



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

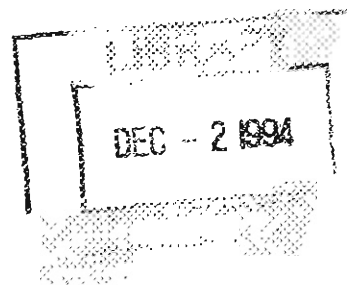
<http://ageconsearch.umn.edu>

aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

CORNELL

WP 94-06
June 1994



Working Paper

Department of Agricultural, Resource, and Managerial Economics
Cornell University, Ithaca, New York 14853-7801 USA

**CAN PRICE SUPPORTS NEGATE THE
SOCIAL GAINS FROM PUBLIC RESEARCH
EXPENDITURES IN AGRICULTURE?**

**Harry de Gorter
and
Johan Swinnen**



It is the policy of Cornell University actively to support equality of educational and employment opportunity. No person shall be denied admission to any educational program or activity or be denied employment on the basis of any legally prohibited discrimination involving, but not limited to, such factors as race, color, creed, religion, national or ethnic origin, sex, age or handicap. The University is committed to the maintenance of affirmative action programs which will assure the continuation of such equality of opportunity.

**Can Price Supports Negate the Social Gains from Public
Research Expenditures in Agriculture?**

Harry de Gorter
Department of Agricultural, Resource and Managerial Economics
Cornell University
448 Warren Hall
Ithaca, NY 14853

and

Johan F.M. Swinnen
Department of Agricultural Economics
K.U. Leuven
Kardinaal Mercierlaaan 92
3001 Leuven, Belgium

Abstract

The burgeoning literature on how the benefits from research may be negative for a given price support arbitrarily ignores the costs of price supports for a given level of research. Furthermore, the very existence of price supports is inconsistent with the normative criterion that governments simply maximize social income. We show that there are always gains from research, even if governments maximize social income subject to a farm income goal. Our results are also consistent with the statements made by Schultz and Ruttan that ignoring price supports will result in an over (or under) valuation of research benefits. Finally, we indicate that the predictions of the "no gains from research" literature may not be substantiated by empirical evidence and that the ideal normative model should include endogenous farm income levels as well.

June 1994

Handwritten text at the top of the page, possibly a title or header.

Handwritten text in the upper middle section of the page.

Handwritten text in the middle section of the page, appearing as a list or series of entries.

Small handwritten text or mark in the center of the page.

Large handwritten text block in the lower middle section of the page.

Small handwritten text or mark at the bottom of the page.

Can Price Supports Negate the Social Gains from Public Research Expenditures in Agriculture?¹

Two recent papers in the *Journal of Public Economics* emphasize how commodity price support programs reduce the social benefits from public investments in agricultural research (Murphy, Furtan and Schmitz; Chambers and Lopez). Murphy, Furtan and Schmitz (MFS) formally calculate the conditions under which the "no-gains-from-research-point" (NGFRP) is achieved for an exporter employing export subsidies. Chambers and Lopez do likewise for an offer to purchase price support program. A NGFRP is obtained when the increase in the deadweight cost of a price support due to public research expenditures is equal to the social benefits from research without price supports. The NGFRP literature concludes that the social return to public agricultural research investments are not only lower but also can be easily negative with commodity policy.²

The policy implications derived from these papers are very significant. MFS and Chambers and Lopez question both the validity of past studies showing high returns to public research expenditures and why governments continue to invest in agricultural research. MFS (p. 162) question the returns to research:

"Why ... continue investing in agricultural research ... if the major impact is ... additional export subsidies? Are the results from past studies showing impressive returns to research still valid?"

Chambers and Lopez (p. 74) argue further:

"... [E]ven as it was argued that public agricultural investment was too low, the world witnessed chronic overproduction of these protected agricultural commodities... [A]gricultural programs will induce a *negative* social rate of return to public investment ... [C]urrent public investment levels in agriculture will be too high rather than too low..."

This paper critically evaluates the main thesis of this NGFRP literature and comes to a

¹ Helpful comments by participants in seminars at Berkeley and Davis are greatly appreciated.

² The idea that commodity policy affects benefits to agricultural research expenditures is not new. For an excellent synthesis and overview of this literature, see Alston, Edwards and Freebairn.

significantly different conclusion. We argue that policy makers should not be advised to question the benefits from public research in the presence of price support programs. This paper shows that the NGFRP result does not hold under a broader and, as we will argue, more appropriate framework. We analyze optimal public research expenditures with price supports under two alternative assumptions regarding the motive of government: (1) maximize national income (which is also the assumption in the NGFRP literature); and (2) maximize national income subject to a farm income constraint. We show that in most circumstances there are always "gross benefits" from public research expenditures with price supports, regardless of the government's motive. This means that the NGFRP result defined specifically by MFS never holds.

We begin by showing under the normative criterion of governments maximizing total income that price supports cannot negate the benefits of public research expenditures. We argue that the NGFRP literature emphasizes the effects of price supports on the benefits from research while ignoring the reverse. Because research and commodity policy exist simultaneously, there is no reason *a priori* to calculate the returns to research with commodity policy fixed and then not calculate the social costs of commodity policy assuming research investments are fixed. With governments maximizing social income, we conclude that the only consistent approach is to calculate the social benefits (costs) of each policy on their own. One should therefore attribute the social costs of price supports to the commodity policy itself and not to the public research investment. The implication is that there is always gains to research.

Further, while the NGFRP literature attribute the idea to Schultz and Ruttan, this may be misleading. For example, Schultz (p. 586) states:

"Western Europe and Japan overprice farm products, and as a consequence the economic value of research is thereby overvalued. The high internal price of rice in Japan is a misleading indicator of the real value the research adds to income"

We show that ignoring price supports when calculating benefits from research can generate either an overvaluation or an undervaluation of the social benefits from research. However, this is shown to be very different from concluding that the social benefits from research can go negative. We interpret the statements made by Schultz and Ruttan to imply that economists are not accurately measuring the benefits to research with price supports if the latter are ignored in the analysis. We maintain, however, that in no way can one attribute the costs of price supports to public research expenditures and conclude that it may not be socially beneficial to have any research expenditures at all.³ Our analysis is therefore consistent with the statements made by Schultz and Ruttan.

However, if the true objective of government is to maximize national income, one would not observe price policy in the first place. The normative question posed in the NGFRP literature is inconsistent: one cannot evaluate the social welfare effects of research with commodity policy in place and make normative statements as if the implementation of commodity policy itself fulfills the same normative criteria. One has to ask why the commodity policy exists in the first place. The only way to reconcile this apparent contradiction is to conclude that the unconstrained maximum of national income may not be the true goal of governments. We therefore develop a model of a government maximizing net social income subject to a minimum farm income constraint. We determine that the NGFRP as defined by MFS does not hold in this more realistic scenario.

This paper develops these two perspectives on analyzing the implications of the twin policies of price supports and public research expenditures as follows: the next section closely evaluates the logic of the NGFRP literature and raises several issues regarding the pertinence

³ On the contrary, we argue that it is better to question the continuation of price supports than to question the existence of research expenditures. There is a possibility of overvaluation of research benefits if the existence of price supports is ignored in the analysis. But this does not alter our conclusion that there is always gains from research.

of this literature's policy conclusions. In Section 3, we derive the NGFRP under the more realistic (and consistent) assumption that governments maximize net social income subject to a farm income goal. The results are that the NGFRP does not exist for the general case of a parallel shift in the supply curve and is far less likely under the special case of a pivotal supply curve shift. A brief discussion on the stylized facts about price supports and research expenditures in relation to the predictions made by MFS is given at the end of section 3. The final section summarizes the implications of these two perspectives offered in this paper and compares them to that of the NGFRP literature. Ideas for further research priorities are also offered.

2. "The *Gains* from Agricultural Research or the *Costs* from Distorted Trade"?

