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Some Preliminary Findings on the Sectoral
Incidence of Protection in Zimbabwe*

by

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I. Introduction

It is important to formulate incentive policies for agriculture by considering the broader context in which they operate and not merely by looking at the direct effects on particular agricultural activities. The size of agriculture in developing countries implies that any policy directed towards this sector inevitably affects other parts of the economy profoundly, since the various sectors must compete for limited resources. Conversely, measures to promote and protect other sectors can severely hamper agricultural development. In this context, the domestic terms of trade between agriculture and the rest of the economy, which result from inward-looking industrialization strategies emerge as a key issue as they affect the level and composition of agricultural output, the adoption of new technologies and the migration of labour from farms to urban areas.

This fact is ignored by the partial-equilibrium approach commonly used in justifying assistance to import-competing industry. However, protectionism not only causes cost pressures on the unprotected sectors but also has a differential impact on domestic prices for tradeables and non-tradeables. Several studies have shown that policies to protect industry increase the price of protected industrial products and of nontraded goods compared to unprotected tradeables [e.g. World Bank (1986), Valdés (1986)]. Quantitative results suggest that it is mainly the agricultural sector, particularly the export-oriented subsector, which suffers from inward-looking industrialization¹. Moreover, many agriculture-specific (direct) interventions to help certain commodities or producers are reactions to (indirect) policies originating elsewhere in the economy, and attempt to compensate for the overall macroeconomic stance².

In this paper, the impact of trade and industrialization policies on the level and structure of incentives for total exports, total agricultural exports and individual agricultural export commodities in the Zimbabwean economy is investigated. To do this, a three-sector general equilibrium model developed by Dornbusch

(1974) and successfully used in other quantitative studies [e.g. García (1981) on Colombia; Oyejide (1986) on Nigeria; Tshibaka (1986) on Zaire; Greenaway/Milner (1986) on Mauritius; Bautista (1987) on the Philippines; Mlambo (1989) on Zimbabwe; Herrmann et al. (1990) on Peru and Malaysia] is applied. It will be shown that a fairly high share of industrial protection is shifted to producers of agricultural exportables as an implicit tax. This result conforms with findings of other studies on the subject. However, government intervention in producer prices has generally been favourable to agricultural production in Zimbabwe³. The question then arises whether indirect policies are sufficiently strong to counteract those direct policies.

The remainder of the paper is organized as follows. Section II introduces the theoretical model and explains the shifting principle. Section III describes the empirical methodology required to operationalize the model as well as the data sources used. In Section IV, estimates of the incidence parameters are presented and discussed. Subsequently, the estimates of the incidence parameters are combined with external information on nominal protection of manufacturing and agricultural exportables to produce true tariff and subsidy rates in Section V and total tariff rates in Section VI. Finally, in Section VII, major results are summarized and conclusions are drawn.

II. The Analytical Framework

Following Dornbusch (1974) we consider a simple general equilibrium model based on the following assumptions⁴:

- a small open economy with initially balanced trade;
- constant factor endowments and real income;
- three sectors, importables (M), exportables (X) and non-tradeables (N);
- substitutability in production and consumption between home goods and both traded goods;
- zero cross price elasticity between traded goods;

- policy interventions take the form of uniform tariffs (t) on imports and/or uniform subsidies (s) on exports;
- initial (free trade) prices for all goods are unity, i.e. $P_M = P_X = P_N = 1$.

As Dornbusch (1974) shows, equilibrium in the non-traded goods market implies trade balance equilibrium and therefore the equilibrium properties of the model can be examined in terms of equilibrium in either market. Thus, general equilibrium following a commercial policy intervention requires that

$$\hat{D}_N = \hat{S}_N \quad (1)$$

$$\text{where } \hat{D}_N = \delta_X \hat{P}_X + \delta_N \hat{P}_N + \delta_M \hat{P}_M \text{ and} \quad (2)$$

$$\hat{S}_N = \epsilon_X \hat{P}_X + \epsilon_N \hat{P}_N + \epsilon_M \hat{P}_M \quad (3)$$

ϵ and δ are compensated supply and demand price elasticities for non-traded goods with respect to i , $i = X, N, M$ and a hat (^) denotes proportionate changes.

Given the system above it can be established [see Greenaway and Milner (1987)] that the proportionate change in the price of non-tradeables (\hat{P}_N) required to restore equilibrium is given by

$$\hat{P}_N = \Omega \hat{P}_M + (1-\Omega) \hat{P}_X \quad (4)$$

where omega (Ω) is the incidence parameter ($0 \leq \Omega \leq 1$) indicating the extent of the shifting of the tax burden. The effect of trade and industrial policies on the structure of relative prices depends therefore on the structure of protection and the value of the incidence parameter:

- If $\hat{P}_M = t = \hat{P}_X = s$ (uniform nominal protection/promotion of importables and exportables), then $\hat{P}_N = \hat{P}_M = \hat{P}_X$, i.e. relative prices are unaltered and there is no true or relative protection of any sector (irrespective of the value of Ω).

- If $\hat{P}_X = s = 0$ but $\hat{P}_M = t$, then $0 \leq \hat{P}_N \leq \hat{P}_M$ as $0 \leq \Omega \leq 1$.
- If $\hat{P}_M = t = 0$ and $\hat{P}_X = s$, then $0 \leq \hat{P}_N \leq \hat{P}_X$ as $0 \leq \Omega \leq 1$.

With $\Omega=1$ for instance, import protection raises the price of both M and N by the same percentage whereas the price of X remains unaffected; there is zero "true protection" of importables relative to non-tradeables but "true disprotection" of exportables relative to non-tradeables. In this case the burden of import protection falls wholly on the exportables sector. At the other extreme, if $\Omega=0$, import protection does not alter the prices of either N or X, the nominal tariff is equal to the true protective rate on importables. Although exportables are not disprotected relative to non-tradeables, the burden of import protection falls equally on exportables and non-tradeables. Thus, in the import protection case the index Ω can be interpreted as an indicator for the shifting of the burden of protection on exportables⁵.

