

WELFARE COSTS AND BENEFITS OF NON-TARIFF MEASURES IN TRADE: A CONCEPTUAL FRAMEWORK AND APPLICATION

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APPENDIX: DERIVATION OF WELFARE MEASURES (NOTE 9)

This appendix provides details on the analytical expressions for the calculation of welfare effects for the different cases discussed in the main text.

Unaware consumers ($I=0$) without standard (see equilibrium E in figure 1)

Analytical expressions at the equilibrium are

$$p^E = \frac{ac_0c_F + bc_Ff_0M_0 + bc_0f_F M_F}{c_0c_F + bc_F M_0 + bc_0 M_F} \text{ for the price,}$$

$$Q^E = \frac{ac_F M_0 - c_F f_0 M_0 + ac_0 M_F - c_0 f_F M_F}{c_0c_F + bc_F M_0 + bc_0 M_F} \text{ for the quantity,}$$

$$PS_O^E = \int_0^{Q^E - Q_F^E} [p^E - p_O^S(Q)]dQ = \frac{c_0 M_0 [ac_F - c_F f_0 + b(f_F - f_D)M_F]^2}{2[c_0c_F + bc_F M_0 + bc_0 M_F]^2} \text{ for the overall profits of } M_0$$

domestic producers,

$$CS^E = \int_0^{Q^E} [p(Q, 0, r) - p^E]dQ = \frac{b[ac_F M_0 - c_F f_0 M_0 + ac_0 M_F - c_0 f_F M_F]^2}{2[c_0c_F + bc_F M_0 + bc_0 M_F]^2} \text{ for the consumer's}$$

surplus,

$$COI = rQ_F^E = rM_F \frac{ac_0 - c_0 f_F + b(f_0 - f_F)M_0}{c_0c_F + bc_F M_0 + bc_0 M_F} \text{ for the cost of ignorance,}$$

$$W_O^E = PS_O^E + CS^E - COI \text{ for the domestic welfare,}$$

$$PS_F^E = \int_0^{Q_F^E} [p^E - p_F^S(Q)]dQ = \frac{c_F M_F [ac_0 - c_0 f_F + b(f_0 - f_F)M_0]^2}{2[c_0c_F + bc_F M_0 + bc_0 M_F]^2} \text{ for the overall profits of } M_F$$

foreign producers,

$$W_I^E = PS_F^E + W_O^E \text{ for the international welfare.}$$

Unaware consumers ($I=0$) or Aware consumers ($I=1$) with a standard eliminating the damage and the cost of ignorance (see equilibrium H in figure 1 and in figure 2)

With the standard leading to $\lambda = 1 + \gamma$, analytical expressions at the equilibrium are

$$p^H = \frac{(1 + \gamma)[ac_o c_F + bc_F f_o M_o + bc_o f_F M_F]}{c_o c_F (1 + \gamma) + bc_F (1 + \gamma) M_o + bc_o M_F} \text{ for the price,}$$

$$Q^H = \frac{ac_F (1 + \gamma) M_o - (1 + \gamma) c_F f_o M_o + ac_o M_F - (1 + \gamma) c_o f_F M_F}{c_o c_F (1 + \gamma) + bc_F (1 + \gamma) M_o + bc_o M_F} \text{ for the quantity,}$$

$$PS_o^H = \int_0^{Q^H - Q_F^H} [p^H - p_o^S(Q)] dQ = \frac{c_o M_o [ac_F (1 + \gamma) - c_F f_o (1 + \gamma) + b(f_F (1 + \gamma) - f_D) M_F]^2}{2[c_o c_F (1 + \gamma) + bc_F (1 + \gamma) M_o + bc_o M_F]^2} \text{ for the}$$

overall profits of M_o domestic producers,

$$CS^H = \int_0^{Q^H} [p(Q, 0, 0) - p^H] dQ = \frac{b[ac_F (1 + \gamma) M_o - c_F (1 + \gamma) f_o M_o + ac_o M_F - c_o (1 + \gamma) f_F M_F]^2}{2[c_o c_F (1 + \gamma) + bc_F (1 + \gamma) M_o + bc_o M_F]^2}$$

for the consumer's surplus,

$$W_o^H = PS_o^H + CS^H \text{ for the domestic welfare,}$$

$$PS_F^H = \int_0^{Q_F^H} [p^H - p_F^S(Q)] dQ = \frac{c_F (1 + \gamma) M_F [ac_o - c_o f_F (1 + \gamma) + b(f_o - f_F (1 + \gamma)) M_o]^2}{2[c_o c_F (1 + \gamma) + bc_F (1 + \gamma) M_o + bc_o M_F]^2} \text{ for the overall}$$

profits of M_F foreign producers,

$$W_f^H = PS_F^H + W_o^H \text{ for the international welfare.}$$

Aware consumers ($I=I$) without standard (see equilibrium K in figure 2)

