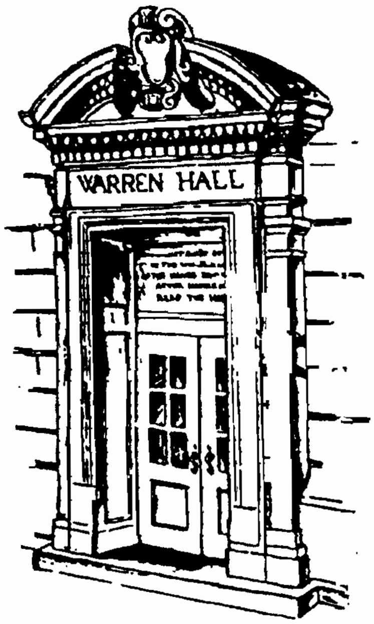
WP 95-12
October 1995



Working Paper

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INEQUALITY AND THE POLITICS OF REDISTRIBUTION AND PUBLIC GOOD INVESTMENTS

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Abstract

This paper shows how inequality affects policy choices in a public choice model with both growth-promoting public good investments and a distortionary commodity policy that redistributes income. We show that a public good investment can offset existing (exogenous) income inequality, but can also be a source of additional (endogenous) inequality. In the first case, the need for distortionary redistribution is reduced, but in the latter case an increase in either source of inequality generates a political need for redistribution which results in more deadweight costs.

We show that the politically optimal policy choice is conditional on pre-policy endowment income inequality, on the income distribution effects of both policies, and on their interaction. There are two distinct types of interaction effects: "economic interaction effects (EIEs)" and "political interaction effects (PIEs)" The PIEs drive the results that are similar to the endogenous policy literature: pre-policy income inequality induces transfers from rich to poor sectors. However, the social gains in bringing public good investment closer to the social optimum may be offset by increased deadweight costs of redistribution. The deadweight cost effect can be separated in two parts. Total deadweight costs increase with more redistribution through the commodity policy. However, the economic interaction effect (EIE) will usually reduce deadweight costs per unit of transfer, thereby mitigating the increase in deadweight costs

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INEQUALITY AND THE POLITICS OF REDISTRIBUTION AND PUBLIC GOOD INVESTMENTS

Introduction

The endogenous policy literature has emphasized the links between income distribution and economic growth (Persson and Tabellini 1992, 1994; Alesina and Perotti; and Alesina and Rodrik). The main insight of these papers is that income inequality has a negative effect on growth because inequality results in a higher demand for fiscal redistribution through the taxation of capital. This depresses private investment by increasing the tax burden of redistribution (Alesina and Rodrik, Persson and Tabellini, 1992, 1994). Alesina and Perotti's conclusion is somewhat different: they argue that income inequality fuels social discontent and political instability. In turn, socio-political instability increases the uncertainty faced by entrepreneurs and, therefore, reduces investment. As a consequence, income inequality has a negative influence on capital accumulation and growth. However, if this is the case, "fiscal transfers may be beneficial, if the fiscal burden of the transfers is compensated by the gain in social harmony" Alesina and Perotti (p.2).

Furthermore, the choice of the policy instrument used for compensating inequality has a crucial impact on growth. For example, Perotti (1990) shows that in a poor society, where educational investment is indivisible, more inequality may lead to higher growth when taxes are used for investment in education. Similarly, Saint-Paul and Verdier (1991) show that more inequality may induce growth if it leads to more redistribution in the form of public education. These results indicate that the choice of the policy instrument matters. Persson and Tabellini therefore (1992, p. 601) suggest that "[f]uture research should try to identify the link between income distribution and policy and the link between policy and growth".[1] Similarly, Alesina and Perotti argue that "[t]he next step ... is to look more explicitly at actual policy instruments. The link between politics and economics goes through policy choices" (p. 22)

[1] Persson and Tabellini (1992) warn, however, that "this is going to be pretty hard work" (p. 601).

The contribution of this paper is to show how inequality affects policy choices in a public choice model which has both growth-promoting public good investment and a distortionary commodity policy that redistributes income between sectors. Our model identifies two sectors with competing interests: a rural (agricultural) and an urban (industry) sector. The importance of public good investments on productivity and growth in agriculture has been well documented for both industrial and developing countries (Huffman and Evenson, 1992, 1994; Ruttan; and Stiglitz).[2]

Our public choice model generalizes the politician-voter model analyzing redistributive policy in Swinnen and de Gorter (1993) by introducing public good investment as a second policy.[3] In this framework, both policies are determined through the interaction of rational and fully informed politicians and voters. The existence of public good investments as a second policy complicates the relationship as to how inequality affects redistribution. We explicitly account for distributional effect of public good investments.[4] Public good investment can therefore offset existing (exogenous) income inequality, but can also be a source of additional (endogenous) inequality. In the first case, the need for distortionary redistribution is reduced, but in the latter case an increase in either source of inequality generates a political need for redistribution which results in more deadweight costs.

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[2] Stiglitz states that the productivity increases induced by public research investments in agriculture have been "little short of an economic miracle" (p.27).

[3] We ignore the important issue why redistribution takes place through distortionary commodity policies and not through lump-sum transfers. Also, to keep the analysis tractable with two endogenous policies, we have a static rather than a dynamic model.

[4] Most of the political economy literature has ignored the "productive" role of government and has focused on the "predatory" role (Rausser; Bardhan). However, while public investment in e.g. agricultural research has contributed importantly to economic growth, an important aspect of public research expenditures has been its impact on the distribution of income (de Gorter, Nielson and Rausser). This means that one can expect that the same political forces affecting commodity policy will be operational in determining public investment policy. While the distribution policies are endogenous in the Alesina type models, the knowledge (or research) policy is not. For example, in Alesina and Rodrik's model endogenous growth arrives through exogenously imposed "(productive) government services".

We show that the politically optimal policy choice is conditional on pre-policy endowment income inequality, on the income distribution effects of both policies, and on their interaction. There are two distinct types of interaction effects: "economic interaction effects (EIEs)" and "political interaction effects (PIEs)". Both are important in explaining political outcomes and have unique policy implications. The PIEs drive the results that are similar to the endogenous policy literature: pre-policy income inequality induces transfers from rich to poor sectors. Furthermore, income distributional effects of public investments are offset by an endogenously induced income transfer. We show that endogenous redistribution through the commodity policy allows the government to bring the public investment closer to the social optimum.

However, the social gains in bringing public good investment closer to the social optimum may be offset by increased deadweight costs of redistribution. The deadweight cost effect can be separated in two parts. Total deadweight costs increase with more redistribution through the commodity policy. At the same time, the economic interaction effect (EIE) will usually reduce the deadweight costs per unit of transfer, which has an mitigating effect on deadweight costs. The net effect of endogenous redistribution with deadweight costs on social welfare has to account for all these factors. In general, the net effect is more likely to be positive when the distributional effects of public good investment are more unequal, when the distortionary effects of the commodity policy are lower, and when the economic interaction effects are stronger (i.e., when the EIE is more negative).

The paper is organized as follows. Section two presents the public choice model for two policies and two sectors. Section three derives the optimal redistributive policy, given public research investments. Section four determines the politically optimal level of public investment with and without economic interaction effects while section 5 provides some concluding remarks.

The Model

Consider an economy with 2 sectors: agriculture (sector A) and industry (sector B). All individuals in the economy have identical preferences and maximize an indirect utility function $U(y^i)$, where y^i represents net income of individual i. Each sector has one representative individual with a pre-policy 'endowment' income $y^i{}_e$ (for i = A, B). The government has two policy instruments affecting incomes in the economy: growth-promoting investments and redistribution. Examples of growth-promoting investments include roads, infrastructure and R&D in situations where the private sector fails to provide social optimal levels themselves, such as in agriculture (Ruttan). Public investments have an impact on income distribution. Denote g^i as sector i's aggregate net benefits of the government's public investment τ in agriculture. The income generated by the investment τ is defined by a research production function f:

$$[1] \qquad g^i(\tau) = \beta^i f(\tau) - \tau/2$$

where β^i determines each sector's share of the benefits derived from the public good investment with $\beta^A + \beta^B = 1$.[5] The second term, $\tau/2$, indicates that taxes to finance the investment τ are shared equally by the two sectors. We ignore deadweight costs of taxation in raising funds for the public good investment.

Redistributive policies between sector A and B involve deadweight costs. Typical commodity policies in agriculture include price supports, export subsidies and import barriers. Redistributive policy is denoted by t, where $t^i(t)$ is the *aggregate net* income transfer for sector i resulting from commodity policy t. Note that $t^i(0) = 0$, and $t^A(t) = t$ and $t^B(t) = - t - c(t)$, where c(t) represents the deadweight costs of the commodity policy. With this definition, commodity policy t represents the aggregate net income transfer to agriculture. Thus, if t is positive,

[5] De Gorter and Zilberman show that, for the case of government investment in agricultural research, the relative values of β^i (one of which can be negative) depend on the elasticity of supply and demand and on the effects of research on agriculture's cost structure. For example, a large cost reduction in agriculture due to research with an inelastic demand could have consumers benefiting more than farmers.

agriculture is subsidized and industry is taxed, as in industrial countries. Furthermore, we assume that $c_t > 0$ for $t > 0$, $c_t < 0$ for $t < 0$, $c_{tt} > 0$ and $c(0) = c_t(0) = 0$. If τ affects for example the supply function in one of the sectors, then it will affect c for a given level of the redistribution transfer policy. This in turn will affect the net sector transfer t^i. Hence, the impact of both policies on sector i's net income y^i is summarized by:

$$[2] \qquad y^i = y^i_e + t^i(t,\tau) + g^i(\tau)$$

Because each policy has a differential impact on income distribution, preference for the public good investment and commodity policy differ between sectors. The policy combination chosen by the government will depend on the preferences of the government, and on the constraints facing it.

The public choice model on redistributive policy by Swinnen and de Gorter (1993) is applied to this combined public investment-commodity policy problem.[6] The political support politicians receive from citizens depends on how each policy affects the economic welfare of individuals in each group. Citizens increase their political support if they benefit from the policies and reduce support otherwise. Formally, individual political support S^i is assumed to be a strictly concave and increasing function of the policy induced change in welfare $V^i(t,\tau) = U^i(t,\tau) - U^i(0,0)$:

$$[3] \qquad S^i = S^i[V^i(t,\tau)] = S^i[U^i(t,\tau) - U^i(0,0)]$$

The functions $S^i(.)$, $U^i(.)$, and therefore $V^i(.)$, are continuous, at least twice continuously differentiable, strictly increasing and strictly concave. An important advantage of this specification is that it avoids indeterminacy and multiple equilibria problems which are typical of

[6] For an application of this model in analyzing redistributive policies only in agriculture, see Swinnen (1994).

deterministic (0-1) voting models (Mueller; Coughlin) and of multiple policy problems (Mayer and Riezman). We assume that S^i is identical for all individuals, the implications of which are discussed later.

In order to stay in power, politicians need to obtain a minimum level of political support. This depends critically on political institutions that determine the rules of the game for political decision-making. Under autocratic political institutions, such as dictatorships, political support from a large part of the constituency may not be needed to stay in power. In general, a more democratic society has more competition between politicians, resulting in politicians giving consideration to the impact on political support from their constituency. Under perfect competition, politicians will choose the policy combination $\{t^*,\tau^*\}$ that maximizes political support in order to stay in power. For our model, this implies the following decision problem for politicians:

$$[4] \qquad \max_{t,\tau} \; S[V^A(t,\tau)] + S[V^B(t,\tau)]$$

subject to the government budget constraint.[7] We refer to the policies t^* and τ^* that solve this problem as the "politically optimal" policies.

Politically Optimal Commodity Policy for a Given Public Investment

The first order condition for the politically optimal commodity policy t^* for a given level of the public investment, financed by tax τ° is given by:

[7] In reality, the two policies may be decided by different parts (e.g. administrations) of the government; they may have different time (dynamic) effects and private research is also undertaken. To capture the essence of these features, we assume that agents have perfect foresight in including future costs and benefits in their valuations. Even if different institutions are involved in the decision-making, those institutions do not act independently of one another as they take each others actions into account. Our specification is a simplified way of modeling this.

[5] $$\frac{S_v^A(t^*,\tau^\circ)}{S_v^B(t^*,\tau^\circ)} = \frac{U_y^B(t^*,\tau^\circ)\,(1+c_t(t^*,\tau^\circ))}{U_y^A(t^*,\tau^\circ)}$$

where $S^i_v = \partial S/\partial V^i$ and $U^i_y = \partial U/\partial y^i$. The size and sign of t* depends on (a) the deadweight costs associated with the commodity policy, (b) the relative pre-policy endowment incomes between agriculture and industry, and (c) the distributional impact of the public investment.