Conversely, with $\Omega=1$, export promotion leaves the price of importables and non-tradeables unaffected. The true subsidy is equivalent to the nominal subsidy and the burden of export promotion falls equally on producers of importables and non-traded goods, who have to pay higher prices for exportables. If $\Omega=0$ export promotion raises the prices of both X and N relative to M; there is zero true subsidization of exportables relative to home goods but true disprotection of importables.

III. Application of the Model

Equation (4) expressed the relationship between changes in the price of importables, exportables and non-tradeables. Expanding (4) and rearranging we derive:

$$(\hat{P}_N - \hat{P}_X) = \Omega (\hat{P}_M - \hat{P}_X) \quad (5)$$

Since the shifting model analyses proportional changes in the price of one group of commodities relative to another, the appro-

appropriate estimating procedure is to transform equation (5) to a double logarithmic specification, viz,

$$\ln(P_N/P_X) = \text{constant} + \Omega \ln(P_M/P_X) + u_t \quad (6)$$

As shown by García (1981), this equation may be disaggregated as necessary to take account of several exportable and importable subsectors. The information required to estimate omega is price movements of importables, exportables and non-tradeables. Ideally, one would rely on producer prices.

In estimating the global and disaggregated forms of the incidence parameter, an important modification is required before equation (6) can be used. Estimations based on time-series data would violate the assumption of constant real income and of a balanced external account. Hence, income (Y) as measured by GDP and balance of trade (BOT) have to be included as additional variables in the regression equations. There are then two basic equations to be estimated.

$$\ln(P_N/P_X)_t = \text{constant} + \Omega \ln(P_M/P_X)_t + \alpha \text{BOT}_t + \beta \ln Y_t + u_t \quad (7)$$

and

$$\begin{aligned} \ln(P_N/P_{XA})_t = & \text{constant} + \Omega_1 \ln(P_M/P_{XA})_t + \Omega_2 \ln(P_{XNA}/P_{XA})_t \\ & + \alpha \text{BOT}_t + \beta \ln Y_t + u_t \end{aligned} \quad (8)$$

where P_{XA} is either the price index for individual agricultural export commodities or an export-share-weighted price index for all agricultural exportables recognized and P_{XNA} is an export-share-weighted price index for all other exportables not included in P_{XA} .

The regression equations were estimated on the basis of annual data for 1966-87. Initially, ordinary least squares (OLS) techniques were used. For all equations estimated there was, however,

evidence of positive autocorrelation. In each case, therefore, the model was re-estimated using the Cochrane/Orcutt iterative procedure.

In addition to total exports (X), estimates are produced for Zimbabwe's major agricultural export goods, i.e. maize (XM), coffee (XC), cotton (XCO), tobacco (XT) and beef (XB) as well as for all five agricultural export categories taken together (XA). Yearly information on unit import and unit export values in Zimbabwean dollar (Z\$) from the Central Statistical Office (CSO) and on producer prices for individual agricultural export commodities from Rukovo (1990) together with information on export revenues according to the standard international trade classification (SITC) from CSO were used to construct price indices for individual export commodities, total agricultural exportables and other exportables (XN). For each of the export categories, four variables are used as proxies for home goods: the building material price index (P_{N1}), the component of domestic workers' wages in the consumer price index (CPI) (P_{N2}), the food component of CPI (P_{N3}) and the composite CPI for higher and lower income urban families (P_{N4}). Moreover, the export price index for total agricultural exports and other exports was calculated with different weights, explanatory variables were taken out and the dynamic structure of the relationship was explored by estimating a distributed lag model. Sources and data for all the variables used as well as the weighting scheme applied are given in Appendices 1-3.

IV. Empirical Results

The results of estimating the shift parameter are presented in Tables 1 and 2. The former gives details for estimates using a basic model where the building material price index (P_{N1}) approximates price movements for home goods whilst the latter presents omega estimates for alternative model specifications. The dependent variable for each equation is listed in the top line of the tables and the estimated coefficients for each independent vari-

Table 1: Estimates of the Incidence Parameter α for Total Exports, Total Agricultural Exports and Individual Agricultural Exports in Zimbabwe, 1966-1987^a

Independent Variables/ Test Statistics	Dependent Variables						
	Total Exports	Total Agricultural Exports	Individual Agricultural Exports				
	$\ln(P_{N1}/P_X)$	$\ln(P_{N1}/P_{XA})$	Maize	Coffee	Cotton	Tobacco	Beef
Constant	1.1720 (0.44)	2.1089 (0.92)	-2.4387 (-1.96)	1.1224 (0.40)	1.9645 (0.77)	1.8961 (0.79)	2.4351 (1.16)
$\ln(P_M/P_X)$	0.7598 (5.46)						
$\ln(P_M/P_{XA})$		0.6451 (5.28)	0.6525 (5.12)	0.7588 (4.95)	0.6471 (4.54)	0.6755 (5.34)	0.4315 (2.88)
$\ln(P_{XNA}/P_{XA})$		0.0669 (0.95)	-0.1103 (-0.65)	0.2372 (1.66)	0.1049 (0.81)	0.1263 (1.38)	0.1191 (1.05)
BOT	$-0.1254 \cdot 10^{-3}$ (-0.72)	$-0.6764 \cdot 10^{-4}$ (-0.45)	$0.2975 \cdot 10^{-4}$ (0.20)	$-0.1271 \cdot 10^{-3}$ (-0.67)	$-0.2166 \cdot 10^{-3}$ (-1.28)	$-0.4293 \cdot 10^{-4}$ (-0.27)	$0.1897 \cdot 10^{-4}$ (0.13)
$\ln Y$	-0.0518 (-0.19)	-0.1527 (-0.65)	0.3174 (2.11)	-0.0476 (-0.16)	-0.1194 (-0.47)	-0.1329 (-0.54)	-0.2192 (-0.98)
Rho	0.9558 (14.90)	0.9583 (15.37)	0.7908 (5.92)	0.9551 (14.77)	0.9626 (16.29)	0.9570 (15.11)	0.9481 (13.70)
\bar{R}^2	0.58	0.80	0.67	0.93	0.69	0.90	0.51
F	10.17	21.48	11.13	66.56	12.32	46.85	6.28
DW	1.59	1.79	1.82	1.59	1.81	1.73	1.78

^a Values in parentheses are t-values, Rho is the regression coefficient of the Cochrane/Orcutt procedure, \bar{R}^2 is the corrected coefficient of determination, F the F-value and DW the Durbin-Watson-statistic.

