known from (2.13)-(2.15). A few comments on the equilibrium time paths are now in order.

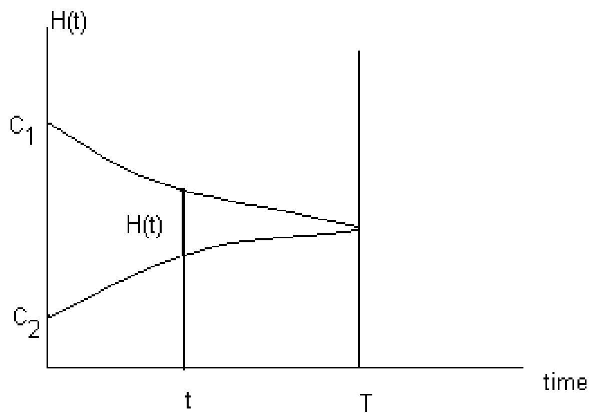

Fig IA

First, consider the optimal strategy of a large seller as given by equation (2.13). A large seller sells the average amount $\bar{y}_i$ from his own stocks at each time t; in addition, he sells an extra amount if at any t the market arrival *z*(*t*) falls short of the average market arrival $\bar{z}$. This is captured by the first term in the right hand side of equation (2.13). If, on the

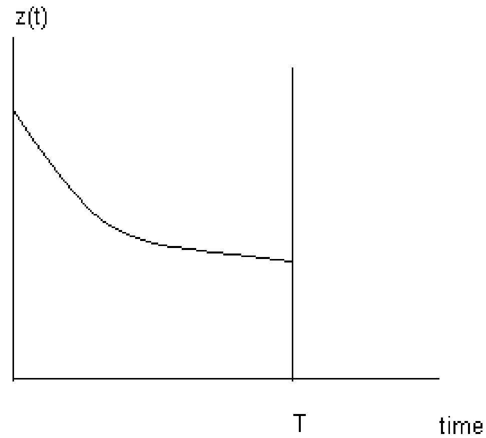

Figure IB

other hand, the actual market arrival at t is greater than the average, he withholds some stocks and sells less than $\bar{y}_i$. In the extreme case, when the actual market arrival exceeds the average market arrival by a very large amount, $y_i(t)$ becomes *negative* and in this case the large seller *buys* from the market. Clearly, through his purchase and sales over time, a large seller tends to smooth out intertemporal prices.

Secondly, to follow their optimal sequence of sales and purchases, the large sellers have to know only the average market arrival $\bar{z}$ or equivalently, the total market arrival H from the small sellers. The market arrival at any time t can, of course, be observed by a large trader at time t. In particular, a large seller neither has to know the future sequence $\{z(t)\}$ of market arrival coming from the small sellers nor the sequence of sales of other large sellers in order to follow his optimal path of sales and purchases.

Thirdly, the degree of withholding or over-releasing of stocks by the large sellers in response to the difference between actual and average market arrival depends on the degree of monopoly which is inversely related to *n.* The higher the value of *n*, i.e., the lower the degree of monopoly, the higher is the total response of the large sellers. This is clear from (2.14) where, in the right hand side, $n/(n+1)$ is increasing in *n*. In the extreme case, when $n \to \infty$, this total response is the highest and is equal to unity. In this case, whatever be the fluctuations in $\{z(t)\}$, $\{y(t)\}$ adjusts in such a way that at each point in time the average amount, i.e. $\bar{z} + \bar{y}$, is sold in the market and $p(t) = \bar{p}, \forall t.$ Here we define $\bar{p} = a - \bar{z} - \bar{y}.$ Thus, as the number of large sellers become very large, there is *perfect arbitrage* leading to perfect smoothing of intertemporal prices. The extent of arbitrage goes down and the price path exhibits fluctuations as the degree of monopoly increases.

2.5 Welfare under Autarky

Welfare, in this model, is taken to be equal to the sum of consumers' surplus and producers' surplus minus storage costs. Formally, we write welfare under autarky, *W* as

(2.16)
$$W = \int_0^T \frac{1}{2}[z(t) + y(t)]^2 \, dt \; + \; \int_0^T p(t)[z(t) + y(t)]dt \; - \; \int_0^T \frac{\mu}{2}[H(t)]^2 \, dt$$

In the right hand side of equation (2.16), the first term represents consumers' surplus, the second term represents producers' surplus and the third term represents storage costs over the time horizon [0,T]. As shown in Appendix B, the above expression may be reduced to