We begin by maintaining the assumption of the NGFRP literature that the government's objective is to maximize social income. The NGFRP literature evaluates the effects of price supports on the *benefits* from research, taking the price support as given and attributing changes in social welfare to the research policy. Another approach would be to do the opposite and evaluate the *costs* of price supports, taking research expenditures as given. Does it make a difference which way you look at it? We show in this section that it does, with important implications for policy analysis. We then attempt to determine which method is appropriate. We conclude that analyzing the effects of one policy (eg, research) while keeping the other policy fixed (eg, price supports) generates misleading policy conclusions and hence is an inappropriate method to analyze commodity and research policy together.

Figure 1 depicts the effect of the dual public policy of research expenditures and a price support P^i with export subsidies. Research expenditures cause the supply curve S_0 to pivot to S_1 . This example is taken from MFS but we make several assumptions to keep the analysis tractable in this section of the paper: (1) there are no international terms of trade effects (with

either the price support or research expenditures); and (2) there are no effects of the price support on the deadweight costs of raising tax revenues and distorting consumption. Ignoring terms of trade effects implies that the world price P^w is fixed and ignoring deadweight costs in consumption implies the domestic demand curve (not shown) is vertical. Neither of these assumptions detract from the objectives of this paper but merely represent specific augmentations of the analysis.⁴

With respect to Figure 1, Alston, Edwards and Freebairn's analysis would take the benefits from research before price supports (area a) and subtract it from the benefits from research with price supports (area $a + b + c - (c + d)$ where area $(c + d)$ is the added taxpayer costs of the price support due to research). The net social benefits of research would therefore be area $b - d$ which in the case of Figure 1 is negative but in general could be either $< =$, or > 0 (see column 6 of Table 1 in Alston, Edwards and Freebairn).⁵

The papers by MFS and Chambers and Lopez go one step further and determine whether or not this net social loss in research benefits (area $b - d$ in Figure 1) is greater than the social benefits of research before price supports are even introduced (area a). This literature on how price supports affect the benefits from research undertake their analysis under the assumption that the *price support is given*. This approach is illustrated in section [A] of Table 1. With research expenditures equal to zero, producer surplus is area $g + e$ in Figure 1 while the cost of the price support *cum* export subsidy to consumers/taxpayers is area $e + b$. Introducing research expenditures causes the supply curve to pivot to S_r , resulting in an increase in producer

⁴ Chambers and Lopez statement (p. 79) that the "terms of trade effect reinforces the likelihood of immiserizing growth" is usually true so we abstract from the terms of trade effects in this section of the paper to simplify the analysis in showing the logic of our arguments.

⁵ In very specific circumstances, it is possible for price supports to have a positive effect on the benefits from research. In practical terms, however, most of the major price support schemes in U.S. agriculture for the major field crops, dairy and sugar sectors correspond to the case where price interventions in favor of farmers tend to *decrease* the social benefits from research. Consequently, there is an emphasis on the "no-gains" rather than the "enhanced-gains" from research.

surplus of area $a + b + c$ and an increase in the costs to consumer/taxpayers of area $c + d$.^{6,7} The net change in social welfare is area $a + b - d$ which can be either positive or negative. The no-gains-from-research-point is when area $a + b = d$ (MFS; Chambers and Lopez). If area d is greater than area b , then the effect of the price support on research gains is negative (see column 6 of Table 1 in Alston, Edwards and Freebairn). The bottom line for this literature is that price supports can affect research gains and when they do, it inevitably reduces the gains to research and perhaps even resulting in negative gains to research (the latter emphasized by MFS and Chambers and Lopez).⁸

Let us now do the opposite of the above analysis by assuming that research expenditures are fixed and analyze the social welfare effects of introducing a price support (section [B] in Table 1). The change in producer surplus is area $e + b + c$ while the change in consumer/taxpayer costs are area $e + b + c + d$, resulting in a decrease in net social welfare of area d . In this case, there is an unequivocal decrease in social welfare. This result is the opposite to that obtained in the NGFRP literature.

Which analysis is correct - assuming the price support is given and evaluate the net social benefits (or costs) of introducing research expenditures (as in [A] of Table 1) or the opposite? One way of getting out of this dilemma is to determine which policy was implemented first.

⁶ As in Alston, Edwards and Freebairn and in MFS, we ignore the tax costs of research expenditures themselves and the associated deadweight costs of raising taxes. Likewise, the analysis ignores the fact that there are declining returns to research. For a more complete model incorporating these features, see de Gorter and Zilberman.

⁷ Notice in Figure 1 that we arbitrarily depict the effect of research to pivot the supply curve. Whether the supply curve shift is pivotal or parallel is immaterial to the main point of this paper. Both types of shifts are discussed in MFS and in Alston, Edwards and Freebairn. Alston, Edwards and Freebairn assume a parallel shift in the supply curve due to research so the net effect of price supports on research gains is reported to be zero in their Table 1 for a small country export subsidy. The NGFRP for an export subsidy with a parallel supply shift in MFS is possible only if there are terms of trade effects.

⁸ Chambers and Lopez show that there are always no gains from research in the case of no export opportunities for a price support *cum* offer to purchase scheme, regardless of the nature of the supply curve shift. In terms of Figure 1, this means that area $a + b$ is always less than area $d + b$. Chambers and Lopez state further in their section 5 that there always exists a NGFRP even with trade possibilities, a situation shown to be exacerbated if there are any (adverse) terms of trade effects associated with the surplus disposal.

Because public research expenditures for agriculture in the United States was first introduced by President Lincoln in 1862 while price support legislation was first implemented by President Roosevelt in 1933, one could easily conclude that [B] in Table 1 is the appropriate method of analysis. However, such a determination is unsatisfactory because both public policies are observed simultaneously in the past six decades and so must now be analyzed jointly rather than recursively in either *ex post* or *ex ante* analysis.⁹

Another possible way of getting out of this logjam is to evaluate the welfare effects of both policies jointly. Producer surplus with neither research expenditures nor price supports is area g while consumer/taxpayer costs are zero. Introducing both research expenditures and price supports increases producer surplus by area $e + a + b + c$ and consumer/taxpayer costs by area $e + b + c + d$. The net change in social welfare is area $a - d$ which can be either positive or negative. This outcome is expected because price supports introduce welfare losses while research expenditures are socially beneficial. However, such an analysis does not inform public policy makers as to the source of the costs/benefits from each policy type, rendering this approach to be inadequate as well.¹⁰

We argue that, *under the assumption of governments' maximizing social income*, the only possible way to analyze the welfare effects of price supports and research expenditures is to evaluate the social costs (benefits) of each policy assuming the other policy is set at its level that maximizes social income. This allows one to overcome the dilemma faced in each of the above 3 paragraphs. Research expenditures with no price supports generates a net social gain of area

⁹ Governments constantly adjust both policies over time. It is possible, however, to argue that policy-makers must decide on research without having any control over price supports. But such an approach to policy advice must be reconciled with how economists' should advise some other policy maker who is deciding on price supports (and apparently has no control over research policy).