Source: Own computations. P_{N1} , P_M and P_X are taken from Appendix 1. P_{XA} is constructed as a weighted export price index for the five individual export commodities where the respective earnings in 1980 are used as weights. Analogous, P_{XNA} is an export price index for all other exports not included in P_{XA} . See Appendices 2 and 3 for the calculation of the price indices.

able (or model) is found by looking at the corresponding cell under the relevant line heading.

The statistical characteristics for all regression results are quite good. The estimated Durbin-Watson statistics mean that the null hypothesis of no positive autocorrelation cannot be rejected. The overall explanatory power of all models is satisfactory, the F-statistics are significant at the 1 percent confidence level in all cases, and the estimates of the incidence parameter are significantly greater than 0 at conventional levels in all but three models.

From the results obtained for the value of Ω , it can be concluded that a major proportion of the incidence of commercial policy interventions designed to protect the importables may be shifted to the export sector in the form of an implicit export tax. As an example, the estimate of Ω in the basic model (Table 1) suggests that the share of incidence borne by the exportable sector is 76 percent. In general, this implies that Zimbabwe's home goods and importables are fairly close substitutes in both consumption and production whereas the relationship between home goods and exportables is weak. It also reflects that Zimbabwe's exportables are fairly inelastic in supply. Hence, they tend to absorb a large proportion of the tariff incidence in the form of reduced rents to the fixed factors of production.

The estimated value of the incidence parameter for total agricultural exports (0.65) is lower than for total exports (0.75). This implies that a one percent tariff will decrease the relative price of total exports by 0.75 percent, but the relative price of agricultural (non-agricultural) exports will fall marginally less (more) than total exports. Obviously, technological and demand characteristics are such that there is less substitutability between non-agricultural exportables and home goods than between agricultural exportables and home goods⁶. This pattern of incidence contrasts with empirical evidence for other developing countries where traditional agricultural exportables exhibit a larger degree of incidence than non-traditional industrial ex-

ports [e.g. in the Ivory Coast; see Greenaway (1989)]. It accords well with a priori theorizing since these other exports are mainly natural resource-based and other constraints like the foreign exchange allocation system hamper adjustment.

Within the agricultural export sector estimates of the incidence parameter in the basic model vary between 0.43 for beef and 0.76 for coffee with those for maize, cotton and tobacco lying between these two extremes. These results contrast with the findings of Mlambo (1989) and can be explained by differences in the data base used. Whereas Mlambo used export price indices [Mlambo (1989), p. 255, Table 6, footnote] we relied on producer prices [Rukovo (1990)], since these are the prices which determine producers' decisions. As clearly shown by Rukovo (1990), nominal protection is high and varies largely for beef. This explains the large discrepancy between Mlambo's estimate of 0.88 and our estimate of 0.43. Obviously, beef producers (mostly large scale commercial farmers) are aware of the eroding effect of increasing home-goods prices and successfully lobbied for higher nominal subsidies to compensate for disprotection by commercial policy.

Modifying the basic model as indicated in Table 2 has only a minor effect on the regression results. As can be seen, the incidence parameters are fairly stable across different model specifications. They are generally high and range from 0.66 to 0.83 for total exports; they are equally concentrated for total agricultural exports, varying from 0.53 to 0.70. There is no clear pattern with regard to food exports (maize, coffee and beef) and cash crops (cotton and tobacco). The range of Ω for coffee exports is between 0.65 and 0.84. The incidence is much lower for beef (0.29 to 0.47), while that for maize, cotton and tobacco is nearly the same lying between 0.57 and 0.76.

The modifications of the basic model stress the robustness of the estimates of Ω . The general conclusion is that the incidence of commercial policy in Zimbabwe is high. This has important implications for the level and structure of incentives.

Table 2: Sensitivity Analysis on the Incidence Parameter θ , Zimbabwe 1966-1987^a

Model ^b	Point Estimates of the Incidence Parameter						
	Total Exports	Total Agricultural Exports	Maize	Coffee	Cotton	Tobacco	Beef
<u>Model 1</u> : Basic model	0.7598 (5.46)	0.6451 (5.28)	0.6525 (5.12)	0.7588 (4.95)	0.6471 (4.54)	0.6755 (5.34)	0.4315 (2.88)
<u>Model 2</u> : Alternative home good price indices							
a) P_{N2} : Wages	0.6581 (2.72)	0.5305 (2.45)	0.5681 (2.36)	0.6541 (2.46)	0.6036 (2.22)	0.5486 (2.41)	0.3190 (1.09)
b) P_{N3} : Food	0.8164 (5.19)	0.6999 (4.88)	0.7596 (5.03)	0.8374 (4.83)	0.6840 (4.47)	0.7287 (4.88)	0.3902 (3.10)
c) P_{N4} : CPI	0.7617 (4.42)	0.6315 (4.00)	0.7110 (4.24)	0.7571 (4.01)	0.5860 (3.88)	0.6670 (4.01)	0.2899 (2.33)
<u>Model 3</u> : Smaller model (no BOT and no Y variable)	0.6605 (1.71)	0.6320 (5.85)	0.6742 (6.28)	0.7446 (5.14)	0.6243 (4.44)	0.6644 (6.16)	0.4691 (3.60)
<u>Model 4</u> : Different specification of P_{XNA} and P_{XA}							
a) weights of 1978		0.6325 (5.40)	0.6526 (5.12)	0.7590 (4.95)	0.6473 (4.54)	0.6788 (5.40)	0.4336 (2.90)
b) weights of 1985		0.6817 (5.94)	0.6525 (5.12)	0.7593 (4.94)	0.6481 (4.54)	0.6874 (5.57)	0.4317 (2.88)
<u>Model 5</u> : Different specification of the income variable (lagged one period)	0.7619 (5.27)	0.6583 (5.19)	0.6805 (6.02)	0.7553 (4.81)	0.6570 (4.32)	0.6822 (5.30)	0.3770 (2.08)
<u>Model 6</u> : Introduction of a lagged endogenous variable	0.8342 (5.18)	0.6399 (4.86)	0.6351 (4.60)	0.7548 (4.54)	0.3563 (3.75)	0.6637 (4.89)	0.0832 (0.69)

^a Values in parentheses are t-values. - ^b The basic model (Model 1) is the model shown in Table 1. All models were corrected for autocorrelation with the Cochrane/Orcutt iteration procedure.