(2.17) $$W = T[as - \frac{1}{2}s^2 - \frac{1}{2}\frac{\sigma_z^2}{(n+1)^2}] - \int_0^T \frac{\mu}{2}[H(t)]^2\,dt$$

where $s = \bar{z} + \bar{y}$, i.e. the average stocks available in the economy, and $\sigma_z^2 = \frac{1}{T}\int_0^T [z(t) - \bar{z}]^2 dt$, is the variance of $\{z(t)\}$. It may be verified that welfare is increasing in the average stock s and falling in the variance of market arrival σ_z^2. Let $u(t)$ be the time path of sales by the small sellers when their total stock H = 1. From (2.11) and (2.12) it follows that $u(t) = \frac{z(t)}{H}$ and $\{u(t)\}$ depends only on n and μ. Let the variance of $u(t)$ be denoted by σ_u^2 where

(2.18) $$\sigma_u^2 = \frac{1}{T}\int_0^T [u(t) - \frac{1}{T}]dt$$

It immediately follows that $\sigma_z^2 = H^2\sigma_u^2$. Also, let us define

(2.19) $$\int_0^T \frac{\mu}{2}[H(t)]^2\,dt = \frac{H^2\mu}{2}\int_0^T [u(t)]^2\,dt = \frac{H^2}{2}\mu_c$$

Then the expression for welfare may be further simplified as

(2.20) $$w = [as - \frac{1}{2}s^2] - \frac{1}{2}H^2\Omega$$

where $w \equiv \frac{W}{T}$ and $\Omega \equiv [\frac{\sigma_u^2}{(n+1)^2} + \frac{\mu_c}{T}]$

In equation (2.20) w is welfare per unit of time and Ω is a constant as far as the present analysis is concerned. Moreover, s, the total stock available in the economy per unit of time, is also treated as given.

Let us now talk about land reforms. In this paper we talk about land reforms in a very simple manner. By land reforms we mean simply a redistribution of initial stocks from the large sellers to the small sellers. In other words, a land reforms measure leads to an increase in H and a fall in X, keeping $H + X$ and hence s, which is equal to $\frac{1}{T}[H + X]$, unchanged. It immediately follows from (2.20) that a measure of land reforms, leading to an increase in H, reduces welfare. Thus we have the following proposition:

<u>*Proposition 1.*</u> *A redistribution of output from the large to the small sellers unambiguously reduces welfare under autarky.*

It must be pointed out that our welfare function does not incorporate any objective of redistribution from the rich to the poor. It only gives an overall measure of efficiency. Thus redistribution can certainly come as a separate objective. Indeed, one of the main purposes of the paper is to see whether such redistribution can be implemented without significant efficiency loss. Our analysis suggests that under autarky there are indeed efficiency costs to be incurred if redistribution is to be implemented.

Why does welfare go down if there is a redistribution of output from the large to the small sellers? We have already noted that welfare is increasing in mean output, i.e. s, and falling in the variance of market arrival σ_z^2. This variance increases as the amount of stocks owned by the small sellers go up. Hence, as H goes up keeping the mean output constant, there is a fall in welfare. Actually, the large sellers' intertemporal buying and selling tend to smooth out prices. On the other hand, the small sellers contribute to price fluctuations. Therefore, redistribution in favour of the small sellers increases price variance, which, in turn, reduces welfare. Moreover, as the small sellers have positive holding costs of stocks per unit of time while the large sellers do not, efficiency requires that all stocks be held and marketed by the large sellers. Hence, on both counts, redistribution from the large to the small sellers reduces welfare. The two negative effects on welfare are captured by the two terms within square brackets in the definition of Ω. However, equity requires redistribution of stocks from the large sellers to the small sellers. Our analysis suggests that under autarky there is a trade off between the efficiency and equity.

3.1 Equilibrium Under Free Trade

We now introduce international trade into our model. We assume that the country is small with respect to the rest of the world and faces a given price p^* in the world market as trade opens up. It is also assumed that while the large sellers have free access to the international market, the small sellers do not. In other words, the large sellers can buy and sell freely in the international market, but the small sellers are constrained to buy or sell only in the domestic market. First we consider the case where the *average* market price under autarky is less than the international price, i.e. $\overline{p} < p^*$. Not surprisingly, in this case the country will emerge as an exporter of the agricultural commodity. We shall also consider below the other case where $\overline{p} \geq p^*$.

Now, under autarky, marginal revenue of a large seller is the same for all time points. Using the demand function it may be easily verified that this common marginal revenue is less than the average market price under autarky. Since $\overline{p} < p^*$ by assumption, the marginal revenue of a large seller under autarky is less than the international price. Therefore, as trade opens up, the large sellers find it profitable, on the margin, to withdraw stocks from the domestic market and sell them to the international market. In other words, the country will be a net exporter of the agricultural good.