¹⁰ Other possible approaches were considered like the average or the difference in the net social costs between [A] and [B] in Table 1. However, neither approach was found to be satisfactory.

a while price supports with optimal research expenditures generates a net social loss of area *d*. Price supports cannot negate the social gains from research in agriculture. The only way one can attribute the social costs of two government policies employed at the same time to a single policy (while maintaining the assumption that the government's goal is only to maximize social welfare) is to identify the root cause of the deadweight costs. It is the implementation of commodity policy alone that generates deadweight costs. The policy combination of zero price supports and positive research expenditures generates the largest possible net social income of area $g + a$ in Figure 1.¹¹

A key question remains, however, about the validity of the remarks by Ruttan and Schultz regarding the overvaluation of research benefits when ignoring the existence of price supports. In the case of a price support with export subsidies in Figure 1, ignoring the existence of the price support program by equating the market price to the support price will overstate the benefits from research by the area $b + c$. Calculating the social returns to research while ignoring the existence of price supports will therefore automatically overstate the benefits from research. This is our interpretation of the meaning of the remarks made by Schultz and Ruttan when they argued that price supports *overvalue* the benefits from research. This conclusion however, is quite different than that of the NGFRP literature which shows how social welfare decreases and perhaps becomes negative with research expenditures for a given price support regime. Our approach has the social gains from research never to be negated by price supports. We interpret Ruttan and Schultz as not attributing the costs of price supports against the benefits

¹¹ Chambers and Lopez appeal to papers by Bhagwati and Johnson on immiserizing growth. A reduction in social income occurs with *exogenous* growth in the Bhagwati-Johnson models. Exogenous growth is a key distinction because it underscores the key difference in the policy conclusion of this literature compared to that of the NGFRP literature; namely, the costs of market distortions (due to a commodity policy like tariffs) increases with growth such that national income may decline. Therefore, governments should reduce the level of the commodity policy distortion, not the level of the public good research expenditure as implied by the NGFRP literature. See also Alston and Martin for a different critique of Chambers and Lopez' self-proclaimed link to the Bhagwati-Johnson literature on immiserizing growth.

of research (unlike the NGFRP literature).

Note however that the conclusion by Schultz and Ruttan on how price supports overvalue the benefits from research is not universal. Take the case of a production quota in a closed economy depicted in Figure 2. The true underlying supply curve is S_0 . Calculating the social benefits of research to be the upper shaded area assuming (incorrectly) that the observed market price P_0 is the competitive market equilibrium price (and that the supply curve is S_1) *understates* the social gains to research (which should be properly measured as the lower shaded area in Figure 2 at the unobserved competitive equilibrium price P_1).¹² In both Figure 1 and 2, however, there are always social gains to research and the existence of price supports cannot negate them. The implications for public policy analysis is that society always gains from research. That should never be questioned. It is just that the social costs of commodity policy are higher with research and that the benefits from research may be (under) overstated if one does not recognize that price supports exist. But the returns to research cannot be negative.

3. Resolving the Dr. Jekyll and Mr. Hyde View of Government

The discussion so far in this paper and in the NGFRP literature assumes that the government's objective is to maximize social income. However, the fixed price support policy itself generating deadweight costs, is inconsistent with this government objective.¹³ Research expenditures and price supports are policies being implemented by the same polity. The discussion in the previous section and in the NGFRP literature contains, therefore, a fundamental inconsistency in applying the normative criterion of maximizing social welfare to the

¹² This non-universal aspect of Ruttan's and Schultz' over versus under-valuation of research benefits with price supports is different than the non-universality of Alston, Edwards and Freebairn's column 6 in their Table 1. For each case in Figure 1 and 2 of this paper, Alston, Edwards and Freebairn have a negative sign in column 6 of their Table 1.

¹³ Only in very special circumstances can commodity policy increase the social benefits from research (see column 6 of Alston, Edwards and Freebairn). Hence, commodity policy generally involves deadweight costs.

determination of research policy, while maintaining a government policy of price supports that in itself does not fulfill this criterion. Analyzing two public policies, each with a different normative criterion but the same government is really a Dr. Jekyll and Mr. Hyde view of government. It implies that the government is trying to increase social welfare using research expenditures and decrease social welfare using price supports. In order to avoid this inconsistency, we develop a model in which governments use both research and commodity policy to maximize social income while satisfying a farm income constraint.¹⁴ It is very common for agricultural economists to evaluate the efficiency of farm policy in the context of governments trying to transfer income to farmers (for example, see Gardner).

As in MFS, consider an export subsidy scheme that maintains a domestic price P^d to both farmers and consumers. Define τ as gross research expenditures. Producer surplus (PS), consumer surplus (CS) and taxpayer expenditures (T) are affected by each policy instrument:

$$(1) \quad PS = PS(P^d, \tau), \quad CS = CS(P^d, \tau) \quad \text{and} \quad T = T(P^d, \tau)$$

As defined by MFS, the gross annual benefit from output increasing research (GARB) is the gross increase in total income net of deadweight costs (excluding investment costs):

$$(2) \quad GARB = \Delta PS + \Delta CS - \Delta T$$

where Δ refers to the changes induced by research expenditures τ . As in MFS, we will consider the case of both a parallel and pivotal shift in the supply curve due to public research expenditures. With a parallel shift in the supply curve, we find that GARB is always positive

¹⁴ What we are in effect arguing is that the calculation of a NGFRP only makes sense if one assumes the government is maximizing income subject to a farm income goal.

when achieving a farm income goal.¹⁵ In the case of a pivotal shift in the supply curve, we find that GARB is far less likely to be negative than that calculated by MFS.

Parallel supply shift

Consider a price support P^l_0 in Figure 3 that achieves a farm income goal equal to area EGL. Given the domestic supply and demand curves S_0 and D , respectively, the resulting domestic supply and demand is Q^s_0 and Q^d_0 . Define the producer surplus that achieves the farm income goal as $PS^* = (P^l_0 - P^m_0)(Q^s_0/2)$. The world market price P^w_0 is determined in panel (b) of Figure 3 by the intersection of the excess supply curve ES_0 and the excess demand curve ED . Export volume is Q^e_0 and export subsidies equal $(P^l_0 - P^w_0)Q^e_0$ corresponding to area ABCD.

The introduction of research expenditures shifts both the supply curve (to S_r) and the excess supply curve (to ES_r). If the domestic price support is maintained at P^l_0 , then producer surplus increases by area GIML. The price support is therefore reduced to P^l_r in order to maintain the farm income goal of PS^* (now area JHM). Domestic production is unchanged at this new domestic price ($Q^s_r = Q^s_0$). Because domestic consumption increases, exports fall to Q^e_r . The per unit export subsidy also declines from $(P^l_0 - P^w_0)$ to $(P^l_r - P^w_r)$. This means total export subsidy costs are reduced from area ABCD to area NORL. Consumer surplus increases by the area EFKJ. The welfare gains to both taxpayers and consumers guarantee that GARB is positive and so the NGFRP does not exist.

Pivotal supply shift

As before, the lower support price P^l_r maintains producer surplus PS^* now equal to area JHL in panel (a) of Figure 4. The pivotal shift in the supply curve results in an increase in production even though the support price has declined. Domestic consumption increases too so

¹⁵ MFS argue that researchers generally support the finding that supply curves exhibit parallel shifts in response to technical change.

the net effect on export volume is ambiguous and depends on the relative size of the demand and supply increase. If the domestic demand function is sufficiently elastic relative to the domestic supply function, then exports will decline. A decline in export volume would also reduce the per unit export subsidy, in which case total export subsidies would unambiguously decline. GARB would be unambiguously positive in this case and again the NGFRP does not exist.

However, GARB is possibly negative only when the increase in output is greater than the increase in demand. This specific case is depicted in Figure 4. Export volume increases from Q_0^e to Q^e , resulting in the world market price to decline to P^w . As both the support price and the world market price decline, the per unit export subsidy can either increase or decrease, depending on the elasticities of the excess supply and demand functions.