V. True Protection of Imports and Exports

As shown by Greenaway (1989), estimates of the shift parameter can be combined with information on nominal import tariffs and nominal export subsidies to calculate "true tariff rates" and "true subsidy rates", i.e., the extent to which the prices of importables and exportables rise or fall relative to the numeraire, non-tradeables. Thus, the true tariff rate t^* is defined as:

$$t^* = \frac{P_M}{P_N} = \frac{1+t}{1+d} - 1 = \frac{t-d}{1+d} \quad (9)$$

and the true subsidy rate s^* is analogously given by:

$$s^* = \frac{P_X}{P_N} = \frac{1+s}{1+d} - 1 = \frac{s-d}{1+d} \quad (10)$$

where $d = \hat{P}_N = \Omega \hat{P}_M + (1-\Omega) \hat{P}_X$

$$d = \Omega t + (1-\Omega)s \quad (11)$$

In equations (9) to (11) d is the proportional change in the home-goods price and t and s refer to the nominal tariff rate and nominal subsidy rate respectively.

Clearly, if importables and home goods are perfect substitutes ($\Omega=1$) then $d=t$ and $t^*=0$ whereas the sign (and value) of s^* is ambiguous depending on $s > t$. In this case importables enjoy no net protection relative to home goods. Exports are truly discriminated against if nominal tariffs exceed nominal subsidies. On the other extreme, if exportables and home goods perfectly substitute for each other ($\Omega=0$), then $d=s$ and $s^*=0$. Here, too, it may well turn out that importables are truly disprotected despite nominal protection. This is the case, if the increase in the home-goods price resulting from export subsidies exceeds nominal tariffs on importables.

Rukovo (1990) provides details on nominal taxes and subsidies for three agricultural exportables (maize, beef and cotton) and Erzan et al. (1989) computed average tariff rates for total manufacturing. It is interesting to use this information to generate estimates of true protection in Zimbabwe. The actual procedure for estimating true tariff and subsidy rates is to use the shift parameters for maize, beef and cotton reported in Table 1 to estimate d from equation (11) and then substitute this into equations (9) and (10) to get t^* and s^* . The results of this exercise together with the nominal tariff and subsidy rates, the shift parameters used and the changes in the home-goods price are reported in Table 3.

According to these figures the 10% average tariff on manufactured products would lead to changes in the average price for home goods in the range of -35% to +140% depending on the size of the shifting parameter and the level of nominal subsidy. Clearly, the assumption of symmetrical substitutability between individual agricultural exportables and total home goods underlying the calculations in Table 3 leads to an exaggeration of the price pressure on non-tradeables. We cannot expect that subsidies or taxes on individual agricultural exports in fact induce quantity adjustments in the market for home goods sufficiently large to produce such pronounced price changes as reported in Table 3. It nevertheless pays to discuss the results in Table 3 first since they demonstrate more clearly that the actual, net effects of simultaneously operating conflicting policies considerably differ from the intended effects. We then discuss the estimates presented in Table 4 where we assumed that repercussions from export subsidies for individual agricultural exports on the home-goods market can be neglected.

From Table 3, it can be seen that true tariff rates range from -54% to +69% depending on the size of the shift parameter and the level of nominal duties on exportables. Other things equal, t^* will increase as Ω falls, and will increase as s falls. Thus, if we compare maize and beef in 1984/85, we find that t^* falls from 28% to -43%. The lower shift parameter (0.43 rather than 0.65)

Table 3: Estimates of True Tariffs and True Subsidies in Zimbabwe, 1981/82-1986/87^a (symmetrical substitutability) (percent)

Tariffs/Subsidies/ Home-goods Prices	Shift Para- meter (Q)	Year					
		1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Nominal Tariff on Manufacturing (t)		10	10	10	10	10	10
Nominal Subsidy (s) ^b							
- Maize		18	84	59	-59	36	123
- Beef		106	177	238	158	41	-69
- Cotton		-11	31	-2	-33	-17	23
Home-goods Price (d)							
- Maize	0.65	13	36	27	-14	19	50
- Beef	0.43	65	105	140	94	28	-35
- Cotton	0.65	3	17	6	5	1	15
True Tariff (t*)							
- Maize		-3	-19	-13	28	8	-27
- Beef		-33	-46	-54	-43	-14	69
- Cotton		7	-6	4	-16	9	-4
True Subsidy (s*)							
- Maize		5	35	25	-52	14	49
- Beef		25	35	41	33	10	-52
- Cotton		-13	12	-7	-29	-16	7

^a Home-goods prices, true tariffs and true subsidies are calculated on the basis of the incidence parameters estimated in the basic model. The nominal tariff rate t is an unweighted average tariff rate for total manufactures as calculated by Erzan et al. (1989). - ^b Unweighted nominal subsidy rates are taken from Rukovo (1990). They are based on export parity prices by accounting for internal marketing and transport margins. Information on nominal protection rates for coffee and tobacco was not available.

Source: Own computations based on the results given in Table 1.

should mean a higher true tariff since importable prices rise to a greater extent vis-à-vis non-tradeables. This however is more than offset by the change in s from an export tax of 14% for maize to an export subsidy of 94% for beef. The apparent perversity of this conclusion serves to emphasize the limitations of simultaneously attempting to protect import substitutes and promote exports. The fact that true protection is likely to be less than nominal protection provides a motive for demanding further nominal protection. The demand for protective barriers tends to be a continuous process, which never seems to satisfy importers.