We now proceed to determine the trade equilibrium. Suppose, for the sake of simplicity, that the large sellers make all their sales to the international market at the terminal date *T*. This is a harmless supposition because, for the large sellers, the variable cost of holding stocks is zero and the international price remains unchanged through out. Thus even if stocks were sold at intermediate dates, the profits would be the same, provided the same amount of total stocks are sold. The problem of a large seller is to

(3.1) $$\max \int_0^T \tilde{p}(t)\tilde{y}_i(t)dt \; + \; p^* X_i(T)$$

subject to $X_i(0) = X_i, \quad X_i(T)$ is free

In equation (3.1), $\widetilde{p}(t), \widetilde{y}_i(t)$ represent domestic price and domestic sales (or purchase) by the ith large seller at time t ; $X_i(T)$, the terminal stock of the ith large seller, represents the amount sold by him to the international market. Clearly, this amount has to be *determined* in equilibrium. The first order conditions, given by the Euler equations, are, as before, $\dot{m}_i(t) = 0, \forall i, t$ and the transversality condition is given by

(3.2) $$m_i(T) = p^*, \forall\, i.$$

The Euler equations yield equations (2.4)-(2.6) as before. These, along with equation (2.8), yield the same time path of $\{z(t)\}$ as obtained earlier. Intuitively, the small sellers' optimal path depend on the *rate of change* in domestic prices and not on their levels. International trade changes the level of domestic prices keeping the rate of change of prices unchanged. Hence the optimal time path of sales by the small sellers remains unchanged too.

Trade equilibrium is determined once we know how much, of the total stock available in the economy, is sold in the domestic market and how much is sold in the international market. The division of stocks between the domestic and the international markets is determined by equation (3.2). Using the demand equation, equation (3.2) may be rewritten as

(3.3) $$a - \widetilde{y}_i(t) - \widetilde{y}(t) - z(t) = p^* \quad \forall t.$$

where $\tilde{y}(t) = \sum_{i=1}^{n} \tilde{y}_i(t)$. Summing over t and dividing by T we get

(3.4) $$a - \tilde{y} - \bar{z} - p^* = \tilde{p} - p^* = \tilde{y}_i$$

where $\tilde{p}$ (which is equal to $\frac{1}{T}\int_0^T \tilde{p}(t)dt$) is the average price in the domestic market in trade equilibrium, $\tilde{y}_i$(which is equal to $\frac{1}{T}\int_0^T \tilde{y}_i(t)dt$) is the *average net sales* of the ith large seller from his own stocks to the domestic market in trade equilibrium and $\tilde{y} = \sum \tilde{y}_i$. Note that $\tilde{y}_i(t)$ could be positive, negative or zero. A large seller starts with his initial stocks and through out the time horizon [0, T] depletes this stocks by selling to the domestic market or adds to his stocks by purchasing from the domestic market. At the terminal period he is left with a stock which he sells to the international market. It is possible that the terminal stock is greater than his initial stocks. This would be the case when his initial stocks are low. In this case a large seller will be selling his *own stocks* entirely to the international market and moreover he will buy additional stocks in the domestic market and sell them in the international market. Consequently, $\tilde{y}_i$ will be negative and the large seller will be a *net buyer* in the domestic market. If, on the other hand, his own stocks are large enough, he will sell part of it to the domestic market and the remaining to the international market. In this case, $\tilde{y}_i$ will be positive and the large seller will emerge as a *net seller* in the domestic market. In the borderline case where he is neither a net buyer nor a net seller in the domestic market, and sells his entire stocks in the international market, $\tilde{y}_i = 0$. It should be pointed out that if a large seller is a net buyer from the domestic market, it *does not* mean that he never sells anything in the home market. The fact that he is a net buyer simply means that the *total* amount he sells to the home market is *less than* the *total* amount he buys from the home market. Similarly, if he is a net seller, then his total sales to the home market exceeds his total purchase from the home market.

To see these things more clearly, note that from (3.3) we get

$$(3.5) \qquad \tilde{y} = \frac{n}{n+1}[a - \bar{z} - p^*]$$

In the extreme case, if $\bar{z} = s$, i.e. all stocks are initially held by small sellers, then the expression within square brackets is negative (since in this case, $a - \bar{z} = \bar{p} < p^*$ by assumption) and consequently each large seller is a net buyer from the domestic market. At the other extreme, if $\bar{z} = 0$, i.e. all stocks are held by the large traders, then $\tilde{y} > 0$, assuming, of course, $a > p^*$. In general, given a constant *s*, as the share of large sellers in total stocks goes down, they tend to become net buyers from the home market.

Since the right hand side of (3.4) is given, equation (3.4) determines $\tilde{y}$. Then the time paths of domestic prices and sales (or purchases) of the large sellers in trade equilibrium may be determined as before using the fact that $\int_0^T \tilde{y}(t)dt = T\tilde{y}$. The solutions are given by

$$(3.6) \qquad \tilde{y}_i(t) = \frac{1}{n+1}[\bar{z} - z(t)] + \tilde{y}_i$$

(3.7) $$\tilde{y}(t) = \frac{n}{n+1}[\bar{z} - z(t)] + \tilde{y}$$

(3.8) $$\tilde{p}(t) = a - \frac{n}{n+1}\bar{z} - \frac{1}{n+1}z(t) - \tilde{y}$$