Higher deadweight costs per unit transfer reduce the absolute size of the optimal transfer policy t*. Deadweight costs reduce the net benefits for the beneficiaries and/or increase the burden on those taxed. This will reduce their marginal utility and their marginal support for t. Therefore, t* will decline.

The *direction* of the optimal subsidy (i.e. the sign of t*) is determined by income inequality, either pre-policy differences in endowment incomes or by the differential impact of public research expenditures on income in each sector. This result is summarized in Propositions 1 and 2.

Proposition 1: *A sector will be subsidized if relative pre-policy endowment incomes are lower while not benefiting more from the public good than the other sector.*[8]

Proof. To show: $ye^A < ye^B$ and $\beta^A \leq \beta^B$ implies $t^* > 0$.

Consider $\beta^A = \beta^B$ (with $\beta^A < \beta^B$,the result is reinforced) and define $k(t) = S_V{}^A(t)/S_V{}^B(t)$ and $r(t) = [U_y{}^B(t)\ (1+c_t(t)]/[U_y{}^A(t)]$. It follows that the first order derivatives $k_t(t) < 0$

[8] Proposition 1 is partially contingent upon the assumption that S is identical for all individuals. The more concave the political support function (reflecting greater political sensitivity to policy induced income changes), the lower the optimal income transfer, *ceteris paribus*. For a given distribution of income between sectors, a more concave support function will reduce $S_V{}^A(.)$ and increase $S_V{}^B(.)$ in equilibrium condition [6]. Therefore, t* will decline to restore the equilibrium. Differences in S can be due to institutional, organizational, distributional, etc. factors (Swinnen and de Gorter, 1993). However, in general, changes in (instead of levels of) either relative incomes or distributional impacts of public good investments affect the commodity policy as suggested in Proposition 1, independent of differences in political support functions.

and $r_t(t) > 0$. With $\beta^A = \beta^B$, it follows that $S_V^A(0,\tau°) = S_V^B(0,\tau°)$ and thus that $k(0) = 1$. Further, $r(0) < 1$ for $y_e^A < y_e^B$ and $r(0) = 1$ for $y_e^A = y_e^B$. Combining this with $k_t(t) < 0$ and $r_t(t) > 0$ implies that $t^* >,=,< 0$ for $y_e^A <,=,> y_e^B$. Q.E.D.

Proposition 1 generalizes the results in the literature (see Swinnen and de Gorter (1993) for a survey), on how differential incomes affect political outcomes by including income distribution effects of public good investments. As described in Swinnen and de Gorter (1993), an egalitarian outcome does not occur with this "liberal" feature inducing redistribution towards lower income sectors, because of deadweight costs associated with redistribution and because of the "conservative" characteristic of this political system which limits the extent of redistribution, even with no deadweight costs[9]. The equilibrium occurs where the ratio of marginal support levels equals the inverse ratio of the marginal utility levels, including deadweight costs, as indicated by condition [5]. The marginal political support levels are endogenous in the politician's decision process and depend on the effects of both policies on the level and distribution of income. The marginal political support of the individuals that are taxed increases, thereby raising the marginal impact of those individuals on the politician's decisions. On the other hand, as marginal political support of the subsidized individuals decreases, the marginal impact of this group in the politicians' calculus is reduced. At one point, the gain in political support for the politician by redistributing income from the group with a lower marginal utility of income to the group with a higher marginal income becomes fully offset by the relative increase of the high income group's marginal support level.

Proposition 2: *A sector will be subsidized if the sector benefits less from public good investment than the other sector while (pre-policy) endowment incomes are not higher than in the other sector.*

[9] See corollary 2.1 for a proof.

Proof To show: $y_e^A \leq y_e^B$ and $\beta^A < \beta^B$ implies $t^* > 0$.

Consider $y_e^A = y_e^B$ (with $y_e^A < y_e^B$ the result is enforced), which implies that $r(0) < 1$ in condition [5]. Assuming $\beta^A < \beta^B$, it follows that $k(0) > 1$ for $\tau^\circ > 0$. Combining this with $k_t(t) < 0$ and $r_t(t) > 0$ implies that $t^* > 0$. Q.E.D.

Politicians respond to the differential income effects of endogenous policy (in Proposition 2) in a similar manner as they do to endowment income gaps (as in Proposition 1). Income transfers are implemented to compensate the sector that benefits less from the public good investment. A sector need not lose in order to have an increase in transfers with commodity policy. If a sector benefits relatively less than the other sector, then it will receive compensation for paying more than its optimal share of taxes.

If agriculture's endowment income is higher than industry's but agriculture benefits relatively more from research, then t^* could be either positive, zero or negative. Likewise, if agriculture's endowment income is relatively lower but agriculture gains relatively more from research, then the sign of t^* is also ambiguous. The outcome depends on the size of the endowment income differential relative to the differential income effect of the public good investment.

Figure 1 illustrates how t^* varies with both factors. The numbers and curves in figure 1 are based on simulations in which specific functions were used for the general model we have used so far. All specifications are consistent with assumptions we have made (see Appendix A.1 for details on the simulations).

The middle line (connecting the open squares) in figure 1 represents the impact of the share of agriculture in public good benefits on the politically optimal redistribution t^* when endowment income in agriculture is equal to that in industry ($y_e^A = y_e^B$). When all public good benefits go to industry ($\beta^A = 0$), then the politically optimal redistribution $t^* = 3.75$. The optimal redistribution declines when agriculture's share in public good benefits increases. With agriculture receiving exactly half the public good benefits, there will be no transfers ($t^* = 0$). The other curves in figure 1 show that when endowment income in agriculture is lower (higher) than in industry, politically optimal redistribution t^* will be positive (negative) at $\beta^A = 0.5$. For example, with endowment income in agriculture 40% below that in industry ($y_e^A = 6$, $y_e^B = 10$), the optimal transfer t^* is 1.2 when both sectors benefits equally from public good investment. The transfer to agriculture becomes zero only when agriculture gets around 65% of the public good benefits.

As indicated earlier, the 'conservative' characteristic of our model indicates that only partial compensation will occur for any exogenous change in relative endowment incomes. However, full compensation occurs for an *endogenous* or policy induced change in relative incomes provided there are no deadweight costs associated with t. This can be summarized in the following corollary:

Corollary 2.1: *The endogenous commodity policy will only partially compensate for an exogenous income difference. Full compensation will occur only if the change in relative incomes is endogenous (policy induced)* ***and*** *if there are no deadweight costs associated with t.*

Proof. Suppose that $\beta^A < \beta^B$ and that deadweight costs associated with t are zero. Full compensation implies that $y^A(t^*,\tau^o) = y^B(t^*,\tau^o)$. This, in turn, implies that $U_y^B(t^*,\tau^o) = U_y^A(t^*,\tau^o)$. Combining this with condition [5] implies that $S_v^A(t^*,\tau^o) = S_v^B(t^*,\tau^o)$. Hence, $U^A(t^*,\tau^o) - U^B(t^*,\tau^o) = U^A(0,0) - U^B(0,0)$. We know that $U^A(0,0) - U^B(0,0)$ >,=,< for y_e^A >,=,< y_e^B. This implies that full compensation occurs, i.e. $y^A(t^*,\tau^o) = y^B(t^*,\tau^o)$, if and only if $y_e^A = y_e^B$. Q.E.D.

With deadweight costs, only partial compensation will occur in response to the differential income effects of research expenditures. However, compensation will be higher than if there was an equivalent differential income effect due to exogenous influences. Hence, political responses to changes in relative income due to exogenous influences like technology or international market forces will be muted compared to income differences induced by public research expenditures.

It is important to note that it is not the absolute level of the marginal political support levels but the relative marginal support levels between the groups that are the determining factor. The pre-policy (i.e. with $t = \tau = 0$) marginal political support levels for both groups are equal: $S_V^A(0,0) = S_V^B(0,0)$. The marginal political support levels will change with any policy that affects one group's welfare differently than the other group. This implies that an income transfer policy will affect the ratio of the marginal support levels and that a public good investment will only affect the ratio if the income effects differ between the sectors ($\beta^A \neq \beta^B$).

Consider now the case where $y_e^A = y_e^B$ and $\beta^A < \beta^B$. The public investment will benefit sector B more and hence will increase the relative marginal political support level of sector A. This in turn will lead to a compensating income transfer policy t from sector B to sector A. This transfer will reduce the marginal support level of sector A and increase that of sector B. In this case, both policies have endogenous offsetting effects on the marginal support levels. The equilibrium will have both marginal support levels equal only when full compensation is achieved in response to the endogenously induced change in relative incomes with the public investment (maintaining the assumption that deadweight costs are zero). Note that in this case the optimal transfer policy t^* is

$$[6] \qquad t^* = \frac{g^B(\tau^\circ) - g^A(\tau^\circ)}{2} = \frac{(\beta^B - \beta^A)}{2} f(\tau^\circ).$$

Politically Optimal Public Investment and Interaction Effects

So far we have established that the sector benefiting less from research will be compensated through commodity policy. The next question is: *how does the commodity policy affect the politically optimal public investment?*

The joint determination of commodity policy and public investment generates two types of "interaction effects". Public investment such as productivity increasing research can affect the deadweight costs of commodity policy (Lichtenberg and Zilberman; Alston, Edwards and Freebairn). We define this **"economic interaction effect (EIE)"** as the change in deadweight costs per unit of transfer induced by the public good investment, i.e. $\partial c/\partial \tau$. When there is no economic interaction effect, $\partial c/\partial \tau = 0$.

There is another interaction effect between policies through how politicians make decisions with respect to changes in political support levels. Each policy affects the political support for the other policy, and so there is an incentive for politicians to change the level of the other policy. We will call this the **"political interaction effect (PIE)"**. For example, we showed above that a given investment will affect the politically optimal commodity policy through its effect on the marginal political support levels. This section discusses how commodity policies will affect the politically optimal public investment through the PIE.

The support maximizing problem yields the following equilibrium condition for the political optimal public investment τ*:

$$[7] \qquad \frac{S_v^A}{S_v^B} = - \frac{U_y^B \, y_\tau^B}{U_y^A \, y_\tau^A} = - \frac{U_y^B}{U_y^A} \; \frac{g_\tau^B - c_\tau}{g_\tau^A}$$

How does the existence of commodity policies affect the political optimal public investment τ* ? From condition [7] it follows that:

$$[8] \qquad \frac{\partial \tau^*}{\partial t} = - \frac{w^A \, y_\tau^A y_t^A + z^A y_{\tau t}^A + w^B \, y_\tau^B y_t^B + z^B y_{\tau t}^B}{w^A \, (y_\tau^A)^2 + z^A y_{\tau\tau}^A + w^B \, (y_\tau^B)^2 + z^B y_{\tau\tau}^B}$$

where $w^i = S_{vv}{}^i (U_y{}^i)^2 + S_v{}^i \, U_{yy}{}^i$ and $z^i = S_v{}^i \, U_y{}^i$. Concavity of S^i and U^i imply that $w^i < 0$ and $z^i > 0$. The sign of [8] will depend critically on, inter alia, the nature of EIEs.

Before discussing the impact of t on the politically optimal investment level, we need a criterion to evaluate this impact. Define therefore $\{\tau^m, t^m\}$ as the "social optimal" policies, which maximize national income $Y = y^A + y^B$. Maximizing national income implies that $t^m = 0$ and that τ^m is determined by the following condition[10]:

[9] $y^A_\tau(\tau^m) + y^B_\tau(\tau^m) = 0.$

which can be simplified to

[10] $f_\tau(\tau^m) = 1.$

Political Interaction Effects

When EIEs are not present, $\partial c/\partial\tau = c_\tau = 0$ and $y_\tau^i = g_\tau^i$ in condition [7] and $y_{\tau t}^i = 0$ in condition [8]. The implication is summarized in the following proposition.

Proposition 3 : *Commodity programs that allow a government to compensate a sector that benefits less from public investment will bring the politically optimal public investment closer to the social optimal investment levels (assuming no economic interaction effects).*

Proof.

I. To show: With EIE = 0, overinvestment $[\tau^*(t^*) > \tau^m]$ occurs if ($t^* < 0$ and $\beta^A < \beta^B$) or if ($t^* > 0$ and $\beta^A > \beta^B$). Otherwise, $\tau^*(t^*) \leq \tau^m$.