According to the figures in Table 3 nominal subsidy rates on exports varied between -59% and 123% for maize, between -69% and 238% for beef and between -33% and 31% for cotton in the period 1981/82-1986/87. The true subsidy rates range from -52% to 49% depending on the value of the shift parameter and the value of nominal duties/subsidies on exportables. Other things equal, s^* will increase as Ω falls and s raises [equations (10) and (11)]. Thus, if we compare the true subsidy rates, resulting from a combined protection of manufactures and maize exports, we find that s^* varies between -52% (1984/85; $s = -59\%$) and 49% (1986/87; $s = +123\%$). The lower shift parameter for beef (0.43 rather than 0.65) should mean a higher true subsidy since non-tradeables prices rise to a lesser extent as a result of import protection. To give an example, if, both, maize and beef are nominally subsidized by 18% in 1981/82 we would expect a higher true subsidy for beef than for maize. However, from equations (10) and (11) the resulting true subsidy rates are 5% for maize and 3% for beef. Obviously, the dampening effect of a smaller Ω on non-tradeables prices is more than offset by the increase of non-tradeables prices resulting from the subsidization of exports. This follows immediately from an analysis of equation (11).

The case where the implicit tax is at a maximum is that which pertains to cotton in 1981/82 and 1983/84. This follows from the relatively high shift parameter - which means that non-tradeables prices rise to a greater extent - and in part from the presence of explicit export taxes on this cash crop. In this case "dis-

protection" brought about by export taxes is enhanced by nominal protection of manufacturing imports.

Where agricultural exports are nominally subsidized, they are also truly subsidized. In other words, disprotection from a 10% import tariff on manufactures is insufficient to offset protection granted by nominal export subsidies. However, there are cases where an import tariff appears to lead to an implicit subsidy on exportables. Beef in 1986/87, e.g., is a case where true taxation is lower than nominal taxation. How can this be explained? The import duties will cause an increase in the price of importables and a fall in the price of beef - both relative to the price of home goods. The export tax on beef will, in turn, decrease the price of beef and increase the price of importables - both relative to the price of home goods. Now, if export taxes are larger than import duties ($|s| > t$), the equilibrium price of home goods will fall by an amount that is less than s but greater than t . This results in lower (higher) true taxes (tariffs) than nominal taxes (tariffs) on exports (imports).

As already mentioned above, the true protection rates are over-estimated because the markets for the individual agricultural exportables are relatively small and sector-specific interventions are unlikely to generate resource movement and spending effects large enough to cause the marked pressure on home-goods prices reported in Table 3. Production-share-weighted nominal protection rates would have been preferable but were not possible to construct given the absence of appropriate information. We, therefore, decided to re-calculate true tariffs and true subsidies under the assumption that export-subsidy induced feedback effects to the market for non-tradeables can be neglected. In this case the equation for calculating changes in the prices of home goods reduces to:

$$\hat{P}_N = Qt \quad (12)$$

and the true tariff rates and true subsidy rates computed from equations (9) and (10) provide lower or upper bounds on the actual rates. The results of this exercise are reported in Table 4.

Table 4: Estimates of True Tariffs and True Subsidies in Zimbabwe, 1981/82-1986/87 (no feed-back effects) (percent)

Tariffs/Subsidies	Home-goods Price (d)	Year					
		1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Nominal Tariff on Manufacturing (t)		10	10	10	10	10	10
True Tariff (t*)							
- Maize	6.5	3	3	3	3	3	3
- Beef	4.3	5	5	5	5	5	5
- Cotton	6.5	3	3	3	3	3	3
True Subsidy (s*)							
- Maize		11	73	49	-62	28	109
- Beef		98	166	224	147	35	70
- Cotton		-16	23	-8	-37	-22	15

Source: Own computations based on Tables 1 and 3.

According to these figures, the true tariff on importables is always positive and ranges from 3% to 5% depending on the value of the shift parameter. Since we ruled out repercussions by export subsidies but the shift parameter falls, we observe an increase in the true tariff for manufacturing in the case of beef. For all cases the estimated true tariff is substantially less than the nominal tariff.

In the case of exportables true subsidies range from 224% for beef in 1983/84 to -62% for maize in 1984/85. In all scenarios import protection either increases nominal taxation or reduces nominal subsidies thereby reinforcing or counteracting sector-specific policies. However, since nominal subsidies and nominal tariffs are high and the incidence parameter is similar for different export commodities a 10% import tariff is unlikely to change the fundamental structure of protection in the agricultural sector.

VI. Total Protection of Agricultural Exports

The incidence parameters estimated for Zimbabwe indicate the extent to which a one percent tariff distortion in the manufacturing sector is shifted on to producers of agricultural exportables. When multiplied by the prevailing tariff rate for manufactures, they provide an estimate of the implicit tax rate on these agricultural products. On the other hand, the negative of the nominal rate of protection provides an estimate of nominal taxation. It measures the tax/subsidy rate which can be manipulated by government and therefore indicates the intended or explicit taxation/subsidization of agricultural products. Taken together, implicit taxes and explicit taxes or subsidies indicate total taxation of agricultural output (TTR) [García (1981)]. Formally, this implies:

$$TTR_i = NTR_i + \Omega NPR_M \quad (13)$$

where NTR_i is the negative nominal protection rate (NPR_i) of a particular agricultural export commodity, Ω is the incidence parameter and NPR_M is the average tariff rate on manufactures. NTR_i is positive if the commodity is nominally taxed; negative if it is subsidized. Hence, the total tax or subsidy rate is determined by

- (i) the magnitude of the import tariff;
- (ii) the size of the shifting parameter, and
- (iii) the extent of nominal protection.

The regression results of the basic model (Table 1) suggest that the shifting of the tax burden differs only slightly across the three agricultural exportables maize, beef and cotton. Thus, differentials in protection between the three agricultural exportables are mainly attributable to differential nominal protection. This is confirmed by the different tax/subsidy rates reproduced in Table 5.

Given the estimated average incidence parameters of 0.65 for maize and cotton and 0.43 for beef, the corresponding implicit taxes on these commodities emanating from the average import tariff of 10% are 6.5% and 4.3% respectively. Total taxes are made up of the direct (explicit) and implicit taxes.

