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SUBSIDY: Some Further Results

by

Jagdish Bhagwati, V.K. Ramaswami and T.N. Srinivasan

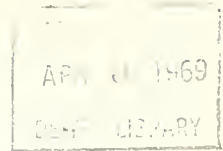
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DOMESTIC DISTORTIONS, TARIFFS AND THE THEORY OF OPTIMUM

SUBSIDY: Some Further Results<sup>1</sup>

Bhagwati and Ramaswami [1] showed that if there is a distortion, the Paretian first-best policy is to intervene with a tax (subsidy) at the point at which the distortion occurs. Hence a domestic tax-cum-subsidy with respect to production would be first-best optimal when there was a domestic distortion (defined as the divergence between domestic prices and the marginal rate of transformation in domestic production) just as a tariff policy would be first-best optimal under monopoly power in trade (which involves a foreign distortion). An important corollary, for the case of a distortionary wage differential, is that while a tax-cum-subsidy policy with respect to factor use would be first-best optimal, the second-best optimal policy would be a domestic production tax-cum-subsidy rather than a tariff policy.

While these central results are valid, Kemp and Negishi [3] have correctly argued that two subsidiary propositions of Bhagwati and Ramaswami (1963) are false. These are:

(1) No tariff (export subsidy) may exist which is superior to free trade in the presence of a domestic distortion; and

(2) no production tax-cum-subsidy may yield greater welfare than non-intervention when the nation has monopoly power.

We can demonstrate, however, that the Kemp-Negishi results are in fact special cases of the first of the following two theorems in the theory of second-best, which we shall prove:

Theorem 1: If under laissez-faire two of the variables DRS, DRT and FRT are equal while the third has a different value, and the policy measure that will secure equal values of the three variables cannot be applied, some policy measure will exist that will raise welfare above the laissez-faire level, though it destroys the equality of the first two variables.<sup>2</sup>

Theorem 2: If under laissez-faire all the three variables DRS, DRT and FRT have different values, and both the policy measures that will secure equal values of the three variables cannot be applied, no feasible form of intervention may exist that will raise welfare.

We use the following notation:

$C_i, X_i$  denote the consumption and domestic output respectively of commodity  $i$ ,  $i = 1, 2$ .

$p_c$  denotes the ratio of the price of the first to that of the second commodity confronting consumers (DRS).

$p_t$  denotes  $DRT = -dX_2/dX_1$ .

$p_f$  denotes the ratio of the world price of the first commodity to that of the second commodity, i.e., the average terms of trade. The marginal terms of trade  $FRT = p_f$  only in the special case in which national monopoly power does not exist.

The welfare function  $U(C_1, C_2)$  and the production functions are assumed to be differentiable as required.  $U_i$  denotes the marginal utility of commodity  $i$  ( $i = 1, 2$ ). It is assumed throughout the analysis that under laissez-faire there is non-specialisation in consumption and production, and that some trade takes place.

Our procedure is as follows. We derive the expression for the change in welfare when there is a slight movement away from an initial equilibrium in which there is no intervention. If the levy of some tax (subsidy) at a small rate will secure a positive value for this expression, we can conclude

that welfare can be raised above the laissez-faire level by applying this tax (subsidy). Note that in such a case some finite (and not merely infinitesimal) tax (subsidy) rate will exist which yields greater welfare than laissez-faire. If the derivative of welfare with respect to the rate of some tax (subsidy) is non-zero at the laissez-faire point, then by continuity it is non-zero for some finite interval of values of the tax (subsidy) rate around the laissez-faire point. If, on the other hand, the levy of some tax (subsidy) at a small rate does not change welfare, then there may not exist any rate of this tax (subsidy) which secures more welfare than under non-intervention.<sup>3</sup>

The change in welfare due to a small deviation from an initial laissez-faire equilibrium is

$$\begin{aligned}dU &= U_1 dC_1 + U_2 dC_2 \\ &= U_2 \left[ \frac{U_1}{U_2} dC_1 + dC_2 \right].\end{aligned}$$

The marginal condition for utility maximization is that  $U_1/U_2 = p_c$ .