To derive the conditions under which export subsidy costs increase, define the supply and demand functions as:

$$(3a) \quad S_0(P) = Q^s(P) = (P - P^m)/\alpha$$

$$(3b) \quad D(P) = Q^d(P) = (P^x - P)/\beta$$

$$(3c) \quad ED(P) = Q^e(P) = (P^z - P)/\gamma$$

where α , β and γ are the absolute values of the slopes of the inverse supply, demand and excess demand curves, respectively while P^m , P^x and P^z are the intercepts on the vertical axis for these same functions. The specific welfare measures can be written as:

$$(4a) \quad CS = (P^x - P^i)^2/2\beta$$

$$(4b) \quad PS = (P^i - P^m)^2/2\alpha$$

$$(4c) \quad T = (P^i - P^w)(P^z - P^w)/\gamma$$

Using (3), we can derive the impact of a change in research expenditure τ on consumption, production and exports. Given the government's objective is to maximize social income subject to the farm income constraint, it follows that $dPS/d\tau = 0$. This implies:

$$(5) \quad dP^i/d\tau = -\delta(P^i - P^m)/2\alpha$$

where $\delta = d\alpha/d\tau$. Therefore,

$$(6a) \quad dQ^s/d\tau = \delta(P^i - P^m)/2\alpha^2$$

$$(6b) \quad dQ^d/d\tau = \delta(P^i - P^m)/2\alpha\beta$$

$$(6c) \quad dQ^e/d\tau = (\delta/2\alpha)(P^i - P^m) [(1/\alpha) - (1/\beta)]$$

Because $P^i > P^m$, conditions (6a and b) indicate that both domestic demand and supply increase with research expenditures. Condition (6c) shows that export volume increases if the demand curve is steeper than the supply curve, i.e. if the absolute value of the demand curve slope $(1/\beta)$ is greater than that of the supply curve $(1/\alpha)$. Combining this result with the definition of the excess demand function and the world market equilibrium condition determines how research affects the world price:

$$(7) \quad dP^w/d\tau = -\gamma dQ^e/d\tau = -(\gamma\delta/2\alpha)(P^i - P^m) [(1/\alpha) - (1/\beta)]$$

Equation (7) shows that the world price will decline only if export volumes increase. Clearly, the decline in world prices will be larger with more inelastic demand curves (both domestic and foreign) and a more elastic supply curve.

The effect of research on the per unit export subsidy is:

$$(8) \quad d(P^i - P^w)/d\tau = (\gamma\delta/2\alpha)(P^i - P^m) [(1/\alpha) - (1/\beta) - (1/\gamma)]$$

The per unit export subsidy will increase if and only if $[(1/\alpha) - (1/\beta) - (1/\gamma)] > 0$. An increase in the per unit export subsidy is more likely with a more elastic supply curve and a more inelastic domestic and foreign demand curve. Similarly, we can show how research affects total export subsidies:

$$(9) \quad dT/d\tau = (\delta/2\alpha)(P^i - P^m)\{(P^z - P^w)[(1/\alpha) - (1/\beta) - (1/\gamma)] + (P^i - P^w)[(1/\alpha) - (1/\beta)]\}$$

which yields the following condition under which total export subsidies will increase:

$$(10) \quad dT/d\tau > 0 \text{ iff } (P^z - P^w)[(1/\alpha) - (1/\beta) - (1/\gamma)] + (P^i - P^w)[(1/\alpha) - (1/\beta)] > 0$$

The first term in the RHS of condition (10) represents the change in per unit export subsidies while the second term represents the change in export volumes. When both are positive, total export subsidies increase. However, total export subsidy costs can either increase or decrease when export volumes increase and the per unit export subsidy declines. Notice however that the reverse is not possible.

Even if total export subsidy costs increase, the increase will be lower than in the MFS analysis. The increase in exports in our analysis is less than that in MFS because the reduction in the support price results in a lower increase in both production and consumption. MFS assume that the support price does not change, leading to an increase in total export subsidies of the area BCDVUT in panel (b) of Figure 4. Employing the same methodology as before, we can derive an expression for how research affects total export subsidy costs in the MFS framework:

$$(11) \quad dT(\text{MFS})/d\tau = (\delta/\alpha^2) [(P^z - P^w) + (P^i - P^w)]$$

where $T(\text{MFS})$ is total export subsidy costs in the MFS framework. Condition (11) indicates

that total export subsidies in the MFS framework always increases. Total export subsidies after the supply shift in the MFS framework exceed total export subsidies in our analysis by the area $ATUV-NORS > 0$.

So far, we have evaluated the impact of research expenditures on total export subsidies. To evaluate the total social welfare effects (i.e. GARB), one needs to include the effects on domestic consumer and producer income. In our framework, producer surplus is unaffected while consumer surplus increases by area EFKJ as prices fall and consumption increases:

$$(12) \quad dCS/d\tau = (\delta/\alpha\beta)(P^x - P^i)(P^i - P^m) = \delta Q^d Q^s$$

GARB is negative in our framework only if the increase in total export subsidies exceeds the increase in consumer surplus. Using (9) and (12) and denoting the absolute values of the elasticities of domestic demand, domestic supply, and foreign excess demand functions by e^D , e^S , and e^E , respectively, it follows that:

$$(13) \quad GARB < 0 \quad \text{iff} \quad e^S > [(1 + NRP)/(1 + NRPe^E)] + e^D/z$$

where $z = Q^s/Q^d$ is the self-sufficiency ratio and $NRP = (P^i - P^w)/P^w$ is the nominal rate of protection. This indicates that $GARB < 0$ is possible in our framework if the domestic supply elasticity is large compared to both demand elasticities. GARB is more likely negative when the self-sufficiency ratio is larger because the impact on domestic consumer surplus is relatively less important.

On the other hand, the MFS framework of analysis has no change in consumer prices (or welfare) but producer surplus increases (by area GIL in panel (a) of Figure 4). It follows that:

$$(14) \quad GARB(MFS) < 0 \quad \text{iff} \quad e^S > [(1 + NRP)/(1 + NRPe^E)]/2$$

GARB(MFS) is affected in the same way by supply and excess demand elasticities, but is not affected by the domestic demand elasticity. In addition, the condition is easier to satisfy because the RHS of (14) is only half of the first term of the RHS of condition (13), implying that under all (relevant) circumstances GARB(MFS) is significantly smaller (and less likely) than the GARB in our framework.

Empirical Evidence

The above analysis shows that the NGFRP does not exist with a parallel shift in the supply curve. A NGFRP is possible with a pivotal shift in the supply curve only if exports increase with research. Even then, we show formally that the NGFRP in our framework is far less likely and that GARB is lower than that calculated by MFS.

Finally, it is instructive to evaluate the predictive capabilities of the NGFRP literature as well. MFS summarize their findings (p. 172):

"...[W]e show why producers are likely to support R&D activities since protection shifts the negative effects via export subsidies to taxpayers. It is generally true that producer groups in countries with high price supports and export subsidies support R&D activities..."

Is there empirical evidence that agricultural sectors with high levels of protection also receive (or demand) high levels of R&D expenditures? Data presented in de Gorter, Nielson and Rausser show that the ratio of public good expenditures to price support subsidies is lowest for sugar, milk, rice and wheat (8.6, 8.4, 6.9 and 15.7 percent, respectively) and highest for soybeans, beef, poultry and pork (291, 125, 286 and 380 percent, respectively). The sectors with high price supports are getting (and perhaps demanding) relatively much less R&D expenditures. Literature is cited in de Gorter and Zilberman which indicates that *underfunding* in public research is much higher in the crop sectors (i.e. wheat) with high price supports than in the livestock sectors (i.e. beef) with low price supports. Furthermore, de Gorter and

Zilberman present the stylized fact that research financed *privately* by farmers is higher in sectors with more elastic demand curves. These sectors have much lower price supports relative to the inelastic demand sectors such as sugar, milk, rice and wheat. Together, this evidence does not corroborate the predictions made by MFS. This lends further support for the hypothesis put forward in this paper that governments choose relative levels of price supports and research expenditures to maximize social income subject to a farm income goal.

4. Implications and Concluding Remarks

The burgeoning literature on the joint determination of research and price support policy in agriculture emphasizes how price supports reduce the benefits from research (Alston, Edwards and Freebairn; MFS; Chambers and Lopez). Indeed, this literature not only questions the conventional wisdom that governments underinvest in agricultural research but also questions research efforts in the first place. The social benefits may be negative, leading MFS (p. 162), for example, to argue "...why continue investing in research?..." and Chambers and Lopez (p. 74) to state "...current public investments levels in agriculture will be too high rather than too low..." The analysis in this paper arrives at a significantly different conclusion. Under the assumption of governments maximizing social income, we find that price supports cannot negate the benefits from research. This is because the NGFRP literature arbitrarily evaluates the effects of commodity policy given research and not vice-versa (see Table 1).