Proof: $\tau^*(t^*) > \tau^m$ implies that $y^A_\tau(\tau^*) + y^B_\tau(\tau^*) < 0$ (using [9] and [10]). Take the case that $\beta^B > \beta^A$: in this case it follows that $-(y^B_\tau / y^A_\tau) < 1$. Using [5] and [7], this, in turn, implies that $1 + c_t(t^*) < 1$, which can only be if $t^* < 0$. Following the same logic, it follows that $t^* > 0$ for $\beta^A > \beta^B$ if $\tau^*(t^*) > \tau^m$.

10 Without deadweight costs (c = 0), t^m is not uniquely determined as each t yields the same Y. With deadweight costs, $t^m = 0$ is the only optimum.

II. To show: $\partial\tau^*/\partial t >,=,< 0$ for $\beta^B >,=,< \beta^A$ with EIE = 0.

The denominator of [8] is negative given our assumptions on S^i, U^i and g^i : the concavity of S^i and U^i imply that the first and third term of the denominator are negative; with no EIEs and concavity of f(.), the second and fourth term are also negative. Without EIEs ($y_{\tau t}^i = 0$) the second and fourth term of the numerator are zero. With $y_t^A = 1 > 0$ and $y_t^B = -1 - c_t < 0$, the sign of the numerator, and thus the sign of $\partial\tau^*/\partial t$ depends on the signs of y_τ^A and of y_τ^B. The signs of y_τ^A and of y_τ^B depend on who has most to gain from public investment. Consider the case where agriculture gains relatively less from public investment, i.e. $\beta^A < \beta^B$. From [1] it follows that, without EIEs, $y_\tau^i = g_\tau^i = \beta^i f_\tau(.) - 1/2$. Define τ^i as the optimal public investment level for sector i: $g_\tau^i(\tau^i) = 0$ or $\beta^i f_\tau(\tau^i) = 1/2$. With $\beta^A < \beta^B$, it must be that $\tau^A < \tau^* < \tau^B$ and that $y_\tau^A(\tau^*) < 0 < y_\tau^B(\tau^*)$. It follows that $\partial\tau^*/\partial t > 0$ for $\beta^A < \beta^B$. The argument for $\beta^A > \beta^B$ follows the same logic.

III. Combining I and II proofs Proposition 3. QED.

Moreover, if there are no deadweight costs associated with the transfer policy t, allowing endogenous redistribution results in politically support maximizing governments to choose social optimal policies.

Corollary 3.1: *Transfer policies that allow a government to compensate sectors that benefit less from public investment will induce the political support maximizing government to choose the social optimal level of public investment if there are no deadweight costs associated with redistribution.*

Proof: Without deadweight costs (c = 0), condition [5] implies that $S^A{}_v U^A{}_y = S^B{}_v U^B{}_y$ at t*. Combining this with condition [7] implies that $f_\tau(\tau^*) = 1$ at (τ^*, t^*), which implies that $\tau^*(t^*) = \tau^m$ (see condition [10]). Q.E.D.

The implication of proposition 3 is that if policy initiatives are taken to limit the use of commodity policy (assuming no concomitant change in the political process or institutions), then support maximizing politicians will choose a public good investment level which is further away from the social optimum than when they are free to use commodity policies. Commodity policy complements public investment in a model of support maximizing politicians with endogenous marginal political support levels. Commodity policy can be viewed as the political price for an increase in public good investments when there is "underinvestment" compared to the social optimum. The option to use an income transfer policy allows governments to compensate those who benefit less (or perhaps lose) from investment and thereby increase the level of public investments.

Figures 2 and 3 illustrate proposition 3 and corollary 3.1. In figures 2a and 2b, endowment incomes are equal in both sectors. The open squares curve indicates the politically optimal level of public investment τ^* with t = 0 for varying distribution of benefits. For example, if agriculture gets only 10% of the public good benefits, $\tau^* = 3.2$ if no redistribution is allowed (t = 0). The agricultural sector is benefiting relatively less and therefore opposes increases in government investment. This opposition limits the government's optimal policy to $\tau^* = 3.2$.

Figure 2a indicates that the social optimum is unaffected by these distributional effects. No matter who gets the benefits, the social optimal investment, τ^m, is 5. As a consequence, the more unequal the distribution effects of τ (i.e. when β^A is further from 0.5), the larger the difference between the social and the political optimum, and the more important "underinvestment" will result.

However, when the government can compensate the sector which is benefiting less through the transfer policy t, the opposition of this sector to increasing τ can be mitigated. As a consequence, the government can increase public investment to $\tau^*(t^*) = 5$, equal to the social optimal level of investment. Figure 2b illustrates how, in the absence of deadweight costs, the political optimum with endogenous redistribution $\tau^*(t^*)$ is also unaffected by the distribution of public good benefits. The compensating redistribution adjusts such that $\tau^*(t^*) = 5$ always. Politically optimal redistribution will ensure full compensation for differences in public good impacts (see corollary 2.1.). Figure 1 shows that for the case depicted in figure 2 ($y^A_e = y^B_e$), when agriculture gets only 10% of the benefits, optimal redistribution $t^* = 3$; with 30% of the benefits, $t^* = 1.5$ and with 50% of the benefits, $t^* = 0$.

Figure 3 illustrates the impact of pre-policy income inequality on these results. It might be politically optimal to "overinvest" in public goods when the sector which benefits relatively more from public goods investment has a lower endowment income. For example, with agriculture having a 40% higher endowment income ($y_e^A = 14$, $y_e^B = 10$) and only 40% of the public good benefits, it is politically optimal to spend 5.14 (= $\tau^*(t=0)$ on public goods, which is more than the social optimal investment level. The reason is that in the absence of redistribution mechanisms, such as commodity policies, compensation for endowment income differences occurs through spending more on public goods than socially optimal because the lower income sector benefits mostly from it. In this case allowing for endogenous redistribution through t, will lower political optimal public investment from $\tau^*(t=0) = 5.14$ to $\tau^*(t^*) = 5.00$, which is equal to the social optimum.[11]

Figures 2 and 3 are based on the case when there are no deadweight costs associated with the transfer policy t. Figure 4 illustrates how deadweight costs change this result. With

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11 Notice that $\partial\tau^*/\partial t >, =, < 0$ for $\beta^B >,=, < \beta^A$ (Proposition 3) holds over the entire domain (i.e. $0 \leq \beta^A \leq 1$). Also, the point where the ($t = 0$ & $y_e^A = 14$)-curve crosses the social optimum line (which is constant at 5.0) coincides with the point in figure 1 where $t^* = 0$ for the $y_e^A = 14$ line. At this point (where $\beta^A = 30\%$), $t^* = 0$ and $\tau^* = \tau^m$ for $y_e^A = 14$ and $y_e^B = 10$.

increasing deadweight costs (h larger)[12] the politically optimal public investment, τ^*, declines. More specifically, $\tau^*(t^*)$ varies between the no deadweight cost level (=5) and the $\tau^*(t=0)$ level. The higher deadweight costs are, the closer $\tau^*(t^*)$ is to $\tau^*(t=0)$. The reason for this is that with higher deadweight costs compensation becomes more expensive and opposition to redistribution will be stronger, leading to a lower equilibrium $\tau^*(t^*)$.

Without deadweight costs $\tau^*(t^*) = \tau^m$. This implies that the political optimal investment level also yields the maximum national income. However, this logic does not hold with deadweight costs. While proposition 3 still holds with deadweight costs, the only relevant criterion is total income at the politically optimal policies, i.e. $Y(\tau^*,t^*)$. Redistribution through t allows the government to increase τ^* to a level closer to the social optimum. This increases total income. However, at the same time redistribution induces deadweight costs, thereby reducing national income. It is possible that when τ^* moves closer to the social optimum, total income $Y(\tau^*,t^*)$ decreases because of the deadweight costs of the induced transfer t^*. The net effect of both impacts depends on the size of the transfer t, and the importance of the deadweight costs, c(t).

Figure 5 shows that with $h = 0.25$ the deadweight cost effect is stronger than the increase in investment effect for $0.1 < \beta^A < 0.9$. Only when the distributional effects of the public good investment are very unequal, i.e. when the share of agriculture in public good benefits is either less than 10% or more than 90%, is $Y(\tau^*(t^*)) > Y(\tau^*(t = 0))$ for $h = 0.25$. When deadweight costs are less important (h smaller), the region where the public investment effect is stronger than the deadweight cost effect is larger (and vice versa).

A similar conclusion can be reached from figures 6 and 7, where the case is analyzed for pre-policy income inequality between agriculture and industry ($ye^A = 14 > ye^B = 10$), which yields a more complex problem. Figure 6 shows how endogenous redistribution, even with deadweight costs, brings politically optimal investment τ^* closer to the social optimum $\tau^m = 5$

[12] h is a parameter in the deadweight cost function in our simulations, with c larger for h larger (h>0) (see appendix I).

(= $\tau^*(t^*)$ without deadweight costs). Notice that for the region where the government overinvests ($30\% < \beta^A < 50\%$), redistribution induces the government to overinvest less: $\tau^m \leq \tau^*(t^*) < \tau^*(t = 0)$.

Figure 7 illustrates how also in this case the public investment effect dominates the deadweight cost effect ($Y(\tau^*(t^*)) > Y(\tau^*(t = 0))$) only when the distributional effects are very unequal: $\beta^A < 10\%$ or $\beta^A > 82\%$.

In summary, the key implication of proposition 3 and corollary 3.1 is that a restriction on the use of income transfers, through for example commodity policies, results in a reduction in public investment expenditures away from the social optimum. In the absence of deadweight costs, this reduces social welfare. However, if those commodity policies include important deadweight costs, this public good investment effect is offset by a reduction in deadweight costs. The net effect is conditional on the size of the transfer and the importance of the deadweight costs. *Redistribution with commodity policies is more likely to improve social welfare if the distributional effects of public good investment are more unequal and if the deadweight costs of the policies are lower.*

In the next section we analyze how this effect changes in the presence of economic interaction effects.

Economic Interaction Effects

Economic interaction effects occur if public good policies affect the social costs of commodity policies, i.e. $\partial c/\partial \tau \neq 0$. This effect is extensively discussed in the case of government investments in agricultural research, inducing productivity increases and therewith affecting the deadweight costs of commodity policies. Most papers argue that public cost-reducing research increases those social costs (Lichtenberg and Zilberman; Alston, Edwards and Freebairn). Two recent papers in the *J. of Pub. Econ.* by Murphy, Furtan and Schmitz , and Chambers and Lopez go further and argue that public research can reduce social welfare. In our model, this would imply that $\partial Y/\partial \tau < 0$ because $\partial c/\partial \tau > 0$. Notice that this is a different argument from our deadweight cost argument, based on PIEs.

Recall in the previous section that the presence of deadweight costs weakened the beneficial impact of redistribution on optimal public good investment (through the PIE), because of the associated increase in deadweight costs, without EIEs. Does the introduction of EIEs further weaken this effect, and maybe reverse it in general?

The optimal level of public investment for sector i, τ^i, is determined by $y_\tau^i(\tau^i) = 0$. With economic interaction effects the optimal public good investment for industry, τ^B, is determined by:

[11] $$y_\tau^B(\tau^B) = g_\tau^B(\tau^B) - c_\tau(\tau^B) = 0$$

Condition [11] indicates that the optimal level for sector B is where the marginal gross income effect of public investment equals the marginal investment tax increase plus the marginal change in deadweight costs of the commodity policy.

A critical factor is how investment affects the deadweight costs of the commodity policy (c_τ). Further, also $c_{\tau t}$, $c_{\tau\tau}$ and c_t need to be determined to solve equation [8] in the presence of EIEs. One would expect these impacts to depend on the specific commodity policy and the economic structure of the sector. To illustrate this effect, we will analyze the impact of productivity increasing public investment on an import tariff in a small country with a simple, partial equilibrium model. We refer elsewhere for the analysis with other commodity policies (Swinnen and de Gorter, 1995).

Figure 8 shows the impact of productivity increasing public investment on an import tariff for a small country. Agricultural producers are protected as world market price p^w is below the domestic price $p^t(0)$, which is sustained by an import tariff equal to $p^t(0) - p^w$. D and S(0) represent the demand and supply curves. Domestic consumption is $Q^d(0)$ and supply is at $Q^s(0)$. The net transfer to the agricultural sector, t, induced by the import tariff $p^t(0) - p^w$ equals area ABED. Deadweight costs associated with transfer t, c(0), equal the sum of areas BIE and NKM.