From the results given in Table 5 one can conclude that the prevailing tariff rate for total manufacturing has only a minor impact on agricultural incentives. Low nominal import protection together with similar incidence parameters for the three agricultural exports means that the level and structure of protection in the agricultural export sector is not affected profoundly by indirect protection. Furthermore, nominal tariffs and subsidies on agricultural exportables are very high. As indicated in the last section this may induce changes in the prices for non-tradeables. The repercussions from these price changes may be sufficiently large to offset the small negative impact brought about by industrial protection.

Table 5: Explicit, Implicit and Total Taxes on Major Agricultural Exports in Zimbabwe, 1981/82-1986/87 (percent)

Crop/Taxes	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Maize						
Explicit	-18.0	-84.0	-59.0	59.0	-36.0	-123.0
Implicit	6.5	6.5	6.5	6.5	6.5	6.5
Total	-11.5	-77.5	-52.5	65.5	-29.5	-116.5
Beef						
Explicit	-106.0	-177.0	-238.0	-158.0	-41.0	69.0
Implicit	4.3	4.3	4.3	4.3	4.3	4.3
Total	-101.7	-172.7	-233.7	-153.7	-36.7	73.3
Cotton						
Explicit	11.0	-31.0	2.0	33.0	17.0	-23.0
Implicit	6.5	6.5	6.5	6.5	6.5	6.5
Total	17.5	-24.5	8.5	39.5	23.5	-16.5

Source: Own computations based on Rukovo (1990), Erzan et al. (1989) and the incidence parameters given in Table 1.

VII. Summary and Conclusions

It was the objective of this paper to investigate the effects on incentives to agricultural exports of policies to encourage import substitution and export promotion in Zimbabwe. To estimate the effect on prices of a system of tariffs and subsidies on imports and exports, a simple model incorporating importables, exportables and home goods was used and different protection measures were calculated. The major results that emerge from our analysis can be summarized as follows:

1. The empirical results obtained for Zimbabwe confirm the findings obtained in other studies on the subject. In particular, they underline the importance of macroeconomic repercussions of commercial policy for the export sector. For example, a uniform tariff of 10 percent on all imports constitutes a tax equivalent of 7.6 percent on all exports. In other words, with the same amount of exports, an exporter can obtain 7.6 percent less of nontraded commodities.
2. The estimates of the incidence parameters for total agricultural exports and individual agricultural exports are highly significant, stable across different model specifications and generally range above 0.6. This implies that a large share of a uniform import tariff is shifted on to producers of agricultural exportables as an implicit tax.
3. The true subsidy rates and true tariff rates are generally lower than the nominal rates. This emphasises the limitations of simultaneously attempting to protect import substitutes and promote exports. While commercial policy authorities can fix individual tariffs and subsidies, they have little or no control over the incidence of the tariff and subsidy structure.
4. From the calculations of total taxes, it can be concluded that a uniform tariff on imports of 10 percent represents a tax on maize and cotton of 6.5 percent and on beef of 4.3

percent. If exports are taxed directly as is the case for cotton in most of the years investigated, the total tax is even higher (ranging between 8.5 percent and 39.5 percent for cotton).

The analysis suggests that direct government intervention in producer prices has generally been favourable to maize and beef exporters whereas cotton exports show no clear protection pattern. Moreover, the average nominal tariff rate on manufacturing has been rather low during the period of investigation. Low nominal import protection together with similar incidence parameters for the three agricultural exportables means that the level and structure of protection in the agricultural export sector has not been affected profoundly by indirect protection. This result contrasts with findings for other LDCs where we observe not only indirect discrimination but also direct discrimination by government through agricultural pricing policies. However, in order to evaluate Zimbabwean incentive policy comprehensively it would be necessary to recognize also the overvaluation of the Zimbabwean dollar which is estimated to result in a net transfer out of agriculture [Masters (1989)].

Notes

- 1 For the economies of Colombia, Uruguay, Argentina, Chile, Brazil, and Peru Clements and Sjastaad (1984) estimated that exporters in all these countries, and producers of import-competing foodstuffs in some of them, have paid at least half of the cost of industrialization programs. For Zimbabwe, the current exchange rate control system is estimated to result in a total net transfer out of agriculture on the order of half a billion dollars; an amount which by far exceeds the entire budget of the Ministry of Lands, Agriculture and Rural Re-settlement [Masters (1989)].
- 2 Empirical findings from the World Bank's project on "The Political Economy of Agricultural Pricing Policies" suggest that the indirect effects of general macroeconomic policies dominate the direct effects from sector-specific agricultural policies in many of the LDCs and NICs investigated. The real-exchange rate effects of general macroeconomic policies are calculated there and the price effects of direct and indirect policies are compared. Descriptions and first results on the comparative study, which encompasses 18 detailed country studies are summarized in Krueger/ Schiff/Valdés (1988) and Schiff (1988). Published country studies include Avillez/ Finan/Josling (1988) on Portugal, Greene/Roe (1989) on the Dominican Republic, Jansen (1988) on Zambia, García/Llamas (1989) on Colombia, Dethier (1989) on Egypt, Jenkins/Lai (1989) on Malaysia, Tuluy/Salinger (1989) on Morocco, Siamwalla/Setboonsarng (1989) on Thailand and Moon/Kang (1989) on Korea.
- 3 See Rukovo (1990) and Takavarasha (1990) for analyses of direct agricultural policy in Zimbabwe.
- 4 These are the assumptions which characterize the special case analyzed on pages 181 et seq.
- 5 A more detailed description and illustration of the shifting principle and the concept of true protection is provided by Greenaway/Milner (1987).
- 6 This presumption is confirmed by the results of the following regression for non-agricultural exportables:

$$\ln (P_{N1}/P_{XNA}) = -3.3834 + 0.7861 \ln (P_M/P_{XNA}) + 0.1883 \ln (P_{XA}/P_{XNA}) \\ (-0.85) \quad (4.66) \quad (1.27) \\ - 0.7169 \cdot 10^{-3} \text{ BOT} + 0.2373 \ln Y \\ (-0.52) \quad (0.41)$$

$$\text{Rho} = -0.1999; \quad \bar{R}^2 = 0.73; \quad F = 14.83; \quad \text{DW} = 1.89 \\ (-0.21)$$

As indicated by the regression results the incidence parameter for non-agricultural exports is higher than the estimator for agricultural exports (Table 1). This implies that the substi-

tutability between importables (exportables) and home goods is higher (lower) for non-agricultural exportables than in the case of agricultural exportables.