We go on to argue that a NGFRP calculation makes sense only in a model of governments maximizing social welfare subject to a farm income constraint. The observed behavior of governments employing price supports is now consistent with the normative criteria evaluating its efficacy. The results indicate that the NGFRP does not exist for parallel shifts in the supply curve and are far less likely for pivotal supply curve shifts than in the MFS analysis. Furthermore, the GARB is higher in those cases than that in MFS. These results are particularly

important, given the commitment by the current administration in Washington to make more productive investments to improve the infrastructure and underlying productivity of the American economy. The conclusion of this paper is that existing price supports should not deter policy-makers from exploiting the high returns to public research expenditures in agriculture, regardless of the motives of government. We also indicate that the predictions made by MFS on which agricultural sectors demand (or receive) more public R&D expenditures may not be corroborated by empirical evidence.

Further research should generalize our analysis to include deadweight costs of taxation and the costs of research expenditures themselves (de Gorter and Zilberman). However, inclusion of these features will not alter the overall implications of our perspectives given in this paper on governments choosing both price supports and public good research expenditures compared to the NGFRP literature.

A more important priority for further research is to relax the assumption that the farm income goal is exogenous. Although a fixed farm income goal is a more realistic and consistent formulation of government behavior, it is nevertheless restrictive. The reality is that not only are the two policy instruments endogenous (P^i and τ as developed in this paper), but the farm income goal itself is endogenous as well. The plausibility of such an hypothesis can perhaps best be explained by examining the political response to the introduction of bST in the U.S. dairy sector. bST is purported to be able to reduce production costs substantially yet farmers and politicians have responded over the years by trying to ban it (state governments in Wisconsin and Vermont have been successful with such pronouncements in the past). Why would farmers insist on such a ban if price supports protect farm income?

The reason is that consumer/taxpayer costs of the price supports increase such that it may be necessary to reduce the price support level. This may reduce farm income, particularly if

demand is inelastic. Farmers are aware that milk price supports are adjusted downwards with the milk price formula based on costs of production and/or taxpayer costs. Farmers are also cognizant of the fact that producer surplus may in fact decline with an inelastic demand. Relaxing this assumption of a fixed farm income goal will make the results even more pertinent to the realities facing policy-makers. Are social benefits from public research expenditures with price supports in agriculture even higher with endogenous farm income goals, thereby rendering the NGFRP even more less likely?¹⁶ The answer to this important question awaits further research.

¹⁶ The literature on endogenous economic policy has also recently recognized that governments employ both redistributive and growth promoting policies in tandem. For example, see the excellent paper by Alesina and Perotti who argue that distributive policies targeted to reduce income inequality allow governments to expand growth promoting public investments.

TABLE 1

"The Gains from Agricultural Research" or "The Costs from Distorted Trade"?

[A] "The Gains from Agricultural Research under Distorted Trade"

Price Support Given

(1) Research expenditures = 0

producer surplus = $g + e$ (see Fig. 1)

consumer/taxpayer cost = $e + b$

(2) Research expenditures > 0

producer surplus = $e + g + a + b + c$

consumer/taxpayer cost = $e + b + c + d$

NET EFFECT OF RESEARCH EXPENDITURES (PRICE SUPPORT GIVEN):

change in producer surplus = $a + b + c > 0$

change in consumer/taxpayer cost = $c + d > 0$

net change in social welfare = $a + b - d >, =, < 0$

[B] "The Costs from Distorted Trade under Agricultural Research"

Research Expenditures Given

(1) Price support = 0

producer surplus = $g + a$

consumer/taxpayer cost = 0

(2) Price Support > 0

producer surplus = $e + g + a + b + c$

consumer/taxpayer cost = $e + b + c + d$

NET EFFECT OF PRICE SUPPORT (RESEARCH EXPENDITURES GIVEN):

change in producer surplus = $e + b + c > 0$

change in consumer/taxpayer cost = $e + b + c + d > 0$

net change in social welfare = $- d < 0$

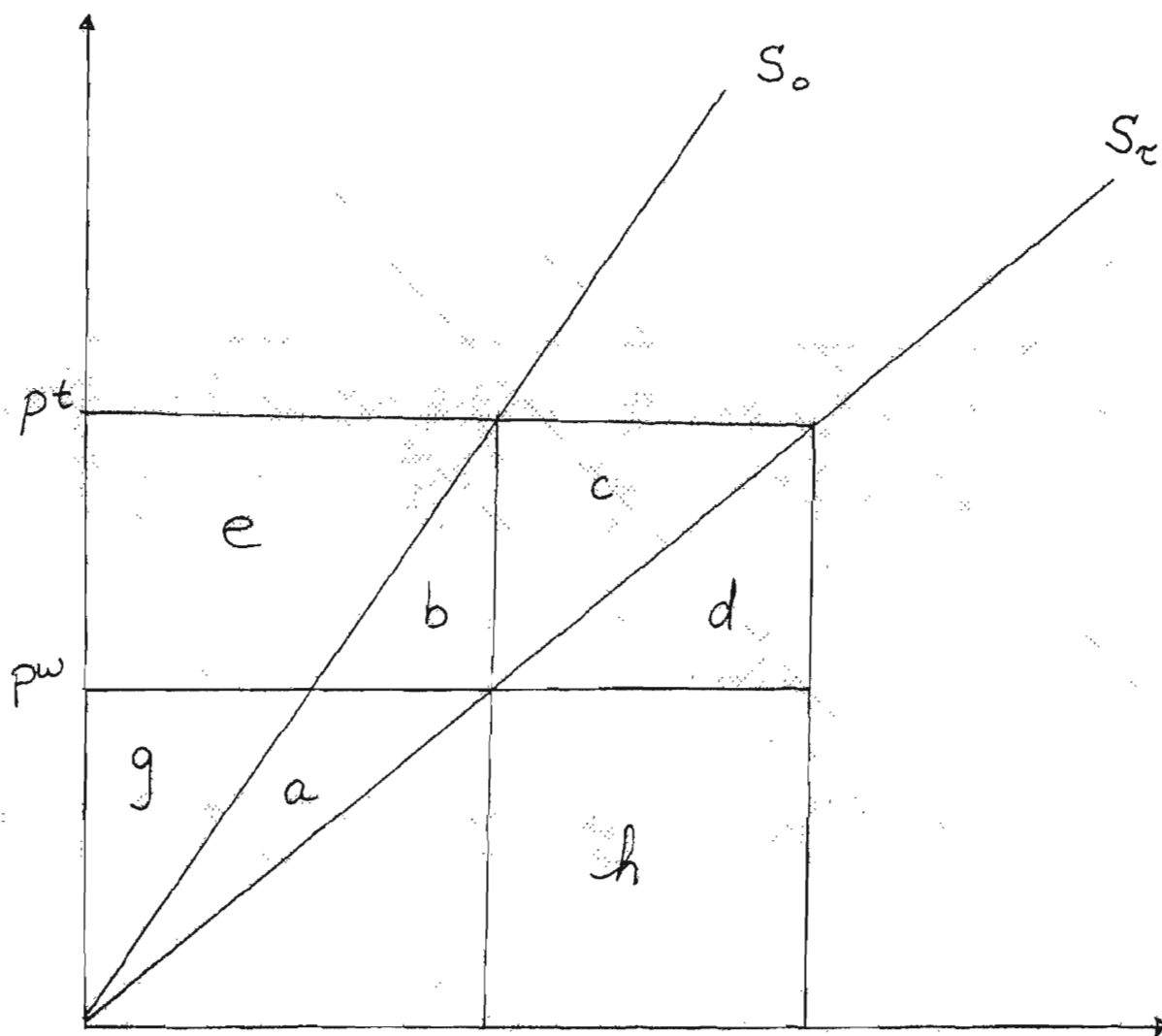


Figure 1: EXPORT SUBSIDY (small country)