The solutions imply that the time paths under autarky and trade differ only with respect to their *levels*. In particular, it may be easily verified that the autarky domestic price lies below the domestic price level under free trade *for all t.* However, in view of equation (3.4) and (3.5), the average domestic price in trade equilibrium may lie above or below the international price depending upon whether the large sellers are net sellers or net buyers in the domestic market. This leads to the following proposition:

Proposition 2. *If the international price is greater than the average domestic price under autarky, then as trade opens up, domestic price increases. However, the average domestic price in trade equilibrium lies above or below the international price according as the large sellers are net sellers or net buyers in the domestic market.*

The intuition behind the second part of the proposition is that if large sellers are net buyers, to earn monopsony profits, they keep the domestic price below the international price. Similarly, if they are net sellers, to earn monopoly profits, they keep the domestic price above the international price.

We end this section by considering the case where $\overline{p} \geq p*$. First consider the case where the average domestic price under autarky is exactly equal to the international price. To determine the pattern of trade, note that the marginal revenue of a large seller under autarky is given by

(3.9) $$m_i(t) = \overline{p} - \overline{y}_i$$

Since $\overline{p} = p*$, it follows that on the margin a large seller will gain by withdrawing stocks from the domestic market and selling them in the international market. In other words, barring the extreme case where the large sellers do not possess any stocks initially, i.e. $\overline{y}_i = 0$, the country will be an exporter of the agricultural good even if the autarky price and the international prices are the same. Clearly, this happens due to imperfect competition in the domestic market. Next consider the case where $\overline{p} > p*$. Even in this case, if the two prices are sufficiently close and/or $\overline{y}_i$ is sufficiently high, the marginal revenue under autarky may be less than the international price and the country will emerge as an exporter. Only when $\overline{p}$ is sufficiently higher than $p*$, the country will start importing the agricultural good. The basic point to note is that even for $\overline{p} \geq p*$, if the difference between the two prices is small, the country might emerge as an exporter though comparative advantage dictates otherwise. The determination of time paths of domestic prices and sales (or purchases) may be derived in the same way as done above and will not be repeated here. Our results regarding the pattern of trade is summarized in the following proposition:

<u>Proposition3</u>. If the average autarky price lies below the international price, the country exports the agricultural good in trade equilibrium. If the average autarky price is equal to the international price, the country still exports the agricultural good. If the average autarky price is greater, the country will import the good provided the difference between the two prices is sufficiently large. If the difference is small, the country may export the good.

3.2 Welfare Comparisons of Free Trade and Autarky

As under autarky, welfare in free trade equilibrium is given by the sum of consumers' surplus and producers' surplus minus storage costs. The only difference is that in trade equilibrium the producers' surplus consists of profit from domestic sales as well as sales to the international market. Let us first assume that $\overline{p} < p^*$ so that the country is a net exporter of the agricultural good. Consequently, welfare, in trade equilibrium, is given by

(3.10) $$\widetilde{W} = \int_0^T \frac{1}{2}[\widetilde{y}(t) + z(t)]^2 \, dt + \int \widetilde{p}(t)[\widetilde{y}(t) + z(t)]dt + p^*[S - \widetilde{S}] - \int_0^T \frac{\mu}{2}[H(t)]^2 \, dt$$

where $S, \widetilde{S}$ denote total stocks and stocks sold to the domestic consumers respectively. Clearly, $[S - \widetilde{S}]$ represents total exports. Analogous to equation (2.20), the above expression may be written as

(3.11) $$\widetilde{w} = [a\widetilde{s} - \frac{1}{2}\widetilde{s}^2] - \frac{1}{2}H^2\Omega + p^*(s - \widetilde{s})$$

where $\widetilde{w} = \frac{1}{T}\widetilde{W}, s = \frac{1}{T}S, \widetilde{s} = \frac{1}{T}\widetilde{S}$ and Ω is defined as before. To analyze gains from trade, we have to compare (3.11) with (2.20). First note that from (2.20) $\frac{dw}{dH} = -H\Omega < 0$ so that autarkic welfare as a function of the stocks held by the small sellers may be represented as a downward sloping straight line as shown in figures IIA and IIB. Next note that from (3.11),

(3.12) $$\frac{d\widetilde{w}}{dH} = \frac{\widetilde{p} - p^*}{T(n+1)} - H\Omega$$

Clearly, at $H = 0$, the right hand side of (3.12) is positive. On the other hand, at $H = S$, the large sellers are net buyers in the home market and hence by proposition 2, $\widetilde{p} < p^*$ so that the right hand side of (3.12) is negative. Thus, there is an H^* such that at $H = H^*$, the right hand side of (3.12) is zero. Next, subtracting (3.11) from (2.20) we get

(3.13) $$w - \widetilde{w} = (s - \widetilde{s})[(\widetilde{p} - p^*) - \frac{1}{2}(s - \widetilde{s})]$$

