'Fair Trade' Coffee and the Mitigation of Local Oligopsony Power

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Abstract: In recent years there has been considerable growth in 'Fair Trade' markets for several commodities, most notably coffee. We argue that coffee is grown under conditions that might well subject growers to the market power of downstream intermediaries (processors). Using an approach designed to evaluate the effects of state trading enterprises on trade and welfare, we develop an oligopsony model of intermediaries. In this model, 'Fair Trade' processors optimize a welfare function that includes the producer surplus of coffee growers. This concern for growers' welfare among some processing firms helps to alleviate the market power distortion. We calibrate the model to price data reported by a fair trade organisation and consider the counterfactual removal of fair trade behaviour by processors. As expected, the income of coffee growers (in aggregate) is reduced, though the effects are quite small.

Key words: coffee, fair trade, oligopsony

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Introduction

A growing phenomenon in consumer goods markets is the growth of *ethical consumption* movements, including 'No Sweat' campaigns for clothing, environmentally-oriented organic food markets, and 'fair trade' markets for goods such as coffee. These markets use alternative distribution channels to link consumers with producers who employ particular methods of production. The purpose of alternative channels is typically the mitigation of an apparent market distortion.

We evaluate a prominent example of alternative distribution channels, the fair trade coffee market.[1] We argue that the circumstances of many coffee farmers in developing countries leave them plausibly exposed to the market power of intermediaries.[2] We adapt a modelling framework that is used to assess the effects of state trading enterprises in other agricultural markets; fair trade intermediaries maximise an objective function that includes the welfare of coffee growers in developing countries. In markets where conventional intermediaries have oligopsony power, the fair trade intermediary's concern for growers' welfare helps to mitigate this distortion.

In order to investigate the possible magnitude of these effects, we calibrate the model to price data for fair trade and conventional coffees, plausible market shares for the two coffee types, and a number of structural parameters consistent with a medium-run view of the problem. We have difficulty reconciling a large market share for

[1] A description of the fair trade coffee market is provided in the next section.

[2] This claim is common in the fair trade movement's own literature. Our contribution is to formalise it, and to evaluate the quantitative limits of fair trade as a response to oligopsony power.

conventional coffee, a small difference between the mark-ups of the processors in the two sectors, and the idea of sizable oligopsony power in the conventional market. Our calculations suggest that fair trade intermediaries can raise the incomes of coffee farmers, but these effects are likely to be quite small. For a wide range of plausible parameterisations of the model, we calculate that the removal of the fair trade channel would reduce the income of coffee farmers by less than 10 per cent.[3]

Our discussion proceeds as follows. In the next section we describe market conditions in the coffee supply chain, as well as the fair trade channel. In the section that follows we review the literature on fair trade coffee. Thereafter, we develop the model, calibrate it to data and then investigate the consequences of fair trade firms for the welfare of coffee farmers.

1. Market Conditions in the Coffee Supply Chain

The conventional coffee market employs a number of types of intermediaries that link growers of coffee beans at one end of the supply chain with consumers of coffee at the other. We begin by describing the conventional market channel. Coffee trees produce 'berries' which the farmers harvest and sell to private processors. These processors then transport the berries to processing plants where the berries are converted into green coffee beans. Local exporters sell the processed beans to international traders, who then sell the beans to coffee roasters. The final product is distributed to retailers who sell coffee to consumers.

For the purposes of this paper, we define 'fair trade' coffee as that sold by an alternative trading organisation, with those certified by the Fairtrade Labelling

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[3] This is the aggregate effect on all farmers, not only on those selling into the fair trade channel.

Organizations International (FLOI) as the most prominent examples.[4] The conditions imposed by FLOI include the following. Farmers must produce the coffee berries using 'sustainable' methods, and are required to form a cooperative that operates democratically and transparently. Buyers, i.e., processors, are required to have long-term trading partnerships with farmers and to provide market information and credit upon request. They are required to pre-finance up to 60 per cent of the total purchase, a commitment that allows farmers to smooth their income streams. Downstream firms are required to pay processors the greater of the market price and the fair trade minimum price plus, in each case, a premium of US$0.20 per pound (Fairtrade Labelling Organizations International, 2012b).

Fair trade organisations make a number of claims about their beneficial effects for farmers. These include the transfer of technology and market information, the smoothing of farm incomes over the season, and insurance against downward price risk. While these are all plausible sources of benefits to farmers, they go beyond the scope of this paper. We limit our analysis to the specific claim that such organisations reduce the market power of first-stage coffee buyers (processors). We find this claim plausible, at least in its qualitative form. Market conditions in coffee are such that: i) the supply of coffee beans is highly price inelastic; and ii) competition among local buyers is plausibly imperfect.

[4] FLO is a certification body that verifies that coffee sold under its label has been produced and sold under particular conditions. It has 25 member organizations operating in 24 countries in Central and South America, Africa and Asia (FLO, 2012a).