It is easy to see from figure 4 that an increase in the transfer t would induce an increase in the import tariff and, thus, an increase in deadweight costs c: $\Delta c/\Delta t > 0$ for $t>0$. We show in appendix that also the other assumptions on the deadweight cost functions of our model are consistent with this example.

Now assume that public investment τ shifts the supply curve from S(0) to S(τ). What happens to deadweight costs? Notice that the shift of the supply curve would induce an increase in transfer t if the import tariff is maintained at $p^t(0) - p^W$. However, as our analysis is *ceteris paribus*, we need to separate the effects of both policies. To analyze the impact of τ on c, we need to keep t constant. In order to keep transfer t constant, the import tariff has to decline to $p^t(\tau) - p^W$ with public investment τ. Domestic prices fall from $p^t(0)$ to $p^t(\tau)$. Consumption and production both increase, to $Q^d(\tau)$ and $Q^S(\tau)$, respectively. Deadweight costs $c(\tau)$ equal the sum of areas FJH and RLM. It is evident from the figure that $c(\tau) < c(0)$: hence $\Delta c/\Delta\tau < 0$. In appendix II, we show formally that $\partial c/\partial t > 0$, $\partial c/\partial\tau < 0$, $\partial^2 c/\partial\tau^2 > 0$, and that $\partial^2 c/\partial\tau\partial t$ <,=,> for t > = < 0 in the case of an import tariff in a small country. Elsewhere we show that $\partial c/\partial t < 0$ holds also for several other commodity policies and can thus be interpreted as a fairly general result: public research reduces deadweight costs per unit of transfer (Swinnen and de Gorter, 1995).[13] We will therefore use this for the rest of our discussion and for the simulations to follow.

What do these results imply for our analysis ? We show that in the case of an import tariff, deadweight costs decrease with public investment given a transfer t. The implication is that governments will tend to increase public investment further when commodity policies are

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13 With $\partial c/\partial\tau > 0$, the effects described in this section would be reversed and the EIE and PIE effects on deadweight costs would enforce one another. $\partial c/\partial\tau$ depends on the specific market intervention and the impact of public investment on productivity. For example, if public good investments cause a pivot in the supply curve rather than a parallel shift, it is more likely that $\partial c/\partial\tau > 0$. However, Murphy, Furtan and Schmitz conclude after surveying the literature that researchers generally support the finding that supply curves exhibit parallel shifts in response to technical change. With a parallel shift it is possible that $\partial c/\partial\tau > 0$ under specific circumstances and highly distortive policies. However, it is generally the case that $\partial c/\partial\tau < 0$ (Swinnen and de Gorter, 1995).

used for compensation, because the EIEs ensure that the public investment has a decreasing effect on deadweight costs per unit of transfer. This does not mean that total deadweight costs necessary decline, because they increase with increasing transfers, through the PIE. However, *the net effect on social welfare of using commodity policies as compensating instruments is more likely to be positive with EIEs than without them.*[14]

Figures 9-12 illustrate this argument, when equal endowment incomes are equal (fig. 9-10) and when $y_e^A > y_e^B$ (fig. 11-12). Fig. 9 shows how $\tau^*(t^*)$ increases and comes closer to the social optimum if EIEs are more important (reflected in higher values of j).[15] For $j = 2$, $\tau^*(t^*)$ in virtually indentical to τ^m, even with high deadweight costs (e.g. when $h = 1$).

Not only is $\tau^*(t^*)$ closer to τ^m when EIEs are more important, but also total income increases. As a consequence, the domain over which endogenous redistribution increases social welfare by simulating public investment, increases with EIEs. For example, figure 10 shows that the domain where the increase in deadweight costs more than offsets the beneficial effect of increased public good investment shrinks from 10% - 90% with $j = 0$, over 25% - 77% with $j = 1$, to 40% - 60% with $j = 2$.

Figure 11 shows how, with $y_e^A > y_e^B$, EIEs induce overinvestment (which was not the case without EIEs). For example, with $j = 1$, $\tau^*(t^*)$ is larger than the social optimum (=5) at β^A = 50%, while without EIEs $\tau^*(t^*) = 5$ at β^A = 50%. With more important EIEs (j=2) overinvestment occurs over the whole domain where β^A > 30%. The main difference with the equal endowment income case is the additional transfers to compensate for $y_e^A > y_e^B$. As the additional deadweight costs are also reduced by τ, pressure by taxpayers grows to increase τ resulting in more (over)investment.

However, again, the key evaluation criteria should not be the investment level, but rather the resulting social welfare, including the distortionary lossess. From figure 12, we can see that

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14 Proposition 3 will still hold in many cases with EIEs. However, with $c_\tau < 0$ there are cases where overinvestment emerges with endogenous redistribution, where underinvestment existed without t. And, thus, Proposition 3 does not hold anymore in all cases with EIEs.

15 j is a parameter in the deadweight cost function in the simulations. With j increasing, the EIE effect becomes stronger (see appendix 1).

despite overinvestment, the resulting income levels are higher than without EIEs, and the region where the net effect is positive is also larger.

In conclusion, economic interaction effects, such as when productivity increasing public research changes the distortions of an import tariff, mitigate the negative deadweight cost effect in endogenous redistribution that stimulate public investment through political interaction effects. As a consequence, they increase the likehood that the net effect is positive.

Concluding Remarks

Inequality induces endogenous redistribution when a political support maximizing government can use e.g. price and trade policies for compensation. This holds for pre-policy (endowment) income inequality, but also for inequality induced by unequal distributional effects of public good investment. Public good policies increase productivity and welfare, but also affect the income distribution. The impact on income distribution imposes an important political constraint on governments investing in public goods. As a consequence, the politically optimal level of public investment will typically diverge from the social optimum. "Underinvestment" in public goods will result when distributional effects of public investment are uneven and when pre-policy incomes are equal (or exacerbate the policy induced inequality). "Overinvestment" may result when the distributional effects of the public good offset pre-policy endowment income inequality.

Redistribution (e.g. through price and trade policies) can enhance social welfare by bringing the politically optimal public good investment level closer to the social optimum. Income redistribution will reduce the political opposition to bringing public investment closer to the social optimum (what we have called the "political interaction effect"). This might happen despite deadweight costs associated with certain redistribution instruments, such as price and trade policies.

Deadweight costs associated with the redistribution complicate the impact because of two offsetting effects. First, an increase in public investment induces an increase in (endogenous) redistribution to compensate for unequal distributional effects of public goods, and thus increases total deadweight costs, which are associated with redistribution. Second, productivity increasing public investment will typically reduce the deadweight costs per unit of transfer (what we have called the "economic interaction effect"). Thus, an induced increase in public investment will lower total deadweight costs. Both effects have opposite impacts on total deadweight costs.

The total endogenous redistribution effect on social welfare incorporates the impact on optimal public investment and both deadweight costs impacts. The net effect is conditional on other factors. In general, the net effect of endogenous redistribution on social welfare is more likely to be positive when the distributional effects of public investment are more unequal, when the distortionary effects of redistribution are smaller and when the economic interaction effects are more important.

APPENDIX

A.1 Simulations

The following functional forms were used for the simulations of social and politically optimal policies:

$U^i = U(y^i) = 2*y^i - 0.05*(y^i)^2$

$S^i = S(v^i) = 2*v^i - 0.05*(v^i)^2$

$v^i = U^i(t,\tau) - U^i(0,0)$

$f(\tau) = 2*\tau - 0.1*(\tau)^2$

$c(t,\tau) = h * t^2 /[1+f(\tau)^j]$, with h and j varying.

With $h > 0$ and $j = 0$, 1 or 2, $c(t,\tau)$ behaves consistent with the assumptions on the general deadweight cost function in the paper (see section The Model).

A.2 Impact of Public Investment on Deadweight Costs of Import Tariffs.

In this appendix, we formally analyze the impact of public investment on deadweight costs of import tariffs (and export taxes) in a small country situation. We use a simple partial equuilibrium model with linear functions, as presented in figure 4 and discussed in the main text.

To derive the effects more formally, define the supply and demand functions as follows:

$$[A.1] \quad Q^s(p) = (p - p^m)/\alpha$$
$$Q^d(p) = (p^x - p)/\pi$$

where p^m and p^x are the intercepts of the inverse supply and demand curves with the vertical axes; and α and π are the absolute values of their slopes. The transfer policy t (which we defined earlier as equal to the net aggregate transfer to agriculture) is:

$$[A.2] \quad t = t^A = [(p^t - p^m)^2 - (p^w - p^m)^2] / 2\alpha$$

and the deadweight costs c which are associated with t are:

$$[A.3]\quad c(t) = (p^t - p^w)^2 / 2\alpha \; + \; (p^t - p^w)^2 / 2\pi \; = \; [(1/\alpha) \; + \; (1/\beta)](p^t - p^w)^2/2.$$

Let us first analyze whether the deadweight cost function of this commodity policy is consistent with our assumptions that $c_t > 0$ for $t > 0$, $c_t < 0$ for $t < 0$, that $c_{tt} > 0$ for all t and that $c(t) = 0$ for $t = 0$. From [A.3] we can see immediately that with $t = 0$ ($p^t = p^w$), $c(0) = 0$ and we can analyze the impact of raising the transfer t on deadweight costs, for a given level of public investment τ:

$$[A.4]\quad \partial c/\partial t = [(1/\alpha) \; + \; (1/\beta)].(p^t - p^w).\; \partial p^t/\partial t$$

With $\partial p^t/\partial t \; = \; \alpha/(p^t - p^m) > 0$, it follows that $\partial c/\partial t > 0$ for an import tariff ($t > 0$) and $\partial c/\partial t < 0$ when $t < 0$ (e.g. in the case of an export tax on agricultural producers). Further, we can derive that

$$[A.5]\; \partial^2 c/\partial t^2 = [(1/\alpha) \; + \; (\quad 1/\beta)].[\partial p^t/\partial t]^2 \, [(p^w - p^m)/(p^t - p^m)] > 0.$$

Therefore, this example is consistent with the assumptions of our model.

Using [A.3] we can also analyze the impact of public investment τ on deadweight costs c associated with transfer policy t, for a given level of t :

$$[A.6]\quad \partial c/\partial \tau = [(1/\alpha) + (1/\beta)]\; (p^t - p^w)\; \partial p^t/\partial \tau$$

To determine the sign of $\partial c/\partial \tau$ we use the fact that t remains constant (ceteris paribus), i.e.

$$[A.7]\quad \partial t/\partial \tau = \; [(p^t - p^m)/\alpha]\; [\partial p^t/\partial \tau - \partial p^m/\partial \tau] \; - \; [(p^w - p^m)/\alpha]\; [\partial p^w/\partial \tau - \partial p^m/\partial \tau] = 0,$$

which implies that

[A.8] $\partial p^t/\partial\tau = -\delta[(p^t - p^w)/(p^t - p^m)]$

where $\delta = -dp^m/d\tau$ reflects the productivity of the investment function. It follows $\partial p^t/\partial\tau >,=,< 0$ for $t <,=,> 0$, assuming that prices never fully prohibit domestic production (i.e. $p^t > p^m$ always).

Combining [A.6] and [A.8] yields that $\partial c/\partial\tau < 0$ for both $t > 0$ and $t < 0$, i.e. deadweight costs for a given level of transfer decrease with an increase in public investment. If tariffs are zero, obviously there is no effect of τ on deadweight costs ($\partial c/\partial\tau = 0$ for $t = 0$).

To solve equation [A.8] of the main text, we also need to calculate $c_{\tau t} = \partial^2 c/\partial\tau\partial t$. Using [A.8] we first derive that

[A.9] $\partial^2 p^t/\partial\tau\partial t = \delta . [(p^w - p^m)/(p^t - p^m)^2] . \partial p^t/\partial t.$

With $\partial p^t/\partial t > 0$ and $\delta > O$ this implies that $\partial^2 p^t/\partial\tau > 0$. We use this to derive that

[A.10] $\partial^2 c/\partial\tau\partial t = -\delta[(1/\alpha) + (1/\beta)].[(p^t - p^w)^2/(p^t - p^m)^2] (\partial p^t/\partial t < 0$, which implies that $y^B{}_{\tau t} = - c_{\tau t} > 0$.

In conclusion, $c_\tau < 0$ and $c_{\tau t} < 0$ always (unless $t = 0$), while $c_t > 0$ for $t > 0$ and $c_t < 0$ for $t < 0$.

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FIG-1.