Now suppose that $\bar{z}$ is close to s, i.e. almost all the stocks are initially owned by the small sellers. In this case the large sellers will be net buyers in the home market and by proposition 2, $\widetilde{p} < p^*$. From (3.13) it then follows that $w < \widetilde{w}$. In other words, when the small sellers initially own most of the stocks, autarky welfare will be less than welfare under trade. Thus, around $H = S$, the $\tilde{w}(H)$ curve will lie above the $w(H)$ curve as shown in figures IIA and IIB. This leads to the following proposition:

Proposition4. *If output is sufficiently redistributed, i.e. the small sellers hold a sufficiently high proportion of the total stocks, then free international trade is better than autarky.*

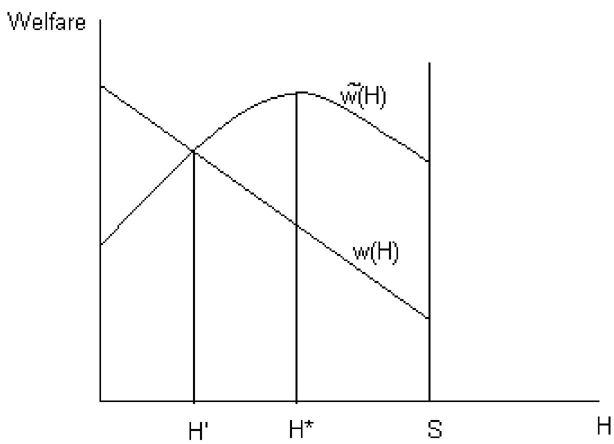

Fig IIA

Next, note that around $H = S$, $\left|\frac{d\tilde{w}}{dH}\right| > \left|\frac{dw}{dH}\right|$ so that if the $w(H)$ line intersects the $\tilde{w}(H)$ curve at all, the point of intersection lies to the left of H^* (figure IIA). Or else the two curves do not intersect at all $\forall H \varepsilon [0,S]$ (figure IIB). Presently we will show that either the trade curve lies above the autarky curve for all H or they intersect only once. We will also derive the condition under which the two cases occur.

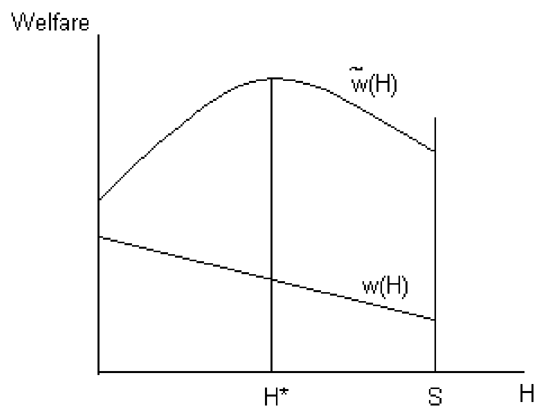

Fig IIB

The sign of the right hand side of (3.13) depends on the sign of the term within square brackets as long as the country is an exporter, i.e. $(s - \tilde{s}) > 0$. In Appendix C we show that the sign of the term within square brackets on the right hand side of (3.13) depends on the sign of $[\bar{y} - (n+2)\delta]$ where $\delta = p^* - \bar{p}$. In other words

(3.14) $$w \le \tilde{w} \Leftrightarrow [\bar{y} - (n+2)\delta] \le 0$$

where the equality sign prevailing in one expression implies that equality prevails in the other. Clearly, if the two welfare curves intersect, as in figure IIA, they intersect at $\bar{y} = (n+2)\delta$ which gives a specific value of H denoted by H' in figure IIA. This means that the point of intersection, provided there is one, is unique. It is also clear that if δ, the difference between the international price and the domestic price under autarky, is large, then the welfare curve in trade equilibrium lies above the welfare curve under autarky for all values of *H*. This case is depicted in figure IIB. Thus, to conclude, for small values of δ the two curves intersect and for sufficiently large values the trade welfare curve lies above through out. It may also be verified that as long as $\delta > 0$, it is not possible for the trade welfare curve to lie below the autarky welfare curve for all *H*. It follows from our analysis that the trade welfare curve lies above the autarky welfare curve for all *H* (figure IIB) if $\delta > \frac{s}{n+2}$ and the two curves intersect at some $H \geq 0$ if $\delta \leq \frac{s}{n+2}$ (figure IIA).

