

Deriving equation (1) for

Hertel, Thomas W. 1990. "General Equilibrium Analysis of Agriculture: What Does it Contribute?". *The Journal of Agricultural Economics Research*, 42(3).

We start from demand and supply in proportional change. The demand equation is

$$\hat{q}_H = \eta_H \cdot \hat{p}_H$$

The supply equation is

$$\hat{q}_F = \eta_F \cdot \hat{p}_F$$

And market clearing condition requires that

$$\hat{q}_H = \hat{q}_F$$

By substitution the market clearing condition will be:

$$\eta_H \cdot \hat{p}_H = \eta_F \cdot \hat{p}_F \quad (i)$$

Using ad valorem tax assumption in the paper, the relationship between farm price, p_F , and market price, p_H , is:

$$p_F = s \cdot p_H$$

where $s > 1$ denotes the subsidy. Totally differentiate:

$$dp_F = ds \cdot p_H + dp_H \cdot s$$

Divide both side by p_F , or $s \cdot p_H$

$$\frac{dp_F}{p_F} = \frac{ds \cdot p_H}{s \cdot p_H} + \frac{dp_H \cdot s}{s \cdot p_H}$$
$$\frac{dp_F}{p_F} = \frac{ds}{s} + \frac{dp_H}{p_H}$$

Re-writing in proportional change:

$$\hat{p}_F = \hat{s} + \hat{p}_H \quad (ii)$$

Re-write (i) using (ii),

$$\eta_H \cdot \hat{p}_H = \eta_F (\hat{s} + \hat{p}_H) \quad (i')$$

Re-arranging:

$$\eta_H \cdot \hat{p}_H = \eta_F \hat{s} + \eta_F \hat{p}_H$$
$$-\eta_F \hat{s} = \eta_F \hat{p}_H - \eta_H \hat{p}_H$$
$$-\eta_F \hat{s} = (\eta_F - \eta_H) \hat{p}_H$$
$$\hat{p}_H = (\eta_F - \eta_H)^{-1} \eta_F (-\hat{s}) \quad (1)$$