Joint Impact of Relative Incomes and Public Good Benefits Distribution on Politically Optimal Redistribution (No DWC, yeB=10, public investment = 5)

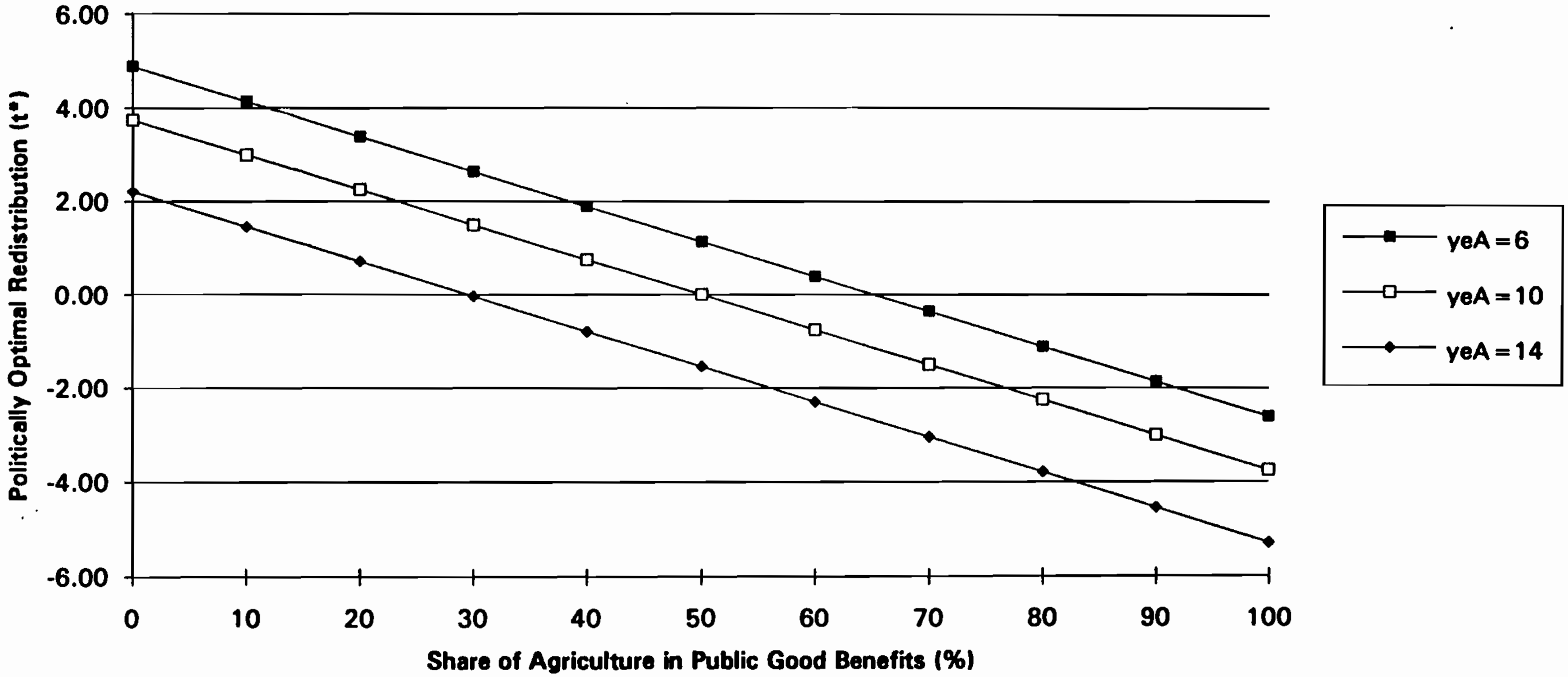


FIG-2A.

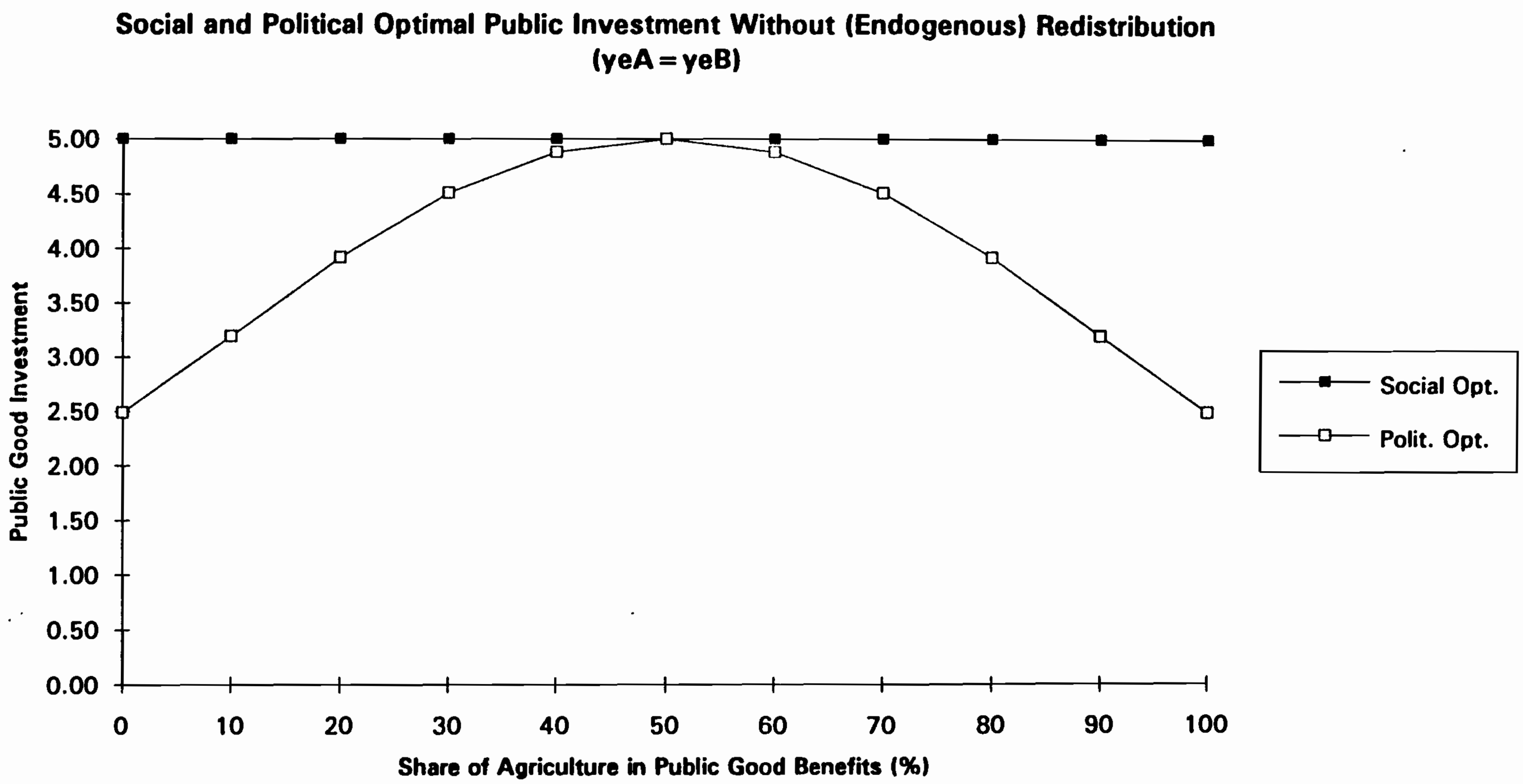
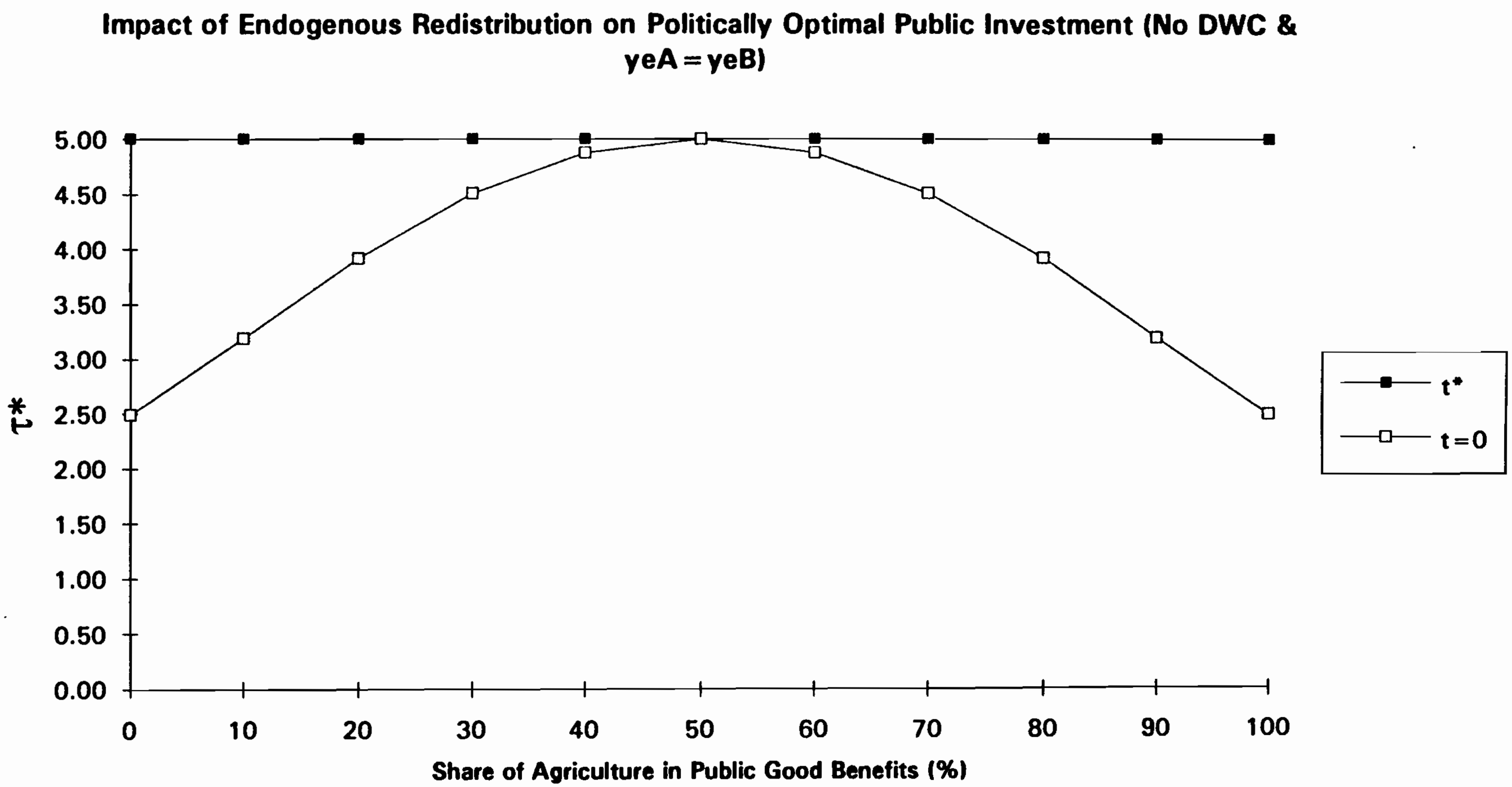

Social and Political Optimal Public Investment Without (Endogenous) Redistribution
(yeA = yeB)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Public Good Investment
0
10
20
30
40
50
60
70
80
90
100
Share of Agriculture in Public Good Benefits (%)
Social Opt.
Polit. Opt.

FIG-2B.



Impact of Endogenous Redistribution on Politically Optimal Public Investment (No DWC & yeA = yeB)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
t*
0
10
20
30
40
50
60
70
80
90
100
Share of Agriculture in Public Good Benefits (%)
t*
t=0

FIG-3.