Let

$$\Delta = \sqrt{\left(2bc_o^2 f_F M_F^2 + c_F^2 f_o M_o (c_o + 2bM_o) + ac_f c_o (c_o M_F + c_F M_o) + c_F c_o M_F (2b(f_F + f_o) M_o + c_o (f_F - r))\right)^2 - 4(c_o M_F + c_F M_o)(bc_o M_F + c_F (c_o + bM_o)) \left(ac_f c_o (c_o f_F M_F + c_F f_o M_o) + b(c_o f_F M_F + c_F f_o M_o)^2 - c_F c_o^2 f_F M_f r \right)}$$

As analytical expressions at the equilibrium are for the price

$$p^K = \frac{1}{2(c_o M_F + c_F M_o)(c_o c_F + bc_F M_o + bc_o M_F)} \left[\frac{\Delta + ac_o^2 c_F M_F + c_o^2 c_F f_F M_F + 2bc_o^2 f_F M_F^2 + ac_o c_F^2 M_o}{+c_o c_F^2 f_o M_o + 2bc_o c_F f_F M_F M_o + 2bc_o c_F f_o M_F M_o} \right. \\ \left. + \frac{2bc_F^2 f_o M_o^2 - c_f c_o^2 M_F r}{+2bc_F^2 f_o M_o^2 - c_f c_o^2 M_F r} \right]$$

$$Q^K = (a - p^K - r(Q_F^K / Q^K)) / b \text{ for the quantity is not reported because of the length.}$$

$$PS_o^K = \int_0^{Q^K - Q_F^K} [p^K - p_o^S(Q)] dQ$$

$$= \frac{M_o}{8c_o (c_o M_F + c_F M_o)^2 (c_o c_F + bc_F M_o + bc_o M_F)^2} \left[\Delta + c_o \left(\begin{array}{l} 2bc_o (f_F - f_o) M_F^2 - f_o c_F^2 M_o \\ + ac_F (c_o M_F + c_F M_o) \\ - c_F M_f (2b(f_F - f_o) M_o + c_o (2f_o - f_F + r)) \end{array} \right) \right]^2$$

for the overall profits of M_o domestic producers.

With

$$\Omega = 8c_o(c_oM_F + c_F M_o)^2(c_o c_F + bc_F M_o + bc_o M_F)^2 \left(\Delta + c_o c_F (-c_F f_o M_o + a(c_o M_F + c_F M_o) - c_o M_F (f_F + r)) \right)^2$$

it is possible to define

$$CS^K = \int_0^{Q^K} [p(Q,1,r) - p^K] dQ$$

$$= \frac{M_o}{\Omega} \left[\begin{array}{l} \Delta^2 - 2\Delta b(c_o M_F + c_F M_o) (-c_F f_o M_o + a(c_o M_F + c_F M_o) - c_o M_F (f_F + r)) \\ -c_F^2 f_o^2 M_o^2 (c_o + 2bM_o) + a^2 (c_o M_F + c_F M_o)^2 (2bc_o M_F + c_F (c_o + 2bM_o)) \\ -2a(c_o M_F + c_F M_o)^2 (2bc_o M_F + c_F (c_o + 2bM_o)) (c_o M_F (f_F + r) + c_F f_o M_o) \\ +2bc_o^2 M_F^3 (2b(f_F - f_o) M_o r + c_o (f_F + r)^2) \\ +2c_F^2 M_F M_o \left(\begin{array}{l} 2b^2 (f_F - f_o) M_o^2 r + c_o^2 (f_o r + f_f (f_o + 2r)) \\ +bc_o M_o (f_o (f_o - 2r) + 2f_f (f_o + 2r)) \end{array} \right) \\ +c_F c_o M_F^2 \left(\begin{array}{l} 8b^2 (f_F - f_o) M_o^2 r + c_o^2 (f_F + r)^2 \\ +2bc_o M_o (f_F^2 + r(r - 2f_o) + 2f_f (f_o + 3r)) \end{array} \right) \end{array} \right]^2$$

for the consumer's surplus,

$$W_o^K = PS_o^K + CS^K \text{ for the domestic welfare,}$$

$$PS_F^K = \int_0^{Q_F^K} [p^K - p_F^S(Q)] dQ$$

$$= \frac{M_F}{8c_F (c_o M_F + c_F M_o)^2 (c_o c_F + bc_F M_o + bc_o M_F)^2} \left[\Delta + c_F \left(\begin{array}{l} +c_o c_F (f_o - 2f_f) + c_o M_f 2b(f_o - f_f) M_o \\ +2bc_F (f_o - f_f) M_o^2 \\ +ac_o (c_o M_F + c_F M_o) - c_o^2 M_f (f_F + r) \end{array} \right) \right]^2$$

for the overall profits of M_F foreign producers,

$$W_I^K = PS_F^K + W_o^K \text{ for the international welfare.}$$