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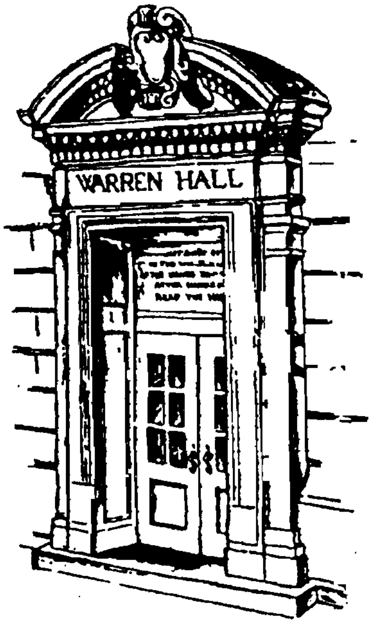

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THE POLITICS OF UNDERINVESTMENT IN AGRICULTURAL RESEARCH

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Abstract

This paper develops a political economy framework that determines the factors causing underinvestment in public research expenditures. Governments are unable to fully compensate for unequal income distribution effects of research because of either their inability to make credible commitments or of deadweight costs associated with compensation.

THE POLITICS OF UNDERINVESTMENT IN AGRICULTURAL RESEARCH

Introduction

Despite the very high productivity of research, a large literature reports severe underinvestment in public research expenditures for agriculture world-wide (Ruttan; Schultz; Huffman and Evenson). Several explanations have been put forward including imperfect information of governments, difficulties in overcoming the particular nature of the 'publicness' of research (transaction costs), and free rider problems (spill-overs and spill-ins between countries or states within a country). Others have claimed that underinvestment may be overstated because studies ignore deadweight costs of taxation (Fox), the country's trade position and terms of trade effects (Edwards and Freebairn), the difference between intermediate and finished products, the effects on unemployment (Schmitz and Seckler), or the increase in the deadweight costs of existing commodity policies (Murphy, Furtan and Schmitz).[1]

This paper develops a political economy framework that determines the political factors causing the apparent underinvestment in public research expenditures in agriculture. A key consideration is the unequal income distribution effects of agricultural research between sectors that leads governments to balance the political costs and benefits of diverging from each interest group's private optimum level of the public good investment. Each group may have a very different optimum for public research. Taking agriculture as an example, inelastic demand and elastic supply in industrial country agriculture may result in consumers benefiting relatively more than farmers (indeed, the latter can even lose). This income inequality generated by public research will lead to underinvestment, unless governments can fully compensate the group benefiting less. Full compensation will generally be impossible because of either the inability of governments to make credible commitments or of deadweight costs associated with the compensation.

[1] The excellent survey in USDA (1995) also argues that studies may ignore private research, lags in the effects of research, and potential environmental and health effects.

The *dynamic* effects of research on income distribution and the government's attempt to compensate through redistributive policy will inevitably lead to underinvestment. This is because the government *cannot credibly commit to full compensation for unequal income effects of research.* This inability of current governments to credibly commit to compensation in the future (when the unequal distributional effects of research emerge) occurs even if non-distortionary lump-sum transfers are available for the redistributive policy. Partial compensation and the resulting reduction in political support prevents the government from choosing the social optimum level of research expenditures in agriculture.

The inevitable existence of deadweight costs with redistributive policy automatically results in partial compensation. Even if governments could credibly commit to compensate for any income inequality due to research, deadweight costs of redistribution leads to underinvestment in research.

The paper is organized as follows. We first present a simple dynamic model with both research and redistributive policy endogenous. After determining the *social optimum* of a social planner optimizing a two-period Benthamite welfare function, we develop a public choice model. In comparing the *political optimal* policies to the social optimum, we derive the political factors described above that contribute to underinvestment in agricultural research.