Politically Optimal Public Good Investment (No DWC)

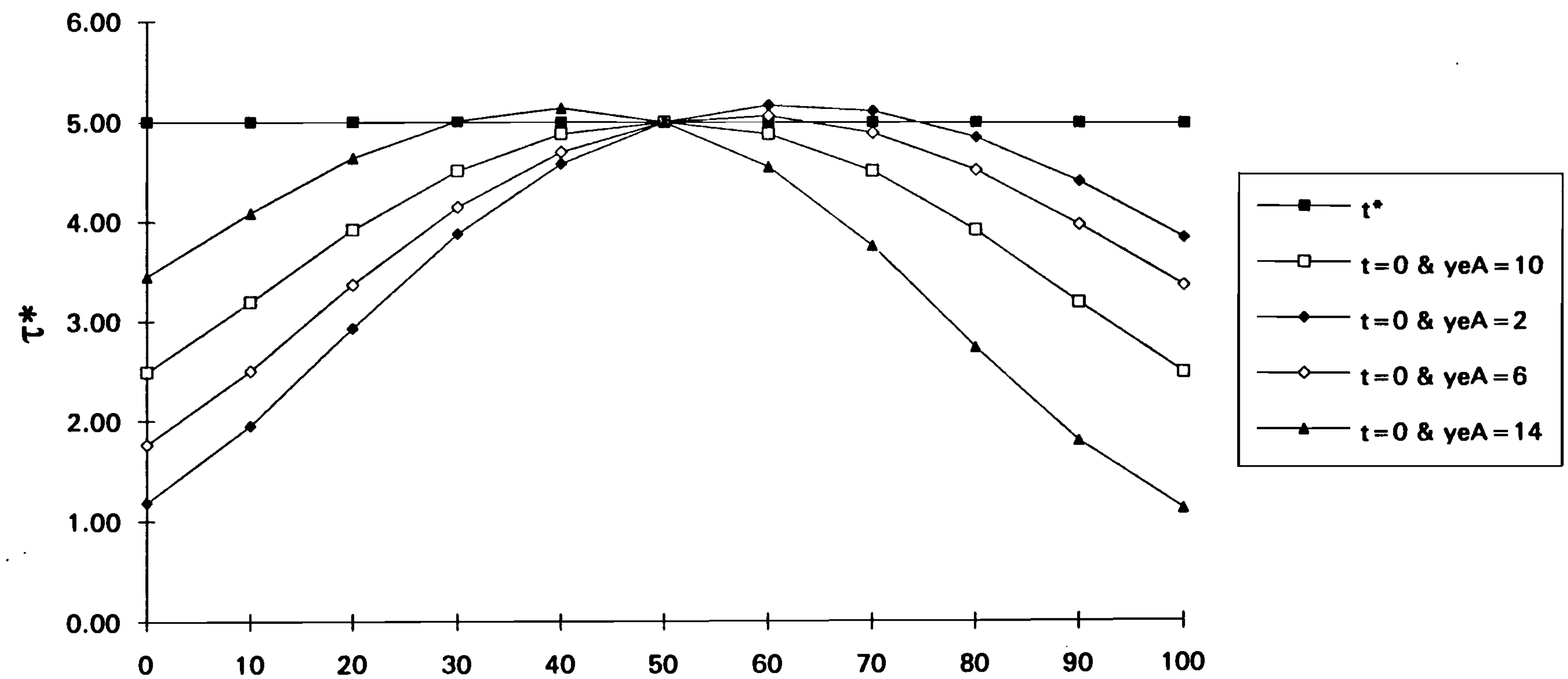


FIG-4.

Impact of DWC on Politically Optimal Investment with Endogenous Redistribution (no EIE & yeA=yeB)

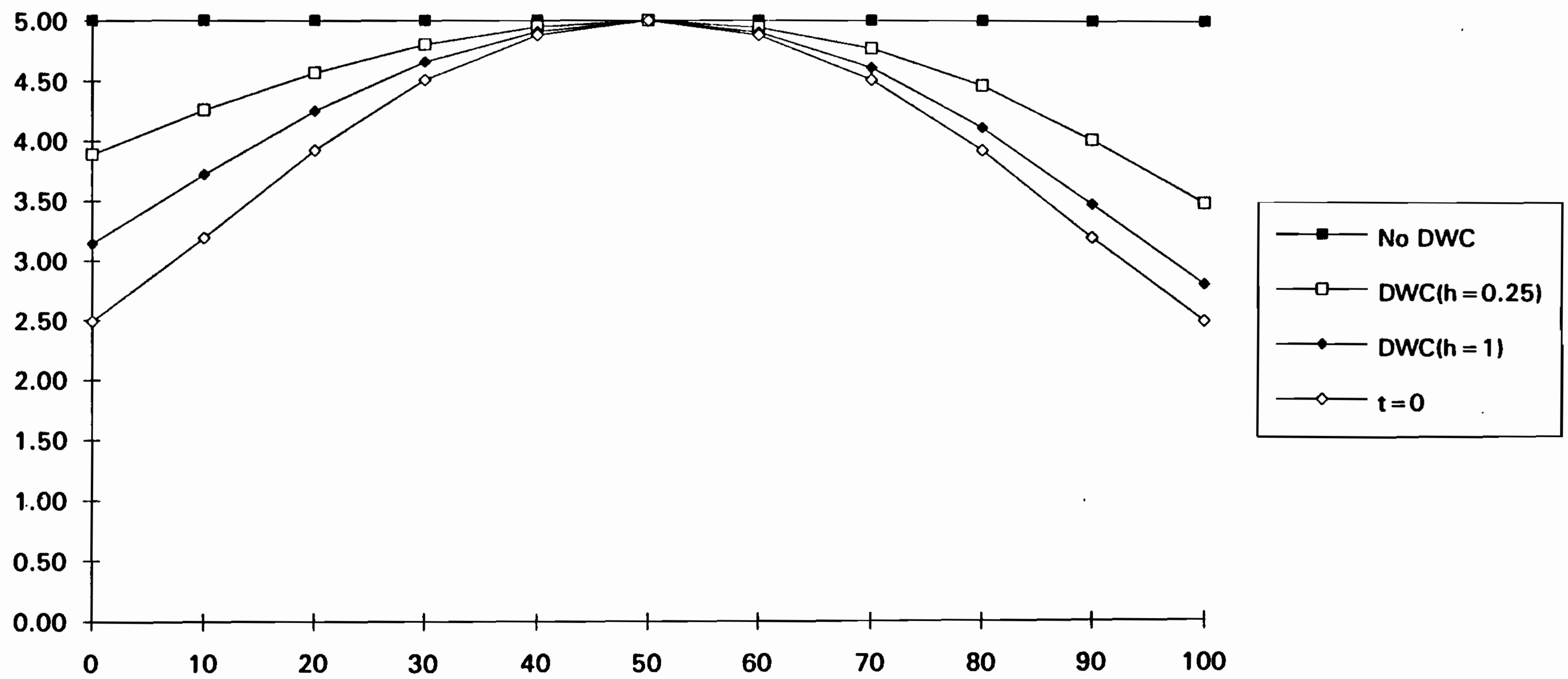


FIG-5.

Impact of DWC on Total Income (Y) at Political Optima with Endogenous Redistribution
(no EIE & yeA=yeB)

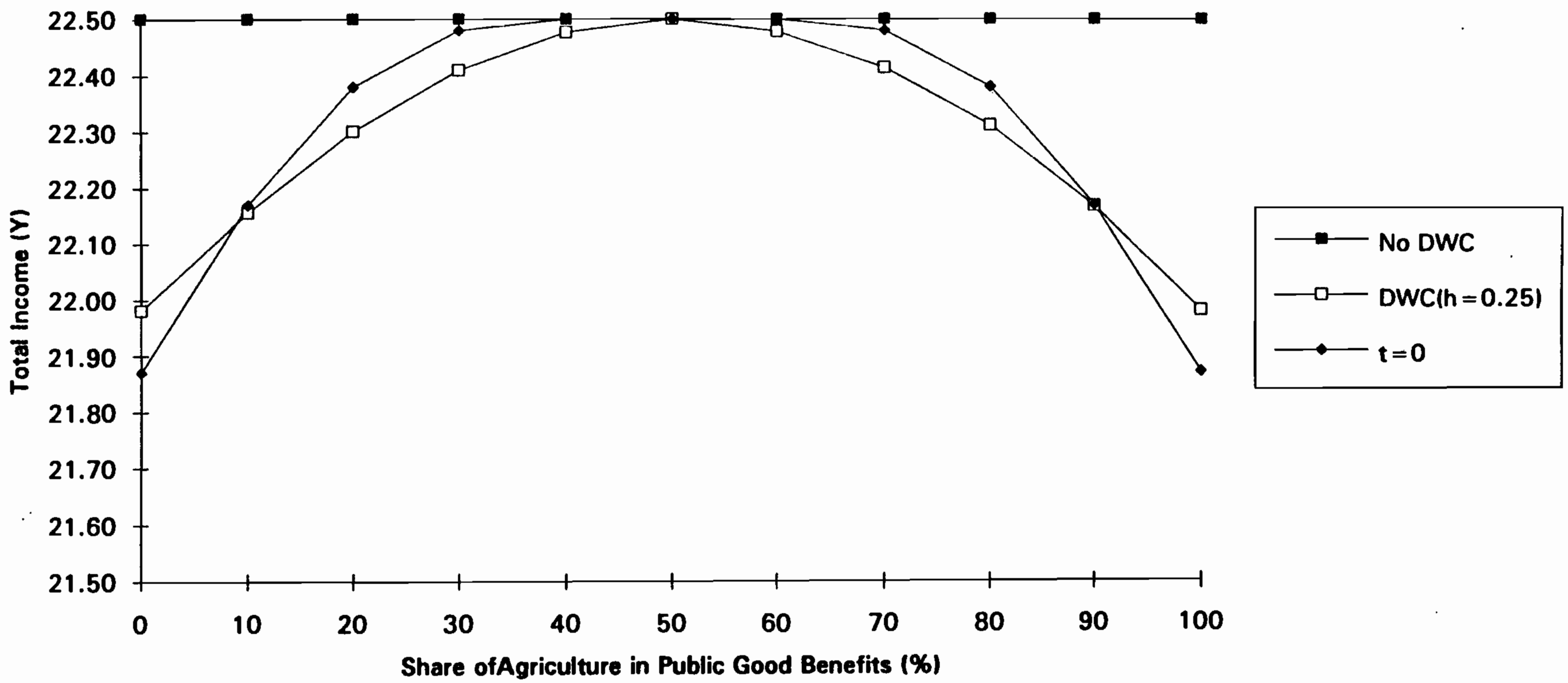


FIG-6.