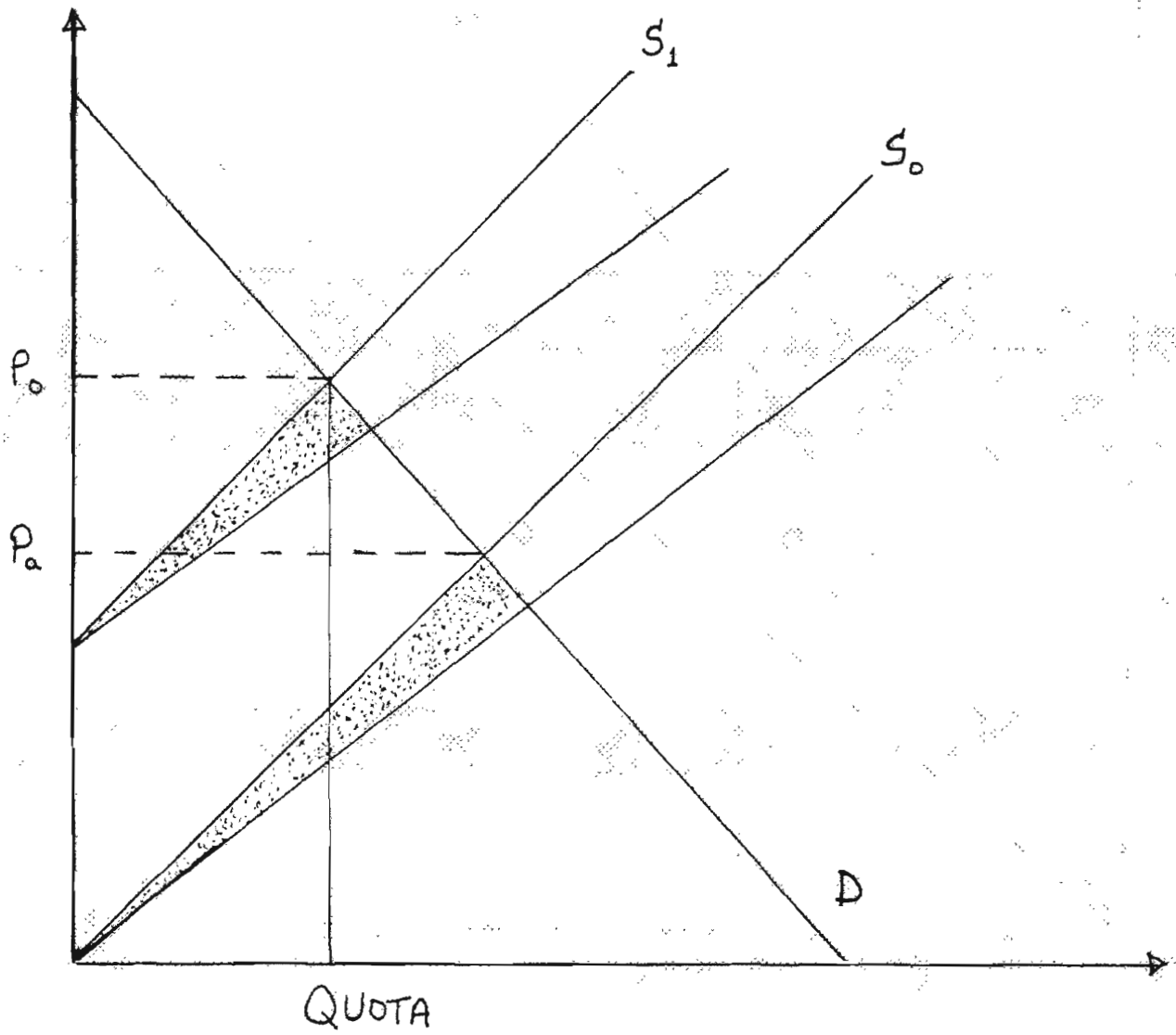
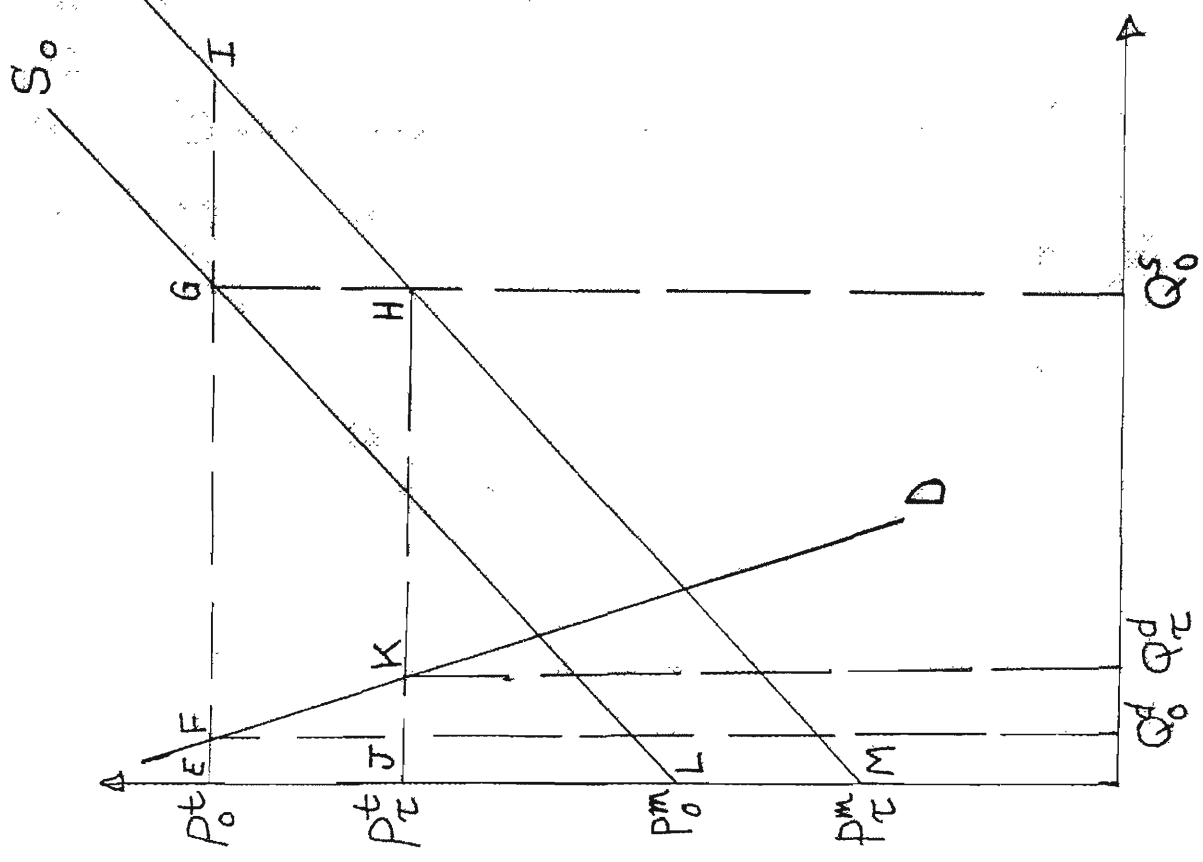


Figure 2 : PRODUCTION QUOTA (closed economy)

(a)



(b)

