

Online Theoretical Appendix

In equilibrium, the three traders receive different proportions of low and high quality goods. Farmers with low and high quality good who are indifferent between going to the two market towns are located at ρ and μ respectively. The supply to each of the three traders is given below:

$$S_2^L(\mathbf{p}) = \begin{cases} (1 - \rho)\lambda & \text{if } p_2 > p_3^L \\ \frac{1}{2}(1 - \rho)\lambda & \text{if } p_2 = p_3^L \\ 0 & \text{if } p_2 < p_3^L \end{cases} \quad S_2^H(\mathbf{p}) = \begin{cases} (1 - \mu)(1 - \lambda) & \text{if } p_2 > p_3^H \\ \frac{1}{2}(1 - \mu)(1 - \lambda) & \text{if } p_2 = p_3^H \\ 0 & \text{if } p_2 < p_3^H \end{cases}$$

and similarly to trader 3. I will assume $p_3^H > p_3^L = p_2$ to derive the supply to traders 1, 2 and 3 given the price vector \mathbf{p} . Trader 2 will not receive high quality goods. This will be true in equilibrium as I confirm below. Each trader's respective supply of low quality goods is:

$$S_1^L(\mathbf{p}) = \rho\lambda = \frac{p_1 - p_2 + t}{2t}\lambda$$

$$S_2^L(\mathbf{p}) = S_3^L(\mathbf{p}) = \frac{1}{2}(1 - \rho)\lambda = \frac{(p_2 - p_1 + t)}{4t}\lambda$$

Each trader's respective supply of high quality goods is:

$$S_1^H(\mathbf{p}) = \mu(1 - \lambda) = \frac{p_1 - p_3^H + t}{2t}(1 - \lambda)$$

$$S_3^H(\mathbf{p}) = (1 - \mu)(1 - \lambda) = \frac{p_3^H - p_1 + t}{2t}(1 - \lambda)$$

The profits of the three traders are:

$$\Pi_1(\mathbf{p}) = (p_1'(\mathbf{p}) - p_1)[S_1^L(\mathbf{p}) + S_1^H(\mathbf{p})]$$

$$\Pi_2(\mathbf{p}) = (p^* - p_2)S_2^L(\mathbf{p})$$

$$\Pi_3(\mathbf{p}) = (p^* - p_3^L)S_3^L(\mathbf{p}) + (p^{**} - p_3^H)S_3^H(\mathbf{p})$$

Recall that trader 1 receives a price $p_1'(\mathbf{p})$ from the processors, where $p_1'(\mathbf{p}) = \gamma_1(\mathbf{p})p^* + (1 - \gamma_1(\mathbf{p}))p^{**}$ and $\gamma_1(\mathbf{p}) = \frac{S_1^L(\mathbf{p})}{S_1^L(\mathbf{p}) + S_1^H(\mathbf{p})} = \frac{\rho\lambda}{\rho\lambda + \mu(1 - \lambda)}$. The following prices constitute a

unique pure-strategy Nash equilibrium if and only if $t < \frac{\lambda}{3}(1 + \lambda)(p^{**} - p^*)$:

$$\begin{aligned} p_2 &= p_3^L = p^* \\ p_1 &= \frac{3((1 - \lambda)p^{**} - t) + \lambda(t + 4p^*)}{3 + \lambda} \\ p_3^H &= \frac{3(p^{**} - t) + \lambda(2p^* - p^{**})}{3 + \lambda} \end{aligned}$$

Note that trader 1 offers a price based on the proportion of low and high quality goods it attracts. The introduction of a third trader who is able to verify quality, drives down the price of low quality good to the marginal value of low quality, given by p^* . The price offered by trader 2 is then too low for it to attract any high quality goods.

In equilibrium, traders 2 and 3 charge the same competitive price: $p_2 = p_3^L = p^*$. The proof is as follows: Consider, for example, $p_3^L < p_2 < p^*$, then trader 3 has no supply, and its profit is zero. On the other hand, if trader 3 charges $p_3 = p_2 + \varepsilon$ where ε is positive and “small”, it obtains the entire supply of low quality good and has a positive profit margin of $p^* - p_2 - \varepsilon$. Therefore, trader 3 cannot be acting in its own best interest if it charges $p_3^L < p_2 < p^*$. Now suppose that, $p_3^L = p_2 < p^*$, then the profit of trader 3 is $(p^* - p_3^L)(1 - \rho)/2$. If trader 3 increases its price slightly to $p_3^L + \varepsilon$, its profit becomes $(p^* - p_3^L - \varepsilon)(1 - \rho)$ which is greater for small ε . In this situation, the market share of the trader increases in a discontinuous manner. Trader 3 will not charge more than its marginal value for low quality good p^* (it would make a negative profit if it did). Trader 2 cannot distinguish between quality. If it charged an ε above p^* , while trader 3 charged p^* , it would attract all low quality farmers. In this case, $\gamma_2 \rightarrow 1$, and the resale price for trader 2 (which was $p_2' = \gamma_2 p^* + (1 - \gamma_2)p^{**}$) reduces to p^* . Thus, trader 2 will also not charge more than its marginal value for low quality good p^* (otherwise it would make negative profits). Hence $p_2 = p_3^L = p^*$.

In addition, if $p_3^H > \lambda p^* + (1 - \lambda)p^{**}$ (the maximum price that trader 2 can offer without making negative profits), then trader 2 has no incentive to deviate. The prices exist in equilibrium if and only if $t < \frac{\lambda}{3}(1 + \lambda)(p^{**} - p^*)$. This condition is more likely to be satisfied if t is low relative to the difference between competitive prices of high and low quality good. In other words, the ratio of transport costs to the price difference between

high and low quality good should not be very large. Note that $p_3^H > p_1 > p_2 = p_3^L$ if and only if $t < \frac{3(1-\lambda)(p^{**}-p^*)}{3-\lambda}$. This feature results in two opposing forces on the price offered by traders 1 and 2 , namely the upward competition effect and the downward composition effect.