The Model

Consider an economy with two sectors: agriculture (sector A) and industry (sector B). All individuals in the economy are assumed to have identical preferences, the same two-period time horizon, and perfect foresight. The problem facing each individual is to maximize a utility function V_T^i:

[1] $$V_T^i = \sum_{t=T}^{2} \delta^{t-1} U(y_t^i)$$

for individual I = A,B and time period T = 1,2. δ is the discount factor, y_t^i represents net income of individual i at time t and $U(y_t^i)$ is the (indirect) utility *i* derived from y_t^i. Each sector has one representative individual with a pre-policy endowment income y_e^i, which cannot be transferred between periods. The government has two policy instruments affecting both the level and distribution of income in the economy: public research investments in agriculture and redistribution (through commodity policy or lump-sum transfers).

Define aggregate public research at time t expenditures by τ_t. The cost of raising taxes to finance research is shared equally between sectors and we assume no deadweight costs (or excess burden) of taxation. Benefits from research can only materialize in the next period (one period after the investment is made) and there are no investments prior to period 1.

Redistribution of income between industry and agriculture through price supports, export subsidies or trade barriers involve deadweight costs. Denote the redistributive policy in period t by r_t. Further $r_t^i(r_t)$ is the aggregate net income transfer for sector i resulting from policy r_t, with $r_t^i(0) = 0$. Define $r_t^A(r_t) = r_t$ and $r_t^B(r_t) = -r_t - c(r_t)$, where *c(.)* represents the deadweight costs of the policy. Hence, policy r_t represents the net transfer to agriculture. A positive r_t means agriculture is subsidized by industry as is so commonly observed in industrial countries. Furthermore, assume that $\partial c / \partial r_t > 0$ for $r_t > 0, \partial c / \partial r_t < 0$ for $r_t < 0, \partial^2 c / \partial r_t^2 > 0$ and $\partial c / \partial r_t(0)$ $= 0$.

Sector i's net income in period t can be summarized by:

$$[2] \qquad y_t^i = y_e + \beta^i f(\tau_{t-1}) - (\tau_t / 2) + r_t^i$$

where the second term in the right-hand side represents the impact of research on i's income in the previous period. Income generated by public research is defined by the research production function f(.). Each sector's share of the benefits derived from public research is represented by β^i, with $\beta^A + \beta^B = 1$.[2] Because each policy has a differential impact on the distribution of income, one group's private optimum of the public good differs from the other group. The optimal policy combination will depend on the objective function of the government and the constraints facing it.

[2] De Gorter and Zilberman show that 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.

In this paper, we evaluate two alternative models: one is the traditional social planner model and the other is based on a public choice formulation of government behavior.[3]

The Social Optimum

The optimal policies for a social planner are determined by maximizing a Benthamite utility function. We assume that the social planner can use lump-sum transfers to redistribute income, and can credibly commit to future policies. The social planner problem is given by:

[3] $$\max_{\{\tau_1,\tau_2,r_1,r_2\}} \quad V_1^A + V_1^B$$

We define the policies $\{\tau_1{}^m, \tau_2{}^m, r_1{}^m, r_2{}^m\}$ that solve this problem as the *social optimal policy* set. Optimal research investment in the second period is zero ($\tau_2{}^m = 0$) because no group benefits. The conditions that determine the other social optimal policies are:

[4] $$U_{1y}^A(r_1^m) = U_{1y}^B(r_1^m)$$

[5] $$U_{2y}^A(r_2^m) = U_{2y}^B(r_2^m)$$

[6] $$-\frac{V_{1\tau}^B(\tau_1^m)}{V_{1\tau}^A(_1^m)} = -\frac{U_{1y}^B(\tau_1^m) - 2\delta U_{2y}^B(\tau_1^m)\beta^B f_\tau(\tau_1^m)}{U_{1y}^A(\tau_1^m) - 2\delta U_{2y}^A(\tau_1^m)\beta^A f_\tau(\tau_1^m)} = 1$$

where $U_{ty}^i = \partial U_t^i / \partial y_t^i, V_{t\tau}^i = \partial V_t^i / \partial \tau_t$, and $f_\tau = \partial f / \partial \tau$.