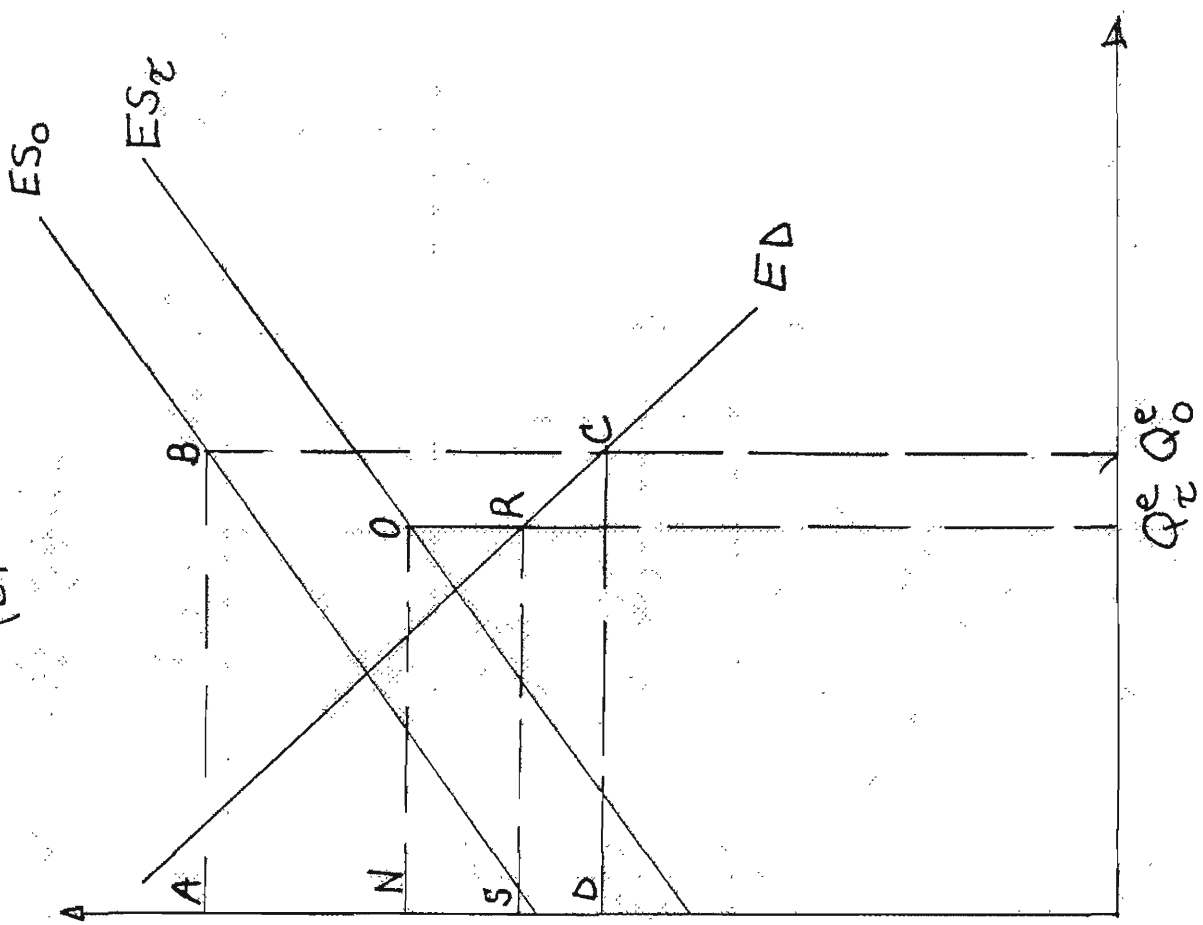
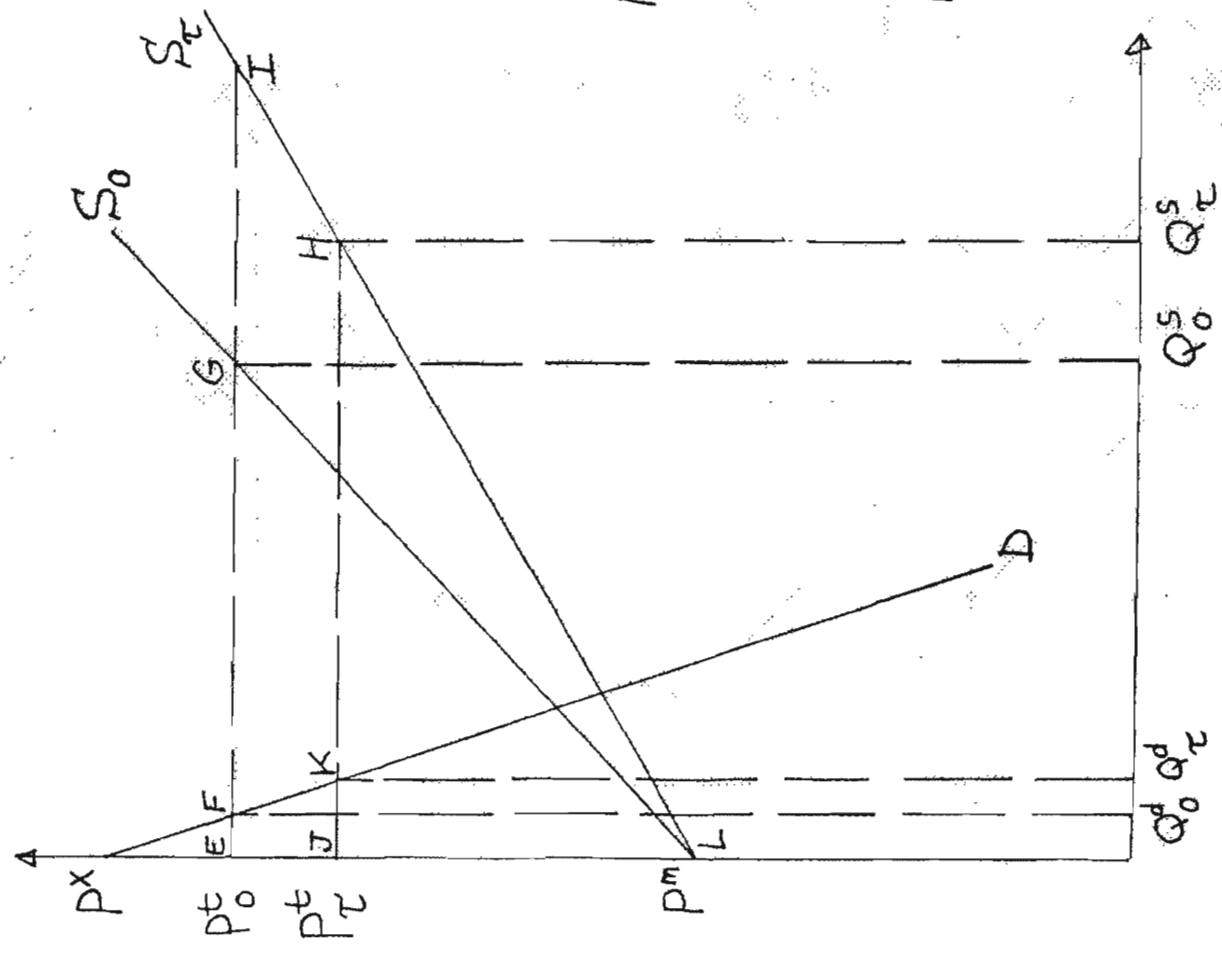


Figure 3: PARALLEL SUPPLY SHIFT

(a)



(b)