We are now in a position to talk about gains from trade. First consider figure IIA. Suppose land distribution is such that $H < H'$. Then, opening up of trade reduces welfare. On the other hand, if trade is not opened up, but there are land reforms leading to an increase in *H*, welfare unambiguously goes down (i.e. the country moves along the *w*(*H*) curve). In other words, when implemented *in isolation*, either trade reform or land reform reduces welfare. However, if the two reforms are implemented simultaneously, the country moves along the $\tilde{w}(H)$ curve to *H** where welfare is maximized. Welfare at this maximizing point may very well be greater than that under autarky. Indeed, if the difference between the autarky and the international price is not very small, welfare under trade at *H** will be greater than welfare under autarky for any *H*. We say that the two reforms are *strictly complementary* if the two welfare curves intersect and initially $H < H'$. If $H' < H < H^*$, then free trade increases welfare independent of any land reforms. But if the aim is to implement land reforms, then this aim can be implemented without any welfare cost if the country opens up to trade. Thus, in this case, successful implementation of land reforms would depend upon trade reforms, i.e. the opening up of trade. The same comments apply to the situation in figure IIB where the trade welfare curve lies above the autarky welfare curve for all *H.* In either case, we ignore the situation where $H > H^*$ because our concern is restricted to less developed countries with sufficiently skewed distribution of income in the agricultural sector. We summarize our findings in the following proposition:

Proposition5. *Suppose the difference between the autarky and the international price is not very large, i.e.* $\delta < \frac{s}{n+2}$. *Then if the initial share of output of the small sellers is not very large, i.e. less than* H', *then the two reforms are strictly complementary. If* $\delta \geq \frac{s}{n+2}$, *land reforms lead to welfare gains if trade reforms are simultaneously implemented, provided the initial share of output of the small sellers does not exceed the optimum* H^*.

We may now consider the case where $p^* \leq \bar{p}$. First consider the case where the two prices are equal. We have already seen that in this case the country will be an exporter of the agricultural good provided $H < S$. Consequently, from (3.14), $w > \tilde{w}$ (since $\delta = 0$) for $\bar{y} > 0$. Only at $\bar{y} = 0$, or alternatively, $H = S$, the two welfare levels are equal. Hence, if the international price is equal to the autarky price, the trade welfare curve lies below the autarky welfare curve for all $H < S$ and only at $H = S$ the two curves intersect. This is shown in figure III.

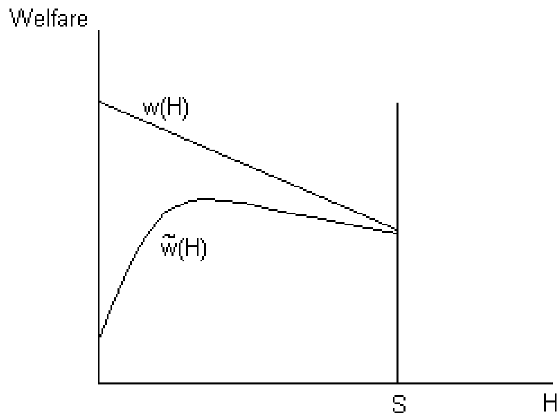

Fig III

Finally consider the case where $p^* < \overline{p}$. If the difference between the two prices is sufficiently large, the country will be an importer at all *H* and in (3.13) $(s-\widetilde{s})$ would be negative. This, along with the fact that $\delta < 0, \overline{y} > 0$ imply that the trade welfare curve lies above the autarky welfare curve for all *H.* So we are in a situation similar to figure IIB. If, on the other hand, the difference between $\overline{p}$ and p^* is small, then for low *H*, the country will be an exporter and $\widetilde{w} < w$. So, in this case, we are in a situation similar to figure IIA. In other words, in the case where $p^* < \overline{p}$, the welfare curves intersect if the difference between the two prices is not very large; the trade welfare dominates autarky welfare for all *H* if the difference is large. Hence our earlier comments regarding the complementarity of the two types of reforms apply in this case as well.

We may now discuss the intuition behind our results. First note that under autarky, redistribution from the large to the small always reduces welfare in our model. In a standard model, as a market gets more oligopolistic, there is a loss in welfare. But this loss in welfare is due to the *fall in output* resulting from the shrinkage of the competitive fringe and an expansion of the monopolistic fringe. In the present model, since total output is given, such effects are absent. On the other hand, in the present context, the large sellers smooth out the price through intertemporal trade and this increases welfare. Thus the net effect of redistribution from the large to the small increases the variability of the price path which is welfare reducing. As trade opens up, the standard monopoly effect comes into play. The oligopolistic large sellers act as discriminating monopolists selling at a higher price in the domestic market which is achieved by restricting domestic sales below the optimum level. So, on one count, welfare falls as the share of output of the large sellers increases. On the other hand, the large sellers still smooth out intertemporal prices and on this count a redistribution from the large to the small reduces welfare like under autarky. The two opposing effects lead to an *optimum distribution* denoted by H^* in figures IIA and IIB.

4. Government Intervention

We had so far been talking about free trade and autarky. We shall now talk about optimal interventions by the government. In particular, we shall discuss the desirability of the kind of interventions, e.g. export quotas or international trade through government agencies, that have been criticized by the proponents of free trade. Not surprisingly, it turns out that some government intervention is optimal, given the distortion created by the existence of oligopolistic traders.