Condition [4] implies that $r_1^m = 0$ and that $r_2^m = [(\beta^B - \beta^A) f(\tau_1)]/2$. This means the social optimum will have full compensation with unequal distributional effects of research: $y_2^A(r_2^m) = y_2^B(r_2^m)$. We assume here that the social planner can use lump sum (non distortionary) transfers to compensate the group that benefits less (or loses from) from research. The social optimal

[3] Throughout the paper we assume that endowment incomes are equal between agriculture and industry. Dropping this assumption complicates the analysis, as both optimal redistribution and research investment are now affected both by endowment income differences and by redistributional effects of research investments (Swinnen and de Gorter, 1995a). However, this complication does not change the main conclusions of this paper.

research investment level is between the preferred investment levels of each sector. Only in the special case where both sectors benefit equally from research ($\beta^A = \beta^B$) will each group's preferred investment level coincide with the social optimum (using [4], [5] and [6]):

$$[7] \qquad U^i_{1y}(\tau^m_1) = \delta U^i_{2y}(\tau^m_1).f_\tau(\tau^m_1)$$

The Political Optimum

A burgeoning literature in political economy specifies a government maximizing some form of a political objective function (Hillman; Alesina and Rodrik; Perrson and Tabellini; Rausser). We extend the basic Downsian public choice model of Swinnen and de Gorter (1993) by including an endogenous public research investment in addition to the redistributive policy.[4] 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 at time t, S^i_t, is assumed to be a strictly concave and increasing function of the policy induced change in welfare :

$$[8] \qquad S^i_t = S^i[V^i(r_t,\tau_t) - V^i(0,0)]$$

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 equilibrium problems which are typical of deterministic (0-1) voting models (Mueller; Coughlin) and of multiple policy problems (Mayer and Riezman).

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

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

impact on political support from their constituency. Under perfect competition, politicians will choose the policy combination $\{r_t^*, \tau_t^*\}$ that maximizes political support in order to stay in power. For our model, this implies the following decision problem for politicians at time t:

[9] $$\max_{\{r_t, \tau_t\}} S_t^A(r_t, \tau_t) + S_t^B(r_t, \tau_t).$$

The policies r_t^* and τ_t^* that solve this problem are the political optimal policies [5].

As in the case for the social planner, there are no incentives for the government to invest in research in period 2: $\tau_2{*} = 0 (= \tau_2^m)$.

Consider then the optimality conditions in period 1:

[10] $$\frac{S_{1v}^A(r_1{*})}{S_{1v}^B(r_1{*})} = \frac{U_{1y}^B(r_1{*})\,(1 + c_r(r_1{*}))}{U_{1y}^A(r_1{*})}$$

[11] $$\frac{S_{1v}^A(\tau_1{*})}{S_{1v}^B(\tau_1{*})} = -\frac{U_{1y}^B(\tau_1{*}) - 2\delta\, U_{2y}^B(\tau_1{*})\beta^B f_\tau(\tau_1{*})}{U_{1y}^A(\tau_1{*}) - 2\delta\, U_{2y}^A(\tau_1{*})\beta^A f_\tau(\tau_1{*})}$$

and for period 2:

[12] $$\frac{S_{2v}^A(r_2{*})}{S_{2v}^B(r_2{*})} = \frac{U_{2y}^B(r_2{*})\,(1 + c_r(r_2{*}))}{U_{2y}^A(r_2{*})}$$

where $S_{tv}^i = \delta\, S_t^i / \partial\, [V^i(r_t, \tau_t) - V^i(0,0)]$.

[5] In reality, the two policies may be decided by different parts (e.g. administrations) of the government. To capture the essence of these features, we assume that agents have perfect information on incentives, costs and benefits. 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.

Distribution of Research Benefits

The political optimal policies will depend critically on the distribution of research benefits.

Proposition 1: *If the distribution of research benefits is equal ($\beta^A = \beta^B$), then support maximizing governments will choose the social optimal research investment ($\tau_1^* = \tau_1^{m'}$), independent of credibility constraints or deadweight costs.*

Proof: see appendix.

There is no incentive for the government to redistribute incomes (recall that each sector shares equally in financing the public good investment and that pre-policy endowment incomes are equal). Private optimum levels of the public good coincide with the social optimum.