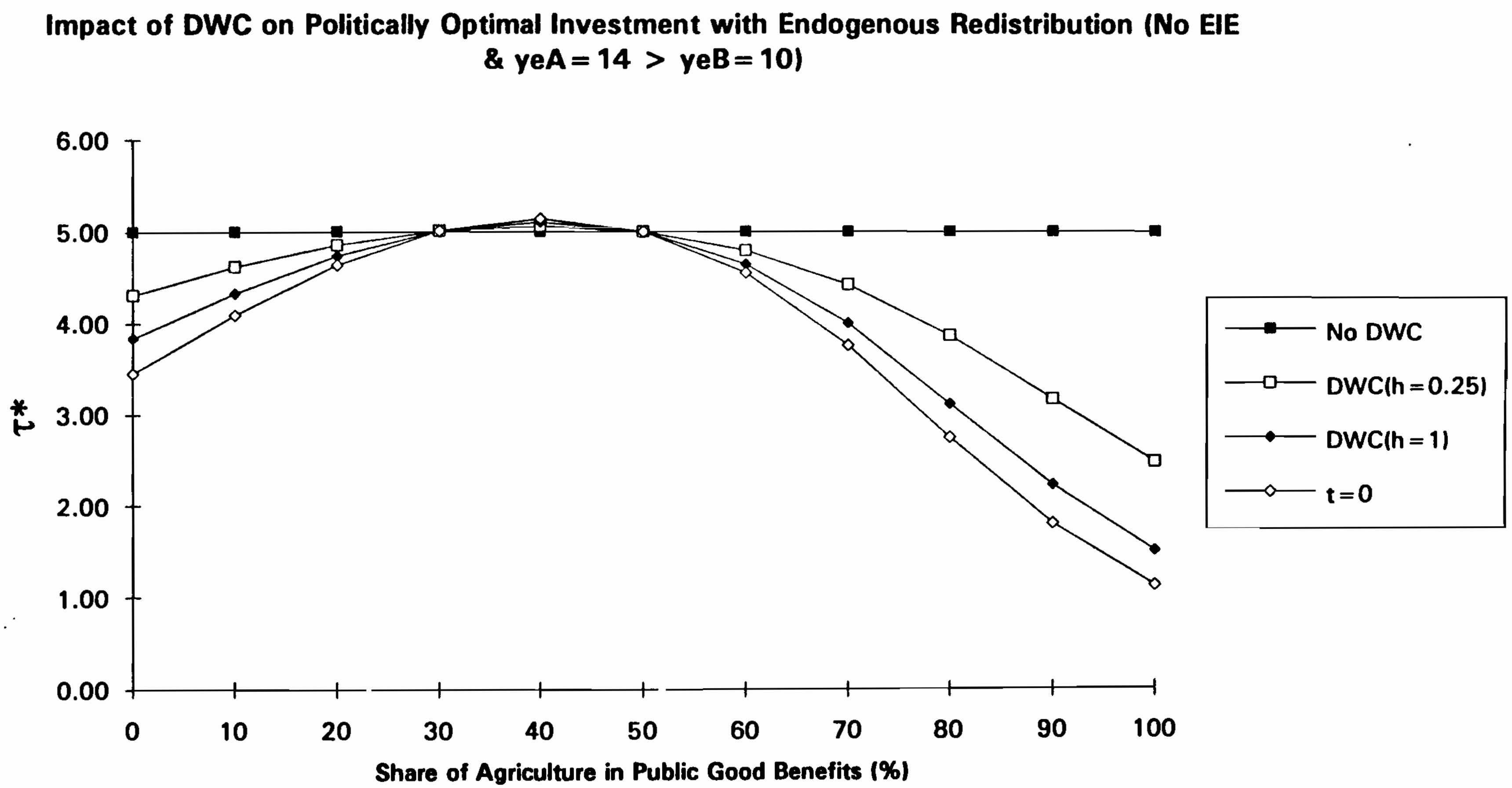
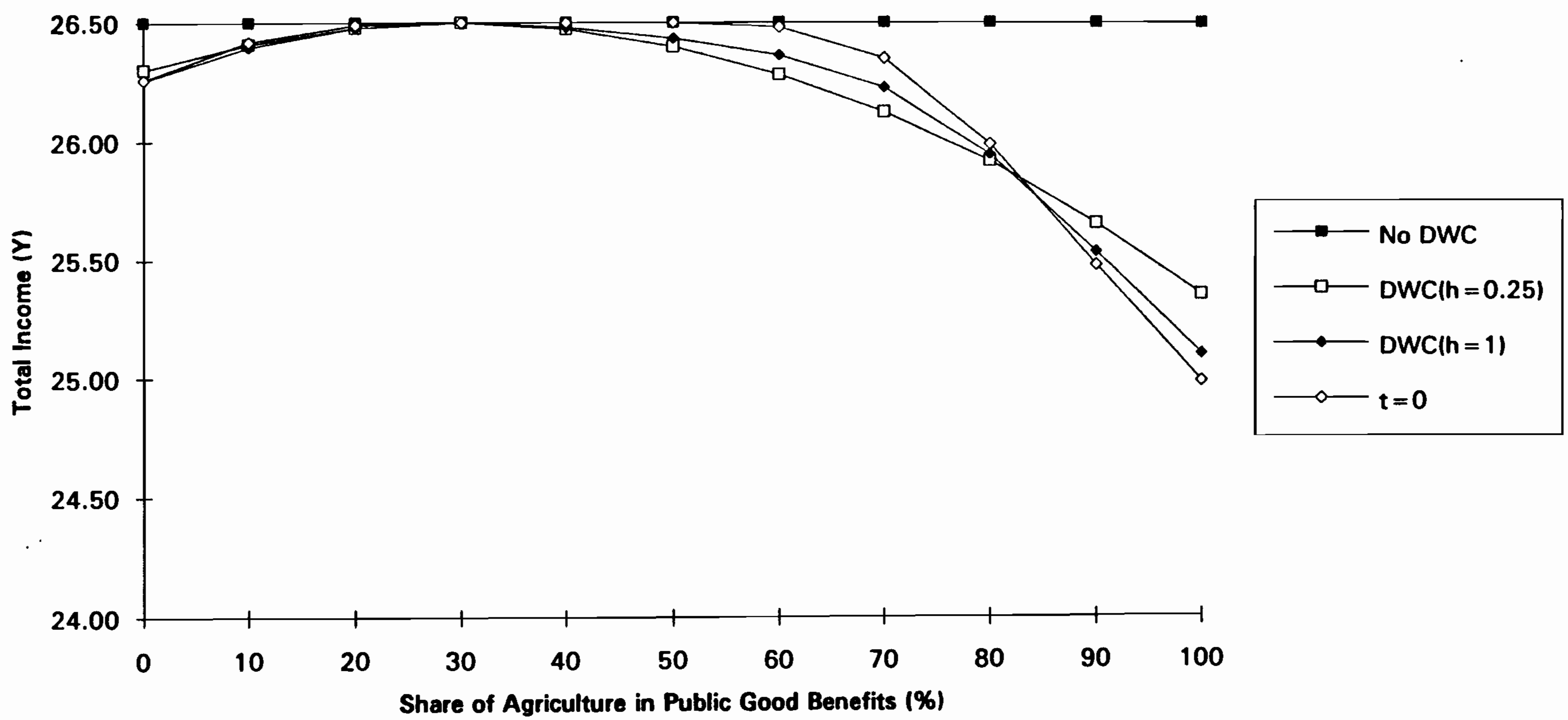

Impact of DWC on Politically Optimal Investment with Endogenous Redistribution (No EIE & yeA = 14 > yeB = 10)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
t*
0
10
20
30
40
50
60
70
80
90
100
Share of Agriculture in Public Good Benefits (%)
No DWC
DWC(h = 0.25)
DWC(h = 1)
t = 0

FIG-7.

Impact of DWC on Total Income (Y) at Political Optima (No EIE & yeA = 14 > yeB = 10)



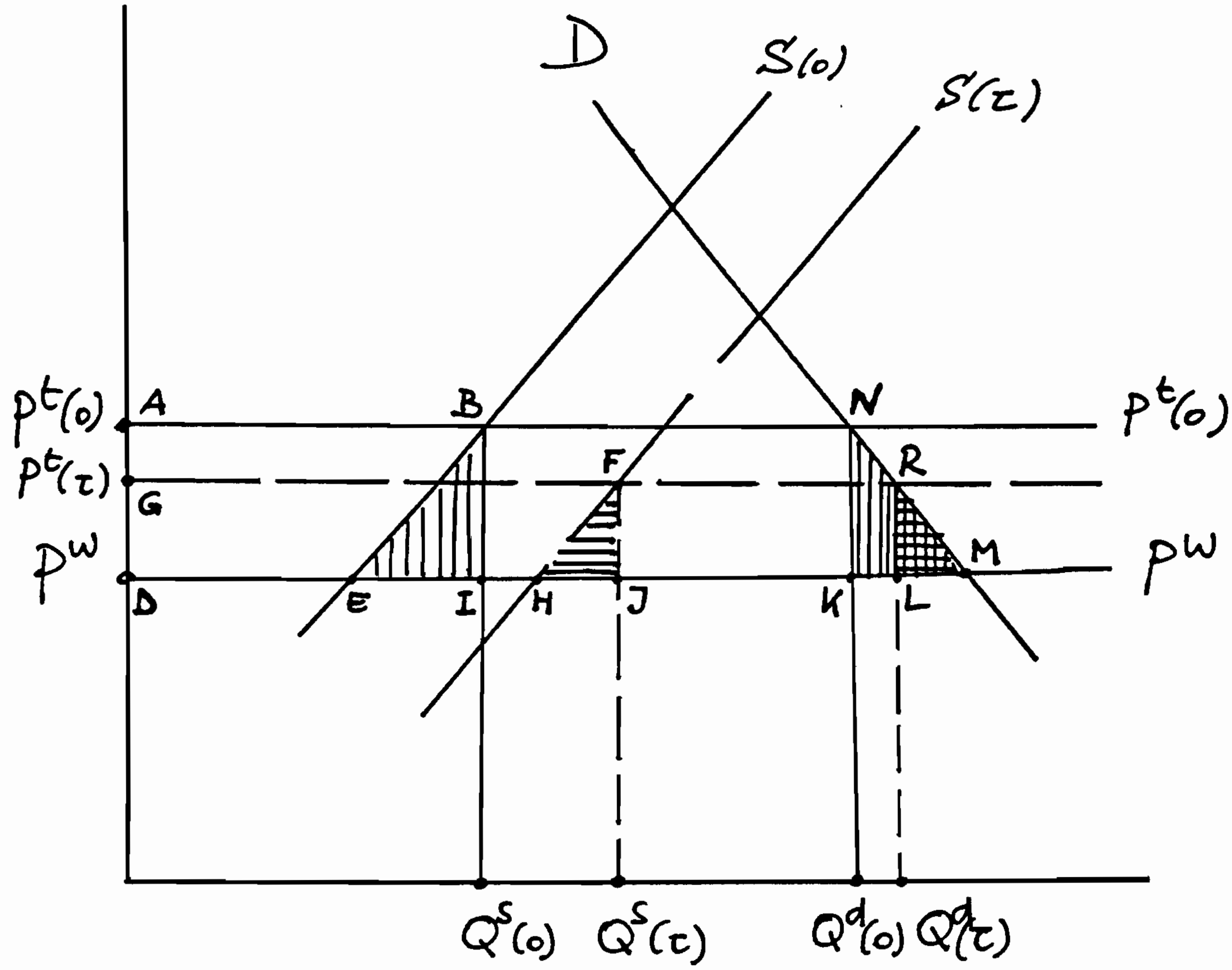


Fig. 8 : Impact of public investment (τ) on deadweight costs of an import tariff.

FIG-9.

Impact of DWC and EIE on Politically Optimal Investment (yeA=yeB)

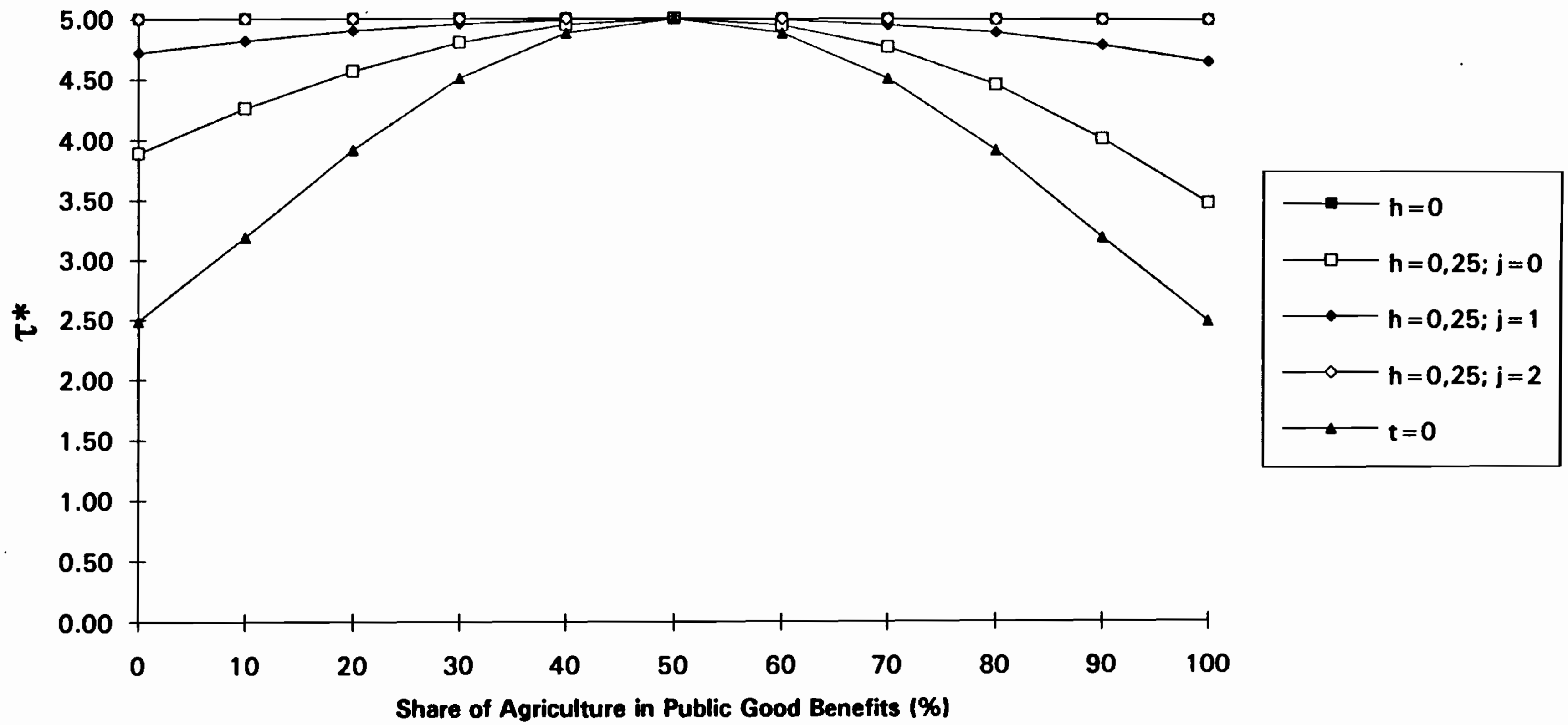


FIG-10.