Let us consider equation (3.11) which represents welfare after international trade opens up. For any given *H*, suppose the government chooses the optimal $\tilde{s}$, i.e. domestic sales, to maximize welfare. The actual choice of domestic sales may be implemented through appropriate policies which we shall discuss later. The first order condition, implied by this maximization, yields

$$(4.1) \qquad \frac{d\tilde{w}}{d\tilde{s}} = \tilde{p} - p^* = 0$$

This is what we should expect. Welfare is maximized at the point where the domestic price is equated to the international price. The government, through an appropriate policy has to fix $\tilde{s}$ in such a way that the corresponding $\tilde{p}$ is equal to the international price. Suppose the government makes the optimal choice at all levels of *H*. We know from equation (3.12) that at $\tilde{p} = p^*$, $\frac{d\tilde{w}}{dH} < 0$. Thus, if the government makes the optimal choice of $\tilde{s}$ for all *H*, the function $\hat{w}(H)$, which represents welfare for different levels of *H with optimal government intervention*, will lie above the free trade welfare curve whenever under free trade $\tilde{p} \neq p^*$. Now, noting that $\tilde{p} = a - \bar{z} - \tilde{y}$ and using (3.5), it is straight forward to verify that $\tilde{p} = p^* \Leftrightarrow \bar{z} = a - p^*$. In other words, under free trade, the domestic and the international prices are equal only at a unique value of *H*, say $\overline{H}$. At this level of *H*, welfare under free trade and welfare under trade with optimal government intervention will be the same. At all other points, the $\hat{w}(H)$ curve will lie above the

$\tilde{w}(H)$ curve. This is shown in figure IV. The $\overline{H}$ point will lie to the right of H^* because at the later point $\tilde{p} > p^*$ and the domestic price falls as H increases. Also the slope of the $\hat{w}(H)$ curve is $-\Omega$ and so the $\hat{w}(H)$ curve and the $w(H)$ curve will be parallel.

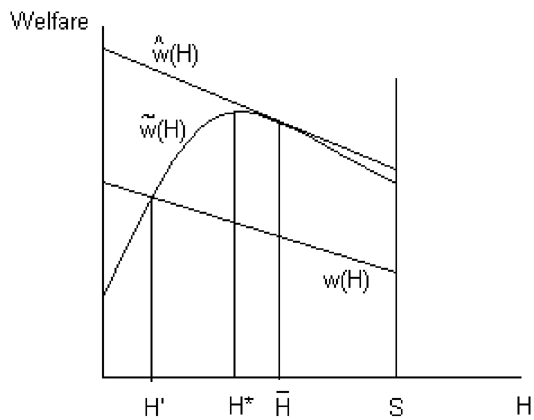

Fig IV

Now suppose that we start with a skewed distribution of agricultural output so that $H < \overline{H}$. Clearly, free trade will not be optimal in this case and optimal government intervention will be desirable. In other words, free trade without any government intervention can be advocated only if we have sufficient land reforms to start with, i.e. only if we have $H = \overline{H}$. It should also be pointed out that the welfare loss due to free trade, as measured by the vertical gap between $\hat{w}(H)$ and $\tilde{w}(H)$, goes down as output is redistributed from the large to the small sellers. Proposition 6 is immediate.

<u>Proposition 6.</u> *If distribution is not at the optimum, government intervention is superior to free trade.*

Given that it is optimal for the government to choose domestic sales, the question arises as to what specific policies should be adopted to fix $\tilde{s}$? We concentrate only on the case where distribution is sufficiently skewed, i.e. $H < \overline{H}$. First, consider the case where the country is a net exporter and the large sellers sell positive amounts to the domestic market from their *own stocks*. Of course, this will be the case when H is low. In this case, under free trade, $\tilde{p} > p^*$ and to achieve the optimal domestic sales have to be increased. Clearly, this can be achieved through an appropriate *export quota*. The size of the required export quota will go down as there is land reform leading to an increase in H. Also, if the country is a net importer and $\tilde{p} > p^*$, once more a higher output has to be sold in the domestic market than under free trade. Since the large sellers will not be willing to undertake this additional import, the government would have to undertake this import through its *own agencies*. In other words, as long as there are distortions in the trade of agricultural goods, we need to have precisely those government interventions which have been criticized by the proponents of free trade.

Before ending this section, let us point out that like under free trade, it is easier to pursue land reforms under restricted trade than under autarky. Suppose the initial distribution is denoted by H_0, as shown in figure IV, and the government wants to improve it to H_1. Under autarky, this measure leads to a welfare loss. But with optimally restricted trade, the welfare level actually goes up if land reform and restricted trade are implemented simultaneously.

5. Concluding Remarks

In this paper we looked at the effects of two types of economic reforms on the level of welfare of a less developed agricultural economy which is characterized by an oligopolistic product market. The first is land reform redistributing output from the large to the small farmers; the second is trade reform leading to the opening up of the domestic agricultural market to the rest of the world. The main conclusions we drew from our analysis were as follows.