When research benefits are unequally distributed between groups (for example, when industry benefits more from research than agriculture because of declining food prices induced by cost-reducing research), governments increase political support by investing at least as much as agriculture's preferred level (because both sectors support that). Furthermore, the government will never invest more than industry's preferred level, because it would support from both sectors. Thus the political optimum τ_1^* will be between each sector's optimum (as in the social planner's case). The optimum is where the marginal increase in support from industry is exactly offset by the marginal reduction in agriculture's political support, as indicated by condition [11].

Notice, however, that governments use income transfers to compensate the sector that benefits less (or loses) from the public good investment. When $\beta^A < \beta^B$, marginal support levels will differ between sectors for the same policy. A group's marginal support decreases when this group benefits more from policies, and vice-versa. Hence, the marginal support level will increase for those who are being taxed through redistribution, or when the investment level diverges from their optimum. The marginal support levels are endogenous in the politician's decision process and will be affected by all policies. Consequently, as the ratio of marginal political support levels adjust with changing investment (in condition [11]), it will also affect the optimal redistribution levels. In this case, it would imply that $S_v^A / S_v^B > 1$ as agriculture is benefiting less from research than industry. Condition [10] implies that the government transfers income to agriculture in this case ($r_1^* > 0$). This result holds in general: the political support mechanism will induce the government to compensate the sector that benefits less from research by transferring income to this sector.

Government Credibility and Deadweight Costs

To illustrate how government credibility affects the outcome, consider the equilibrium if the support maximizing government could credibly commit to implement policies in the next period. The condition for optimal redistribution in period 2, r_2^*, becomes:

$$[13] \qquad \frac{S_{1v}^A(r_2^*)}{S_{1v}^B(r_2^*)} = \frac{U_{2y}^B(r_2^*)(1+c_r(r_2^*))}{U_{2y}^A(r_2^*)}$$

Proposition 2: *If support maximizing governments can credibly commit on future compensation for unequal distribution of research benefits* ***and*** *if compensation does not induce deadweight costs, then the politically optimal research investment will be the social optimum.*

Proof: see appendix.

In the absence of deadweight costs, support maximizing governments will fully compensate for any unequal distributional effects of research benefits in the period they occur: $r_2^* = [\beta^A f(\tau_1^*) - \beta^B f(\tau_2^*)]/2$, which implies that post-policy incomes are equal: $y_2^A(r_2^*) = y_2^B(r_2^*)$. It is important that this future compensation is guaranteed (because we have assumed that governments can credibly commit to future policies), as it allows the government to choose the social optimal research investment in period 1: $\tau_1^* = \tau_1^m$. By transferring income from industry to agriculture to compensate for the unequal benefits of research, industry's support for increased research declines, because industry now incorporates the politically induced compensation payments in its assessment of net changes in income. Similarly, the opposition of agriculture to increasing research investment decreases as compensation payments increase. In terms of condition [11], this implies that S_{1v}^A / S_{1v}^B adjusts so that $S_{1v}^A = S_{1v}^B$ at the political equilibrium, resulting in equal incomes and the social optimal level of the public research investment.

If the government cannot credibly commit to full compensation in the future, then the outcome is characterized by conditions [10], [11], [12]. Notice that condition [12] implies that the government in period 2 is only concerned with income transfers in that period. Since research investments have taken place in the previous period, the government takes τ_1 as given in period 2. Therefore, the marginal support levels will not be affected by τ_1, but by r_2 only. As a consequence, the government will only partially compensate agriculture.[6] With negative impacts on income having a larger impact on political support than an equal increase in income, the reduction in political support of the taxed industry will increasingly offset the increase in political support by subsidizing agriculture. The equilibrium will be reached before incomes are equal: $y_2^A(r_2^*) < y_2^B(r_2^*)$. The reason why full compensation resulted with credible commitments was that governments internalized both period effects and policies in their calculations. For the first period government, second period income transfers are fully endogenous with credible commitments, but not without them. Full compensation will always result if income inequality is endogenously induced (Swinnen and de Gorter, 1995a).