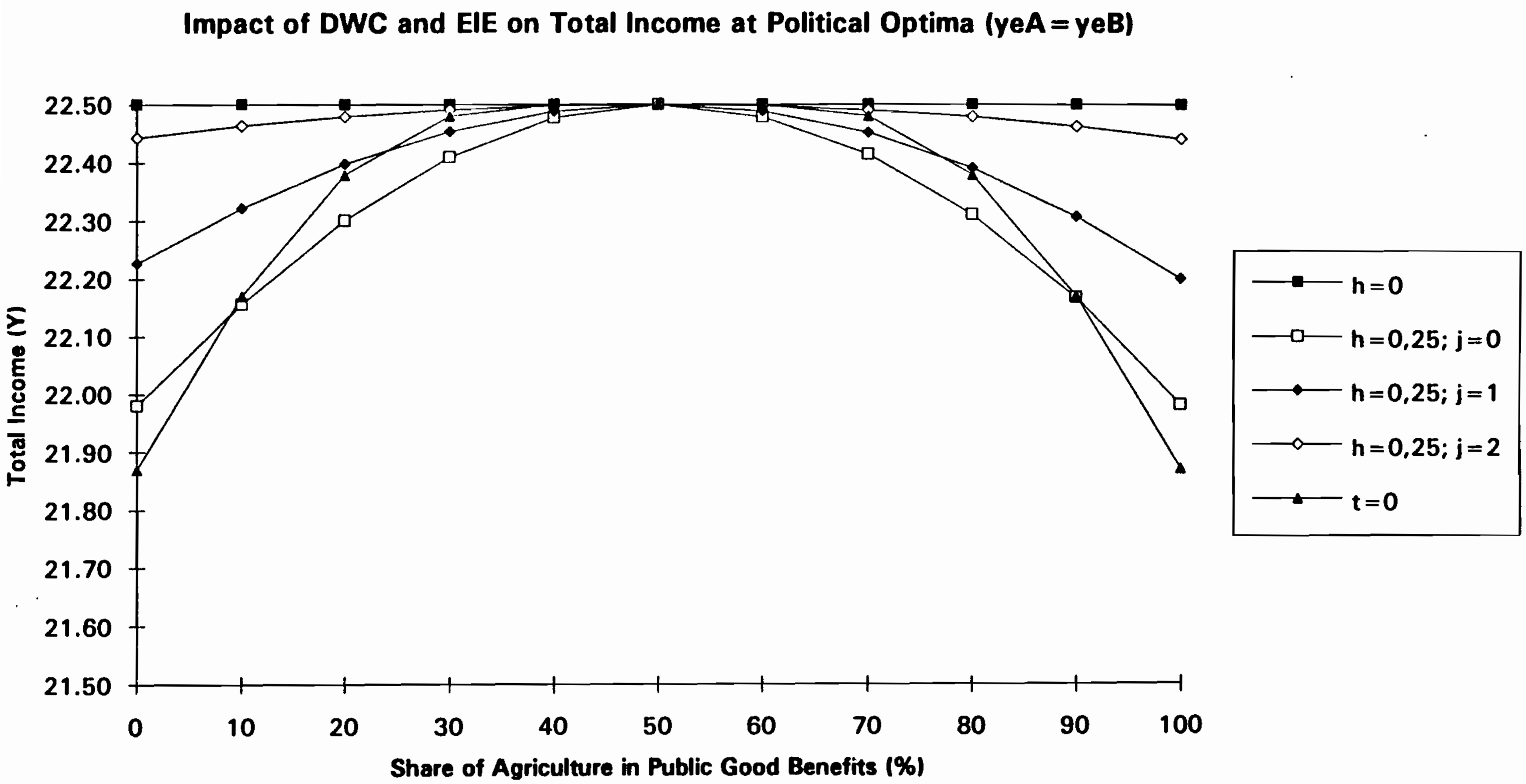

Impact of DWC and EIE on Total Income at Political Optima (yeA=yeB)
22.50
22.40
22.30
22.20
22.10
22.00
21.90
21.80
21.70
21.60
21.50
Total Income (Y)
0
10
20
30
40
50
60
70
80
90
100
Share of Agriculture in Public Good Benefits (%)
h=0
h=0,25; j=0
h=0,25; j=1
h=0,25; j=2
t=0

FIG-11.

Impact of DWC and EIE on Politically Optimal Investment (yeA = 14 > yeB = 10)

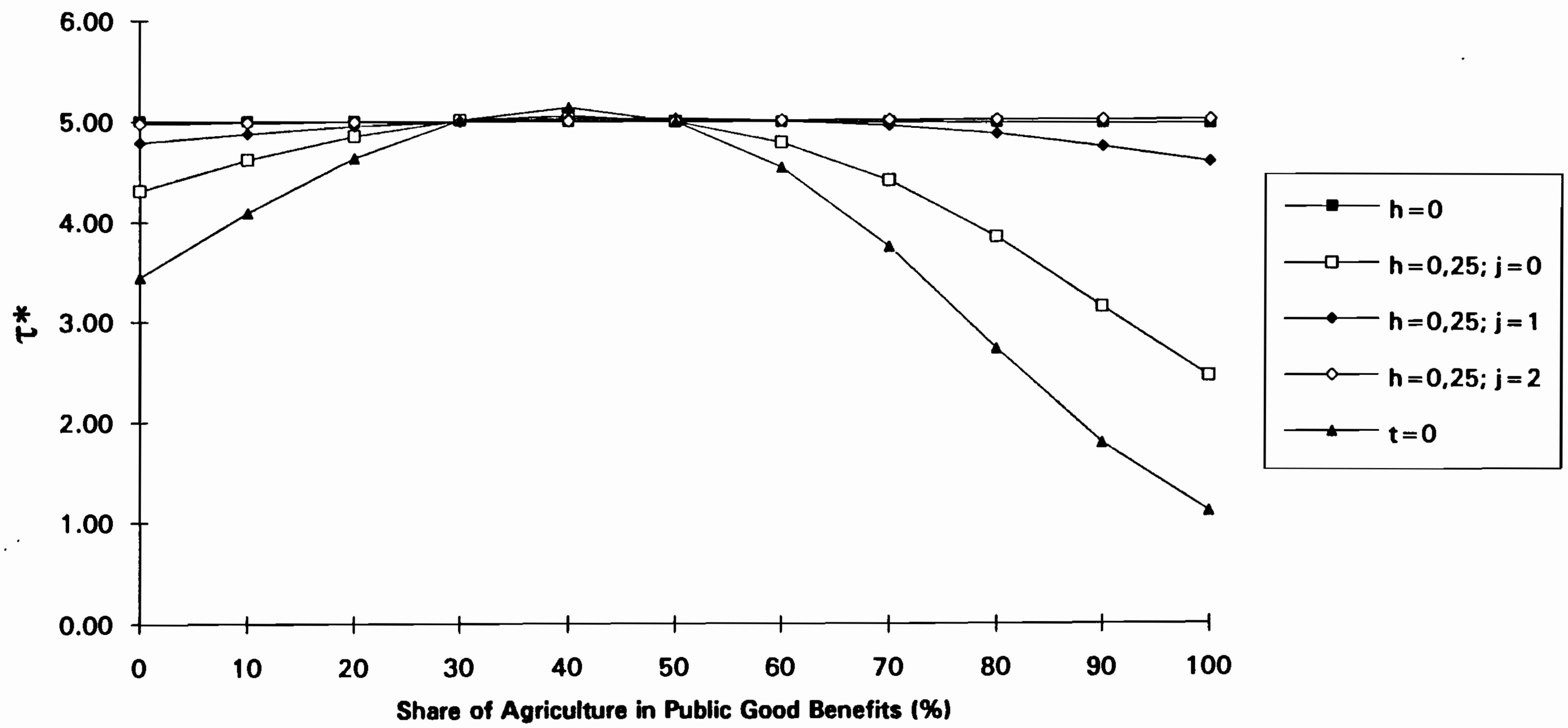
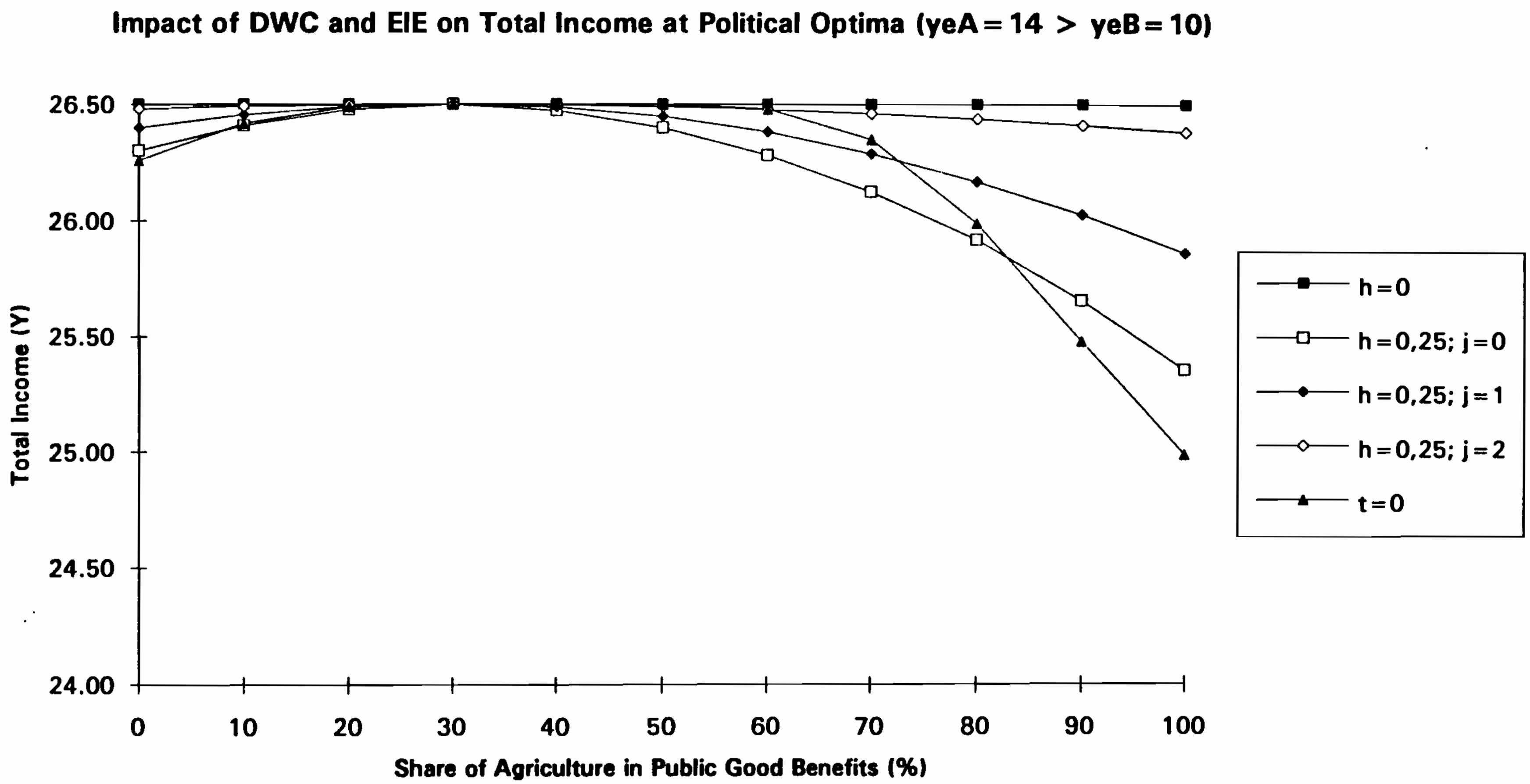


FIG-12.



Impact of DWC and EIE on Total Income at Political Optima (yeA = 14 > yeB = 10)
26.50
26.00
25.50
25.00
24.50
24.00
Total Income (Y)
0
10
20
30
40
50
60
70
80
90
100
Share of Agriculture in Public Good Benefits (%)
h = 0
h = 0,25; j = 0
h = 0,25; j = 1
h = 0,25; j = 2
t = 0

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