Firstly, we showed that if initial distribution of output is sufficiently skewed and the difference between the average autarky price and the international price is not very large, then there is a strict complementarity between the opening up of free trade and redistribution of output. Undertaken in isolation, each leads to a loss in welfare, but if undertaken jointly, welfare unambiguously increases.

Secondly, if the difference between the autarky and international prices is large, then free trade welfare is always greater than welfare under autarky. Indeed, the higher is the difference between international and autarky prices, the higher is the gain from free trade for any given distribution of output. Moreover, the trade off between redistribution and welfare loss disappears once free trade is opened up. Thus if the economy is open, it becomes easier to pursue land reforms.

Thirdly, restricted trade with optimal government intervention in general dominates free trade; government intervention can be totally removed only if distribution attains a certain optimum level. On this count, too, proper land reform is a prerequisite for the optimality of free trade.

Fourthly, as compared to autarky, restricted trade also makes land reforms easier, for the latter increases the welfare level and hence reduces the welfare cost of land reforms.

To make our model tractable, we made a number of simplifying assumptions. Firstly, we assumed that while the small sellers have a positive and rising marginal cost of holding per unit of stock per unit of time, the large sellers have zero costs. The analysis, however, goes through, though at the cost of complicating the algebra, if both types of sellers have positive costs but the cost of holding for the large sellers is lower. Similar simplifications were made by assuming that demand is linear and that the discount rate is zero. Once more, non-linear demand or positive discount rates could be brought in, but only at the cost of making the analysis messy.

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Appendix A

Derivation of equations (2.13)-(2.15):

We have, by definition,

(A.1) $$z(t) = z(0) + \int_0^t \dot{z}(\tau)d\tau$$

(A.2) $$y_i(t) = y_i(0) + \int_0^t \dot{y}_i(\tau)d\tau$$

Hence $$y_i(t) = y_i(0) - \frac{n}{n+1}\int_0^t \dot{z}(\tau)d\tau \quad \text{[using equation (2.5)]}$$

(A.3) $$= y_i(0) - \frac{n}{n+1}[z(t) - z(0)] \quad \text{[from (A.1)]}$$

Hence, integrating over *T*, and dividing both sides by T, we get

$$\frac{1}{T}\int_0^T y_i(t)dt = y_i(0) - \frac{n}{n+1}\frac{1}{T}\int_0^T z(t)dt + \frac{n}{n+1}z(0)$$

Substituting the value of $y_i(0)$ from (A.3) and using the definitions of $\bar{y}_i, \bar{z}$ the above expression becomes

(A.4) $$\bar{y}_i = y_i(t) + \frac{n}{n+1}[z(t) - \bar{z}$$

which is nothing but equation (2.13). Summing (A.4) over *n* we get equation (2.14). Finally, from (2.14) and the demand equation we get (2.15).

Appendix B

Derivation of equation (2.17):

From equation (2.14) we have

(B.1) $$y(t) + z(t) = \frac{n}{n+1}\bar{z} + \frac{1}{n+1}z(t) + \bar{y}$$

Now, consumers' surplus = $\frac{1}{2}\int_0^T [y(t) + z(t)]^2 dt$

Similarly, producers' surplus = $\int_0^T [a - \{y(t) + z(t)\}][y(t) + z(t)]dt$

$$= a\int_0^T [y(t) + z(t)]dt - \int_0^T [y(t) + z(t)]^2 dt$$

Hence consumers' surplus + producers' surplus

(B.2) $$= aS - \frac{1}{2}\int_0^T [y(t) + z(t)]^2 dt$$

where $S = X + H$, the total stocks available in the economy. Using (B.1), we may write, after some straight forward algebraic manipulations,

(B.3) $$\int_0^T [y(t) + z(t)]^2 dt = T\frac{\sigma_z^2}{(n+1)^2} + Ts^2$$

where $s = \frac{S}{T}$ and $\sigma_z^2 = \frac{1}{T}\int_0^T [z(t) - \bar{z}]^2 dt$. Equation (2.17) follows directly from (B.2) and (B.3).

Appendix C

Derivation of equation (3.14):

The sign of $(w - \widetilde{w})$ depends on the sign of $\{(\widetilde{p} - p^*) - (s - \widetilde{s})\}$. Now from equation (3.4), $(\widetilde{p} - p^*) = \widetilde{y}_i$ and by definition, $(s - \widetilde{s}) = (\bar{y} - \widetilde{y})$. Hence it is sufficient to look at the sign of $\{\widetilde{y}_i - \frac{1}{2}(\bar{y} - \widetilde{y})\}$. Using equation (3.5) and the fact that $\bar{y} = a - \bar{z} - \bar{p}$, it is straight forward to show that the required sign depends on the sign of $[\bar{y} - (n+2)\delta]$, where $\delta = (p^* - \bar{p})$.