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Appendix 1: Data Base for the Regression Analysis on True Protection in Zimbabwe, 1966-87 (a)

Year	GDP in 1980 prices (Mill. US\$ Z\$)	Trade Balance (Mill. US\$)	Price of Non-tradeables				Prices of Total		Prices of Agricultural Exports					Weighted Totals		
			Building Material	Wages	Food	CPI	Imports	Exports	Maize	Coffee	Cotton	Tobacco	Beef	1980	1978	1985
	Y	BOT	PN1	PN2	PN3	PN4	PM	PX	PXM	PXC	PXCO	PXT	PXB	PXA1	PXA2	PXA3
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1966	1189	7	27.6	35.8	42.4	45.2	28.10	33.70	33.84	27.86	39.20	55.86	41.91	48.46	46.27	47.73
1967	1271	-29	28.4	36.1	43.1	46.1	28.00	32.60	34.27	29.91	41.63	64.57	43.76	54.37	51.30	53.57
1968	1373	-71	29.2	36.9	44.1	47.1	27.60	33.30	38.27	28.32	41.63	64.57	44.66	54.53	51.84	53.72
1969	1546	3	30.3	38.3	44.6	48.4	28.10	35.40	36.32	29.05	40.45	53.25	44.31	47.63	46.04	46.92
1970	1669	-8	31.6	38.7	46.0	50.0	29.40	39.50	38.67	36.27	40.45	53.05	44.09	47.81	46.57	47.46
1971	2006	-52	32.6	40.0	47.2	51.6	31.30	36.80	35.35	34.09	43.57	58.70	45.32	51.83	49.52	51.16
1972	2297	37	33.7	42.5	49.5	53.8	30.60	27.30	30.45	30.64	48.80	61.88	49.78	55.18	52.01	53.99
1973	2493	82	36.0	44.5	51.2	55.8	31.90	40.60	42.79	31.91	70.91	68.71	60.18	66.49	62.68	64.54
1974	3079	-2	41.9	48.1	56.7	60.0	43.50	53.20	47.19	36.32	74.67	98.49	70.05	85.77	79.84	83.61
1975	3294	0	47.9	53.9	61.4	64.6	48.00	58.40	43.53	39.64	70.00	86.55	72.69	77.85	73.54	75.94
1976	3268	187	52.9	60.5	66.9	70.4	54.40	59.30	51.76	83.23	95.68	86.55	70.27	86.30	81.25	85.56
1977	3064	166	61.7	67.8	73.5	77.1	60.00	61.70	61.18	125.91	88.00	92.18	71.40	89.24	86.02	90.74
1978	2998	214	69.2	73.8	82.1	82.3	68.20	65.70	62.35	82.77	88.00	124.33	70.60	106.30	98.85	105.79
1979	3105	124	82.8	80.4	91.3	91.6	93.30	75.50	71.18	116.95	97.33	103.65	86.87	99.77	96.51	100.35
1980	3441	-34	100.0	100.0	100.0	100.0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1981	3905	-288	125.5	129.8	113.4	114.6	99.50	110.60	141.18	68.73	106.67	231.17	126.74	179.94	170.68	177.83
1982	4035	-363	142.2	141.0	126.3	135.7	99.10	125.10	141.18	79.00	137.33	210.49	159.28	179.55	172.84	176.26
1983	4088	-193	166.2	227.6	152.1	158.0	116.40	146.30	141.18	97.59	137.33	237.20	161.04	195.64	186.70	192.99
1984	3997	-87	190.5	256.4	183.8	177.7	131.20	158.30	164.71	135.82	152.00	259.86	182.44	216.55	208.58	214.90
1985	4419	82	236.1	283.8	200.6	195.3	152.70	188.50	211.76	175.82	178.67	337.75	189.00	272.03	258.99	271.44
1986	5135	170	260.8	336.6	225.1	222.8	159.70	192.00	211.76	249.05	200.00	394.23	221.71	315.48	299.09	316.36
1987	5649	225	292.4	364.9	261.0	247.9	183.00	194.00	211.76	133.86	213.33	274.16	291.44	252.50	250.89	247.14

Appendix 1 (Cont.)

