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## Measuring research benefits in an imperfect market: second reply

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In a recent comment on Voon (1994), Holloway (1999) has made the following conclusions:

Under conditions that are almost identical to ones considered by Voon (1994) and by Sexton and Sexton (1996), pivotal shifts in marginal costs generate strictly greater benefits under monopoly.

This paper reconsiders the above conclusion. A simple geometric approach similar to Alston et al. (1988) and Voon and Edwards (1991) is used for the reassessment. The analysis shows that a pivotal shift in the marginal costs generates greater benefits under perfect competition than it does under monopoly. This is opposite to Holloway's finding.

The model is depicted in Fig. 1. Instead of a parallel shift in the MC curve, as in Voon (1994), a pivotal shift above the origin is assumed. This implies that the supply price elasticity is greater than unity ( $e > 1$ ; see Voon and Edwards, 1991).

Under monopoly,

$$\Delta CS_m = agP'_m - afP_m = P_m fgP'_m - P_m fjP'_m + fgj$$

$$\Delta PS_m = P'_m gdb - P_m feb = bec + ekdc + jgke - P_m fjP'_m$$

$$\begin{aligned}\Delta TS_m &= \Delta CS_m + \Delta PS_m = bec + ekdc + jgke + fgj \\ &= bec + ekdc + fgke\end{aligned}$$

Under perfect competition,

$$\Delta TS_c = bhi = bec + ekdc + khid$$

$\Delta TS_c > \Delta TS_m$  if  $khid > fgke$ . Since  $ghk$  is common, it is possible to prove the above by showing the triangle  $gid$  ( $\bar{ir} \cdot \bar{gd}$ ) to be larger than the triangle  $fhe$  ( $\bar{hm} \cdot \bar{fe}$ ).

$$(\bar{ir} \cdot \bar{gd}) > (\bar{hm} \cdot \bar{fe}) \text{ if : (1) } \bar{ir} > \bar{hm} \text{ and (2) } \bar{gd} > \bar{fe}.$$

1. It can be shown that  $\bar{ir} > \bar{hm}$  or  $\bar{iu} > \bar{rn}$  (since  $(Q'_c - Q_c) > (Q'_m - Q_m)$ ).
2. It can also be shown that  $\bar{gd} > \bar{fe}$  or  $\bar{sd} > \bar{fj}$ . Since  $\bar{ed}$  (along MR) is steeper than  $\bar{fg}$  (along D) and  $\bar{jg} = \bar{es}$ , therefore,  $\bar{sd} > \bar{fj}$ .

The geometrical analysis above shows that a pivotal shift in marginal costs generates greater total benefits under perfect competition than it does under monopoly. The same conclusion can be derived by allowing the shift to be pivoted at or below the origin where  $e = 1$  and  $e < 1$ , respectively.

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