Economic agents in period 1 fully understand the incentives of the government in period 2. Therefore, as agriculture realizes that there will only be partial compensation in period 2, agriculture's opposition to period 1 research investment beyond it's preferred level will be higher. As a consequence $S_{1v}^A > S_{1v}^B$ at $(\tau_1^*, r_1 = 0)$. This will induce the government to compensate partially in advance ($\tau_1^* > 0$ with $S_{1v}^A > S_{1v}^B$) but in equilibrium, it is still the case that $S_{1v}^A(\tau_1^*, r_1^*) > S_{1v}^B(\tau_1^*, r_1^*)$ such that $r_1^* > 0, \tau_1^* < \tau_1^m$ and $r_2^* < r_2^m$. The result is that the government will underinvest in research because the sector which benefits less from research is only partially compensated and will oppose increases in research investments more than if there was full compensation. In general:

Proposition 3: *If support maximizing governments cannot credibly commit to future compensation for the unequal distribution of research benefits, then the politically optimal research investment will be less than the social optimum.*

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6 Swinnen and de Gorter, 1993, have called this feature the "conservative" characteristic of the political model.

Proof: see appendix.

Proposition 3 holds independent of deadweight costs. It is easy to see from conditions [10], [12] and [13] that deadweight costs would increase the marginal burden on industry for compensating agriculture for the latter's smaller share of research benefits. This will reduce industry's political support even more for a given transfer to agriculture, and bring the optimal transfer r_t^* closer to zero. As a consequence, second period compensation will only be partial, even if credible commitments can be made by the government. Again, this results in first period compensation and in a lower research investment level. This effect occurs even if the government can credibly commit future policies. The general conclusion is:

Proposition 4: *If compensation for unequal distribution of research benefits induces deadweight costs, then the politically optimal research investment will be less than the social optimum.*

Proof: see appendix

There is one more important element to this issue. Thus far, we have assumed that there is no direct impact of research on the deadweight costs of the transfer ($\partial c / \partial \tau = 0$). In many cases, cost-reducing research will affect the agricultural supply curve and therefore the deadweight costs of market interventions such as price supports, impact tariffs, etc. (Murphy, Furtan and Schmitz). This effect will only occur in period 2. Condition [11] then becomes:

$$[14] \qquad \frac{S_{1v}^A(\tau_1*)}{S_{1v}^B(\tau_1*)} = -\frac{U_{1y}^B(\tau_1*) - 2\delta\, U_{2y}^B(\tau_1*)\left[\,\beta^B f_\tau(\tau_1*) - c_\tau\,\right]}{U_{1y}^A(\tau_1*) - 2\delta\, U_{2y}^A(\tau_1*)\beta^A f_\tau(\tau_1*)}$$

where $c_\tau = \partial c / \partial \tau$ reflects the additional (second period) effect.

The research investment may increase or decrease the deadweight costs associated with the transfer (i.e., $\partial c / \partial \tau > 0$ or $\partial c / \partial \tau < 0$). The effect depends on how research affects the supply curve and on the redistributive policy instrument (Swinnen and de Gorter, 1995b). When research induces a parallel shift in the supply curve, $\partial c / \partial \tau < 0$ for most policy instruments. In this case there is an additional benefit from research. The effect will mitigate the negative impact of deadweight costs and will bring the political optimum closer to the social optimum. This mitigating effect will depend on the size of $\partial c / \partial \tau$. Simulations reported in Swinnen and de Gorter (1995b) show that it can bring the political optimum very close to the social optimum, but does not fully offset. When research induces a pivot in the supply curve and very distortionary transfer policies are used (e.g., an export subsidy), then the likelihood increases that $\partial c / \partial \tau > 0$. Deadweight costs increase, forcing an increase in the gap between the political and social optimum level of research.

Concluding Remarks

This paper develops a public choice model to show how governments that face political constraints diverge from social optimal levels of research investments in agriculture. In our model, underinvestment in research occurs even with perfect information, and no transaction costs nor deadweight costs of redistributive policy. The key factor is that the benefits from agricultural research are unequally distributed. This causes differential political reactions from each group in society. Furthermore, the inability of government to commit to future actions leads to a time inconsistency problem. Because of government's inability to have credible commitments, only partial compensation will occur in response to the unequal benefits from research. The result is underinvestment in public research expenditures. Deadweight costs of income redistribution further reduces compensation and induces a wider gap between social and political optimal investment levels. However, we indicate from previous research that this gap may be reduced if research causes a decline in the deadweight cost per unit of transfer.