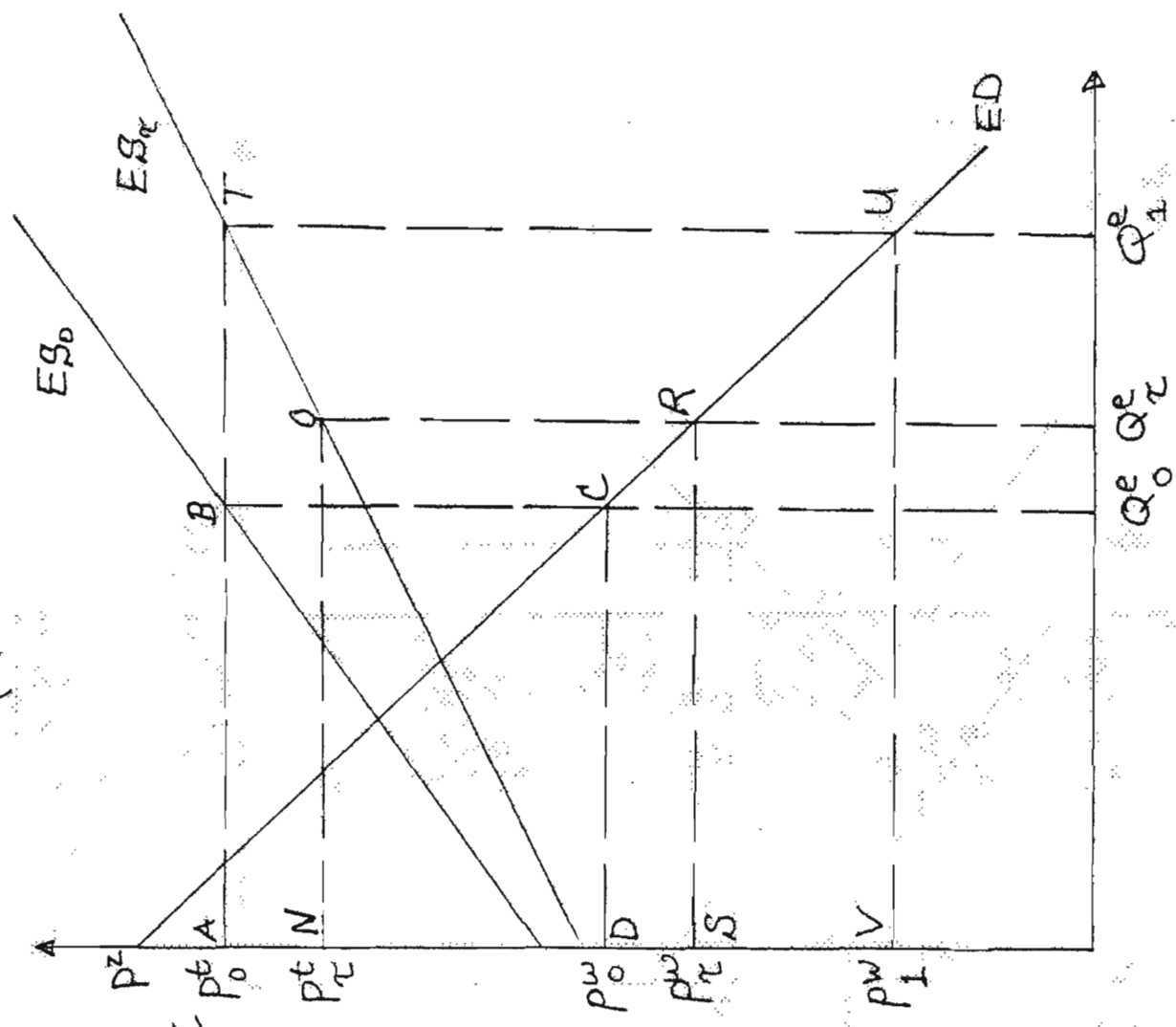


Figure 4 : PIVOTAL SUPPLY SHIFT

References

- Alesina, A. and R. Perotti. "Income Distribution, Political Instability and Investment", Institute for Policy Reform, Paper IPR53, 1992.
- Alston, J.M., G.W. Edwards and J.W. Freebairn, "Market Distortions and Benefits from Research." *American Journal of Agricultural Economics* 70 (1988): 281-288.
- Alston, J. M. and W. J. Martin, "Reversal of Fortune: Immiserizing Technical Change in Agriculture" paper presented at the IATRC Annual Meetings, Florida, December 1992 (revised 1994).
- Bhagwati, J. "Immiserizing Growth: A Geometric Note." *Review of Economic Studies*, 25 (1958):201-205.
- Chambers, R.G., and R. Lopez, "Public Investment and Real-Price Supports", *Journal of Public Economics*, 52(1993):73-82.
- de Gorter, H., D. J. Nielson and G. C. Rausser, "Productive and Predatory Public Policies: Research Expenditures and Producer Subsidies in Agriculture" *American Journal of Agricultural Economics*, 74 (1992):27-37.
- de Gorter, H. and D. Zilberman, "On the Political Economy of Public Good inputs in Agriculture", *American Journal of Agricultural Economics*, 72(1990): 131-37.
- Gardner, B.L. The Economics of Agricultural Policies, Macmillan Publishing Co., New York 1987.
- Johnson, H.G. "The Possibility of Income Losses from Increased Efficiency or Factor Accumulation in the Presence of Tariffs." *Economic Journal*, (1967):151-54.
- Murphy, J. A., W.H. Furtan and A. Schmitz, "The Gains from Agricultural Research under Distorted Trade", *Journal of Public Economics*, 51 (1993):161-172.
- Ruttan, V., Agricultural Research Policy, University of Minnesota Press, Minneapolis, MN 1982.
- Schultz, T.W., "On Economics and Politics of Agriculture" in Distortions of Agricultural Incentives, (T.W. Schultz ed.) Bloomington, Indiana University Press, 1978.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions.

2. It is essential to ensure that all entries are supported by appropriate documentation and receipts.

3. The second part of the document outlines the procedures for reconciling bank statements with the company's records.

4. This process involves comparing the bank's records with the company's ledger to identify any discrepancies.

5. Any differences should be investigated immediately to determine the cause and correct the records.

6. The third part of the document provides a detailed explanation of the accounting cycle and its various steps.

7. Understanding the accounting cycle is crucial for ensuring the accuracy and integrity of the financial statements.

8. The cycle begins with identifying the accounting period and ends with preparing the financial statements.

9. Each step in the cycle is interconnected, and any error in one step can affect the entire process.

10. Therefore, it is important to follow the accounting cycle meticulously to avoid any mistakes.

11. The fourth part of the document discusses the role of the auditor in verifying the accuracy of the financial records.

12. Auditors are responsible for examining the company's books and records to ensure they are free from errors and fraud.

13. Their findings are reported in an audit report, which provides an independent opinion on the company's financial health.

OTHER A.R.M.E. WORKING PAPERS
(Formerly A.E. Working Papers)

No. 93-09	Processed Sweet Potato: Responding to Kenya's Urban Food Needs	Njeri Gakonyo
No. 93-10	Estimating Consumer Energy Demand Using International Data: Theoretical and Policy Implications	Dale S. Rothman Jong Ho Hong Timothy D. Mount
No. 93-11	Monitored Retrievable Storage of Spent Nuclear Fuel in Indian Country: Liability, Sovereignty, and Socioeconomics	Jon D. Erickson Duane Chapman Ronald E. Johnny
No. 93-12	Urban Influences on Farmland Use in New York State	Thomas A. Hirschl Nelson L. Bills
No. 93-13	An Empirical Evaluation of Incremental Conditional Damages and Benefits	Gregory L. Poe Richard Bishop
No. 94-01	Income and Dietary Change: International Comparisons Using Purchasing-Power-Parity Conversions	Thomas T. Poleman Lillian Thomas
No. 94-02	Meeting Clean Air Standards for Acid Rain and Urban Ozone: Implications for Electric Utilities in New York State	Martha Czerwinski Brian Minsker Timothy Mount
No. 94-03	Economic Evaluation of Residential Solar Electricity in Developing Countries	Duane Chapman
No. 94-04	Fishing in Stochastic Waters	Gunter Schamel John M. Conrad
No. 94-05	Implementing the Convolutions Approach: A Companion to "Measuring the Difference (X-Y) in Simulated Distributions: A Convolutions Approach"	Greg Poe