So

$$\begin{aligned}dU &= U_2 [p_c dC_1 + dC_2] \\ &= U_2 [p_f dC_1 + dC_2 + (p_c - p_f) dC_1] \\ &= U_2 [d(p_f C_1 + C_2) - C_1 dp_f + (p_c - p_f) dC_1].\end{aligned}$$

Assuming balanced trade,

$$p_f C_1 + C_2 = p_f X_1 + X_2.$$

So

$$\begin{aligned}
 dU &= U_2 [d(p_f X_1 + X_2) - C_1 dp_f + (p_c - p_f) dC_1] \\
 &= U_2 [p_f dX_1 + dX_2 + (X_1 - C_1) dp_f + (p_c - p_f) dC_1] \\
 &= U_2 [dX_1 (p_f + \frac{dX_2}{dX_1}) + (X_1 - C_1) dp_f + (p_c - p_f) dC_1] \\
 &= U_2 [dX_1 (p_f - p_t) + (X_1 - C_1) dp_f + (p_c - p_f) dC_1] \tag{1}
 \end{aligned}$$

Theorem 1: There are three ways in which, under laissez-faire, two of the variables DRS, DRT and FRT have equal values, while the third has a different value:  $DRS = FRT \neq DRT$ ,  $DRS = DRT \neq FRT$  and  $DRS \neq DRT = FRT$ . We consider these three cases in turn.

Case I:

Assume that national monopoly power does not exist. We then discuss two alternative cases in turn: (i) production externality<sup>4</sup>; and (ii) wage differential in one activity.<sup>5</sup> In either case,  $DRS = FRT \neq DRT$ , and we have  $p_c = p_f$ ,  $dp_f = 0$  and  $p_f \neq p_t$ . So (1) reduces to:

$$dU = U_2 [dX_1 (p_f - p_t)]. \tag{2}$$

It is clear that any policy measure that slightly increases (reduces) the output of the first commodity will raise welfare, if  $p_f$  is greater (less) than  $p_t$ .

So if, in the externality case, it is not feasible to secure first-best through the levy of a production tax-cum-subsidy, greater welfare than under laissez-faire can be attained if (i) a tariff (trade subsidy) or (ii) a factor tax-cum-subsidy is imposed. Note further than a tariff is not necessarily superior to a factor tax-cum-subsidy policy: which of these measures is preferable in a given situation will depend on the form of the welfare and production functions. Thus in any specific situation, a factor

tax-cum-subsidy policy may be the second-best, optimal policy and the tariff (trade subsidy) the third-best, optimal policy.<sup>6</sup>

In the case of a distortionary wage differential, the first-best policy is a factor tax-cum-subsidy, the second-best policy is a production tax-cum-subsidy and the third-best policy is the tariff.<sup>7</sup>

Case II:

Now assume that there is no domestic distortion but national monopoly power exists, so that  $DRS = DRT \neq FRT$  under laissez-faire. Then  $p_c = p_t = p_f$  and  $dp_f \neq 0$ ; and so (1) reduces to

$$dU = U_2(X_1 - C_1)dp_f. \quad (3)$$

Thus production, consumption and factor-use tax-cum-subsidies will exist that will raise welfare above the laissez-faire level by changing the marginal rate of transformation through trade. It would appear, however, that we could not determine a priori what the second-best, optimal policy will be: and the ranking of the three policies--production, consumption and factor-use tax-cum-subsidies--which are available when the first-best tariff policy is ruled out, will depend on the specific situation being considered.

Case III:

Suppose now that there is no national monopoly power or distortion or externality in production but that the sellers of one commodity charge consumers a uniform premium over the cost of both domestic and imported supplies. Then under laissez-faire  $DRS \neq DRT = FRT$ . We have  $dp_f = 0$ ,  $p_f = p_t$ ,  $p_c \neq p_f$ ; and so (1) reduces to

$$dU = U_2[(p_c - p_f)dC_1]. \quad (4)$$

Thus clearly the levy of a consumption tax-cum-subsidy will secure Paretian first-best. Furthermore, levy of a tariff is necessarily superior to laissez-faire. Moreover, the imposition of production or factor-use taxes (subsidies) may also be superior to laissez-faire (unless inferior goods in social consumption were ruled out).<sup>8</sup>

This completes our proof and discussion of Theorem 1. An intuitive explanation is perhaps in order. A small deviation as the result of the levy of a tax (subsidy) from an initial situation of equality of the values of two of the variables DRS, DRT and FRT does not entail welfare loss. So if the tax (subsidy) brings the value of the third variable closer to those of the two variables which were initially equal, the welfare gain on this account will constitute a net improvement in welfare. More than one form of tax (subsidy) may secure this result; and so the levy of any one of these will be superior to laissez-faire.