Year	Prices of Other Exports																	
	Weights = 1980						Weights = 1978						Weights = 1985					
	excl. Maize	excl. Coffee	excl. Cotton	excl. Tobacco	excl. Beef	excl. Agri.	excl. Maize	excl. Coffee	excl. Cotton	excl. Tobacco	excl. Beef	excl. Agri.	excl. Maize	excl. Coffee	excl. Cotton	excl. Tobacco	excl. Beef	excl. Agri.
PXNM1	PXNC1	PXNCO1	PXNT1	PXNB1	PXNA1	PXNM2	PXNC2	PXNCO2	PXNT2	PXNB2	PXNA2	PXNM3	PXNC3	PXNCO3	PXNT3	PXNB3	PXNA3	
(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	
1966	33.70	33.75	33.26	29.60	33.50	28.20	33.69	33.82	33.26	28.72	33.11	25.66	33.70	33.89	33.10	26.82	33.46	23.71
1967	32.58	32.62	31.88	26.69	32.33	24.49	32.52	32.66	31.88	25.42	31.80	20.64	32.56	32.69	31.62	22.68	32.28	17.67
1968	33.25	33.34	32.64	27.52	33.02	25.39	33.06	33.41	32.64	26.27	32.49	21.45	33.19	33.46	32.39	23.60	32.97	18.76
1969	35.39	35.46	35.00	32.10	35.18	30.84	35.36	35.53	35.00	31.39	34.76	28.60	35.38	35.61	34.85	29.86	35.14	27.19
1970	39.51	39.53	39.42	37.00	39.39	36.40	39.54	39.57	39.42	36.45	39.17	34.98	39.52	39.60	39.40	35.30	39.37	33.83
1971	36.81	36.82	36.26	32.75	36.59	31.20	36.87	36.86	36.26	31.88	36.19	28.67	36.83	36.89	36.06	30.01	36.55	26.57
1972	27.27	27.27	25.59	20.91	26.75	16.91	27.15	27.23	25.59	19.53	25.69	11.50	27.23	27.19	24.96	16.57	26.65	8.29
1973	40.58	40.68	38.19	35.40	40.12	30.95	40.50	40.78	38.20	34.28	39.20	26.48	40.55	40.88	37.30	31.88	40.04	23.56
1974	53.26	53.35	51.49	44.83	52.79	41.06	53.49	53.56	51.50	43.02	52.00	36.17	53.33	53.75	50.86	39.15	52.71	31.55
1975	58.54	58.56	57.48	53.20	58.05	51.15	59.11	58.80	57.48	52.07	57.38	48.72	58.73	59.01	57.14	49.67	57.99	45.91
1976	59.37	59.09	56.41	54.26	59.03	49.24	59.66	58.79	56.41	53.18	58.52	45.27	59.47	58.52	55.34	50.85	58.98	40.60
1977	61.70	61.14	59.61	56.07	61.46	51.44	61.72	60.34	59.61	54.85	61.01	46.15	61.71	59.62	58.84	52.24	61.42	41.02
1978	65.73	65.55	63.93	54.86	65.58	50.57	65.86	65.34	63.93	52.52	65.35	44.51	65.77	65.15	63.27	47.51	65.56	37.15
1979	75.54	75.14	73.76	70.30	75.22	66.45	75.71	74.62	73.77	69.17	74.69	62.07	75.59	74.16	73.12	66.77	75.17	57.80
1980	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1981	110.31	110.97	110.91	88.31	110.21	84.76	109.14	111.49	110.91	83.50	109.45	72.19	109.93	111.96	111.03	73.19	110.14	62.73
1982	124.95	125.50	124.13	109.32	124.27	104.81	124.33	126.08	124.13	105.91	122.66	94.57	124.75	126.59	123.77	98.61	124.12	88.67
1983	146.35	146.73	147.01	129.50	145.94	127.91	146.54	147.33	147.01	125.87	145.25	120.47	146.41	147.88	147.28	118.10	145.88	113.06
1984	158.24	158.50	158.80	139.53	157.71	136.59	157.99	158.78	158.80	135.48	156.57	126.16	158.16	159.03	158.99	126.79	157.60	118.00
1985	188.28	188.61	189.28	160.91	188.49	157.37	187.39	188.77	189.28	154.96	188.46	143.43	187.99	188.91	189.57	142.19	188.49	129.45
1986	191.81	191.50	191.36	154.62	191.28	145.98	191.06	190.79	191.37	146.55	189.88	123.53	191.57	190.15	191.13	129.25	191.14	103.45
1987	193.83	194.53	192.46	179.18	191.63	172.20	193.15	195.28	192.47	175.98	187.04	157.63	193.61	195.95	191.90	169.13	191.19	156.16

(a) All prices are expressed in Zimbabwean dollars (Z\$). PN1 is the building materials price index, PN2 is the component of domestic workers wages in the consumer price index (CPI), PN3 is the food component of CPI and PN4 the average CPI. The prices of total agricultural exportables (PXA1, PXA2, PXA3) were calculated as weighted price indices for maize, coffee, cotton, tobacco and beef. Export earnings for the five products are used as weights (PXA1: 1980; PXA2:1978; PXA3:1985). For beef, export earnings from meat, fresh, frozen or chilled and other meats were used as an approximation of the beef export share. The prices for other exportables [columns (17)-(34)] were calculated in an analogous manner. The weights for the indices were calculated from CSO, Quarterly Digest of Statistics, various issues. This information and the formulas for calculating the price indices are given in Appendices 2 and 3.

Source: Column (1): Reserve Bank of Zimbabwe; column (2): IMF (1988); columns (3)-(8): CSO, various issues; columns (9)-(13): Rukovo (1990); columns (14)-(34): calculated with data given in columns (8)-(13) and Appendix 2.

Appendix 2: Weights of Commodity Groups in the Price Index of Exports

SITC Code	Section	1980		1978		1985	
		\$ thousand	share (%)	\$ thousand	share (%)	\$ thousand	share (%)
		x_i	q_i	x_i	q_i	x_i	q_i
0a	Maize	7398	0.94	25433	4.55	33247	2.15
0b	Coffee	6871	0.87	11612	2.08	48586	3.14
0c	Meat	18626	2.37	37274	6.67	43238	2.80
0d	All other food	70090	8.90	31475	5.63	113338	7.33
1a	Tobacco	122848	15.60	102494	18.35	365890	23.68
1b	Beverages	156	0.02	235	0.04	363	0.02
2a	Cotton	58052	7.37	41072	7.35	151678	9.82
2b	Other crude materials except fuels	111374	14.14	85071	15.23	139076	9.00
3	Mineral fuels, related products and electricity	11571	1.47	7872	1.41	15915	1.03
4	Animal and vegetable oils and fats	2775	0.35	5764	1.03	4183	0.27
5	Chemicals and related products	7961	1.01	4623	0.83	24162	1.56
6	Basic manufactures	288581	36.64	168347	30.13	516267	33.30
7	Machinery, transport, radio/TV and electr. equipm.	15220	1.93	14059	2.52	24859	1.61
8+9	Miscellaneous manufactured goods	66003	8.39	23330	4.18	66311	4.29
	Total	787526	100.00	558661	100.00	1545343	100.00

Source: CSO: Quarterly Digest of Statistics, various issues.

Appendix 3: On the Calculation of Price Indices for Total Agricultural Exports and Other Exports

For total agricultural exports (P_{XA}), the price index is calculated as

$$P_{XA} = \frac{[q_{0a} \cdot P_{XM} + q_{0b} P_{XC} + q_{0c} P_{XB} + q_{1a} P_{XT} + q_{2a} P_{XC0}] / [q_{0d} + q_{1b} + q_{2b} + \sum_{i=3}^9 q_i]}$$

For other exports (P_{XNA}), the price index is calculated as

$$P_{XNA} = [P_X - q_j \cdot P_{XAJ}] / \sum_{i \neq j} q_i \quad \text{or}$$

$$P_{XNA} = [P_X - \sum_j P_j P_{XAJ}] / \sum_{i \neq j} q_i$$