Appendix

Proof of proposition 1.

To show: $\beta^A = \beta^B \Rightarrow \tau_1^* = \tau_1^m$

With $\beta^A = \beta^B$, condition [12] implies that $r_2^* = 0$. This means that $y_2^A(*) = y_2^B(*)$, which implies that $U_{2y}^A(*) = U_{2y}^B(*)$ in [11]. Then, assume that $r_1 = 0$, which makes $U_{1y}^A(*) = U_{1y}^B(*)$ in [11], which in turn implies that $S_{1v}^A(*) / S_{1v}^B(*) = 1$. All this implies that condition [11] can be written as $U_{1y}^i(\tau_1^*) = \delta U_{2y}^i(\tau_1^*) f_\tau(\tau_1^*)$, which is identical to condition [7] and thus implies that $\tau_1^* = \tau_1^m$. We only need to show further that $r_1 =0$ is consistent with the political equilibrium. This can be done by substituting $\tau_1^* = \tau_1^m$, $\beta^A = \beta^B$ and $\tau_2^* = 0$ into condition [10], which gives $r_1^* = 0$. Q.E.D.

Proof of proposition 2.

Introducing $r_1^m = 0, r_2^m = [(\beta^A - \beta^B) f(\tau_1^m)]/2$ and τ_1^m in [10], [11] and [13] shows that $\{r_1^m, r_2^m, \tau_1^m\}$ solve the conditions for $\{r_1^*, r_2^*, \tau_1^*\}$ when $c(r_t) = c_t(r_t) = 0$. Q.E.D.

Proof of proposition 3.

Assume. $c(r_t) = c_t(r_t) = 0$. Define $k_t(r_t) = U_{ty}^B(r_t) / U_{ty}^A(r_t)$ and $z_t = S_{tv}^A / S_{tv}^B$. From condition [12], we know that at $r_2 = 0, S_{2v}^A = S_{2v}^B$ and thus $z_2 = 1$. Further, $U_{2y}^B < U_{2y}^A$ and $k_2 < 1$ at $\tau_1 > 0$ and $r_2 = 0$ for $\beta^A < \beta^B$. With $\partial z_2 / \partial r_2 < 0$ and $\partial k_2 / \partial r_2 > 0$, it follows that $r_2^* > 0$. However, there is less than full compensation $(y_2^A(r_2^*) > y_2^B(r_2^*))$ because $z_2(r_2^*) = k_2(r_2^*) > 1$, which implies that $\beta^B f(\tau_1) - r_2^* > \beta^A f(\tau_1) + r_2^*$ and, hence, that $r_2^* < ((\beta^B - \beta^A)/2) f(\tau_1)$. With imperfect compensation in the second period, condition [10] implies that $k_1 = 1$ and $z_1 > 1$ at $\tau_1 > 0$ and $r_1 = 0$. With $\partial k_1 / \partial r_1 > 0$ and $\partial z_1 / \partial r_1 < 0$, it follows that $r_1^* > 0$ for $\beta^A < \beta^B$. Furthermore, it must be that $z_1(r_1^*) > 0$ at $\tau_1 > 0$ and thus also at $\tau_1^* > 0$. Hence, using this in condition [11] implies that $V_{1\tau}^B(\tau_1^*) + V_{1\tau}^A(\tau_1^*) > 0$. Comparing this with condition [10] implies that $\tau_1^* < \tau_1^m$. Q.E.D.

Proof of proposition 4.

The proof is similar to the proof of proposition 3. Again we have partial compensation in the second period, because with $c_r(r_2) > 0$ for $r_2 > 0$ in condition [13], it still follows that $r_2^* > 0$, but $y_2^A(r_2^*) < y_2^B(r_2^*)$. As a consequence $S_{1v}^A > S_{1v}^B$ at $(r_1 = 0, r_2^*, \tau_1^*)$. Condition [10] implies that $r_1^* > 0$ but also that $S_{1v}^A > S_{1v}^B$ at (r_1^*, r_2^*, τ_1^*). Using this in condition [11] and comparing with [6] implies that $\tau_1^* < \tau_1^m$. Q.E.D.

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