But it should be noted that when only the policy that secures first-best can make DRS, DRT and FRT equal, and adoption of this policy is ruled out, as when national monopoly power exists but a tariff cannot be levied, alternative policies cannot be ranked except with reference to the facts of a given situation. The corollary of this proposition is that when a second-best policy alone can secure equality of DRS, DRT and FRT, as when a distortionary wage differential cannot be directly attacked, the third-best policy cannot be determined a priori.

Theorem 2: Assume now that national monopoly power exists, and that there is a production externality or that factor taxes (subsidies) cannot be used to eliminate a distortionary wage differential. Then  $DRT \neq DRS \neq FRT$ . We rule out the case in which, by chance,  $DRT = FRT$ . So  $p_f \neq p_t$ ,  $dp_f \neq 0$  and  $p_c = p_f$ ; and (1) reduces to

$$dU = U_2 [dX_1 (p_f - p_t) + (X_1 - C_1) dp_f]. \quad (5)$$

The levy simultaneously of both a tariff and a production tax (subsidy) would secure first-best in the case of a production externality and second-best in the case of a distortionary wage differential. But if only a tariff or a production tax (subsidy) is applied, there may be exactly offsetting changes in  $dX_1(p_f - p_t)$  and  $(X_1 - C_1)dp_f$ , and welfare may not increase. So if both the policy measures needed to secure equality of DRS, DRT and FRT cannot be applied, no feasible intervention may exist that will raise welfare above the laissez-faire level.

## Footnotes

1. H. G. Johnson has provided useful comments on an earlier draft of this note.
2. DRS, DRT and FRT denote respectively the marginal domestic rate of substitution in consumption, the marginal domestic rate of transformation in production and the marginal rate of transformation through trade.
3. If the function relating the level of welfare and the rate of a specified tax (subsidy) is concave, and has a local maximum at the laissez-faire point, then this local maximum is a global maximum, and a finite tax (subsidy) must reduce welfare below the laissez-faire level. If this function is not concave, however, the local maximum need not be a global maximum and therefore some finite tax (subsidy) may exist which raises welfare above the laissez-faire level.
4. A production externality that would produce a domestic distortion, in the sense of a divergence between the domestic prices and DRT, is where the production functions are the following:

$$X = X(L_x, K_x)$$

$$Y = Y(L_y, K_y, X)$$

where the output of commodity y is a function of not merely the inputs of labour ( $L_y$ ) and capital ( $K_y$ ) but also the output-level of commodity x, but the market does not remunerate the x-producers for this productivity.

5. We will be assuming that the wage differential is distortionary, as in Bhagwati and Ramaswami [1].
6. Thus Kemp and Negishi [3], who do not consider the entire range of policies that may be available when the first-best policy is ruled out, imply incorrectly that the "second-best, optimal" policy in a situation with domestic distortions will be a tariff (trade subsidy) policy.
7. Note that a consumption tax-cum-subsidy policy can only make the economy worse off, by adding a consumption loss to the loss already being suffered by the economy thanks to the distortion.
8. Note that in the present case, dealing with a domestic consumption distortion, a production or factor-use tax-cum-subsidy policy may improve welfare, whereas Case I, dealing with a domestic production distortion, did not admit to a consumption tax-cum-subsidy raising welfare above the laissez-faire level. The reason for this asymmetry is as follows. In



the latter case, a consumption tax-cum-subsidy, whether small or large, cannot shift production, and hence cannot improve welfare. In the former case, however, a production or factor-use tax-cum-subsidy can affect consumption through its income effect. The levy of such a tax-cum-subsidy at an infinitesimal rate cannot of course change welfare, because the income effect is zero to a first order of approximation; but when the rate is large welfare may improve if the function relating welfare and the rate of tax (subsidy) is not concave (a possibility introduced by the presence of goods inferior in social consumption).

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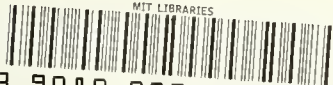
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