1.1 Price Inelastic Supply

Coffee trees grow best in tropical areas without frost and with few sudden changes in temperature. The Arabica bean, which is most commonly used in ‘fair trade’ and other high quality coffees, is best grown in the highlands of tropical zones (Milford, 2004). High altitudes limit the number of alternative crops in several ways. Centuries of erosion mean that mountainous regions often have thin soils, thereby limiting the biological viability of alternative crops. Rugged terrain and poor quality infrastructure in developing countries combine to make transportation and communication difficult and, thereby, limit the number of cash crops that can be successfully marketed outside the immediate vicinity.

Another two important features of the coffee market are the slow maturation of coffee trees and their subsequent long harvesting lives. Coffee trees take two years to reach maturity and about five years to reach their optimal yield. Once a tree has reached maturity, high quality beans can continue to be harvested for a further twenty years.[5]

The combination of these three characteristics – the lack of economically viable substitute cash crops, slow maturation and long harvesting lives – implies an inelastic supply of coffee berries.[6] Empirical estimates confirm this intuition. Akiyama and Varangis (1990) estimate supply elasticities over 2-, 5- and 10-year intervals for a number of coffee-producing countries. The simple cross-country averages of these estimates are 0.12, 0.21, and 0.35, respectively. Such low supply

[5] See Milford (2004) on these points.

[6] In a general equilibrium sense we can think of the coffee trees, and (to a lesser degree) the land, as a specific factor that the farmers supply jointly with their labour. Ownership of specific factors can make farmers' welfare extremely sensitive to the coffee prices, and can limit the mobility of rural labour when coffee prices fall.

elasticities over fairly long time horizons suggest at least two vulnerabilities for small coffee farmers. First, they are highly exposed to fluctuations in world market prices. This is especially true if farmers lack access to credit, futures markets and/or adequate storage facilities. Second, inelastic supply makes farmers potentially vulnerable to the oligopsony power of local buyers.

1.2 Ownership Structure and the Potential for Oligopsony Power

The production of coffee beans is typically organized around smallholder agriculture. Gresser and Tickell (2002) report that seventy per cent of global coffee production is grown on small plantations of less than 10 hectares. Ronchi (2006) notes that ninety-two per cent of Costa Rican coffee farms have fewer than five hectares. That small farmers are vulnerable to the monopsony/oligopsony power of first-stage buyers is a running theme in agricultural economics, in developed and developing countries alike.[7] Responses by governments to such market power have often included encouraging the formation of cooperatives or creating state marketing boards with statutory power to buy from farmers and to sell into marketing channels. One can view the fair trade channel as a particular (private) form of these more common (government) responses to oligopsony power.

The discussion of market power within the fair trade movement often focuses on the market shares of global coffee roasters. A frequently cited statistic is that five roasting firms – Kraft, Nestle, Sara Lee, Procter & Gamble, and Tchibo – account for almost 50 per cent of global processing. However, such a figure typically includes freeze-dried markets and/or lower quality Robusta beans. Given the focus of the fair

[7] Sexton and Lavoie (2001) offer a broad overview of the literature on market power in the agricultural marketing and food processing sectors.

trade movement on the fresh, higher-quality Arabica market, we do not wish to lean on concentration in this part of the supply chain as our source of oligopsony power. We focus instead on the existence of buying power at the farm gate, which is the place where market power would impinge most directly on farmers' welfare.

There are a number of possible sources of oligopsony power in developing country markets for coffee berries. As in many agricultural markets, local scale economies in transportation and/or processing may limit direct competition through barriers to entry. Farmers in remote regions – with poor communication and transportation links – may lack access to alternative buyers.[8] Credit constraints may also limit farmers' ability to bargain effectively with buyers. Developing country governments may not provide effective enforcement of anti-trust law, where it exists, because of inadequate resources or because of outright corruption.

Regardless of the source of oligopsony power, there is evidence that it is a feature of coffee markets in developing countries. In a study of Costa Rican coffee farmers, Ronchi (2006) finds evidence of market power. Lopez and You (1993) find evidence that the coffee exporters' association in Haiti was a source of oligopsony power. We take the existence of market power in coffee markets as a plausible stylised fact and develop a suitable theoretical model to represent it.

2. Literature on Fair Trade Coffee

The fair-trade movement is most visible at the extreme ends of the coffee supply chain. Fair trade organisations interact with small growers of coffee berries at the upstream end and focus their appeals to consumers of coffee at the retail end. Several

[8] As an example, we note that in 2000, only 22 per cent of roads in Costa Rica were paved. (World Bank Development Indicators, 2008).

aspects of the fair trade coffee supply chain are analysed in the economics literature: using case studies and field interviews (e.g., Imhof and Lee (2007) and Milford (2004)); econometric estimation of consumer demand (e.g., Pierre (2007)) and of buying power (e.g., Ronchi (2006)); and theoretical models (e.g., Becchetti and Adriani (2004) and Richardson and Stähler (2007)). These authors tend to limit their investigations to only one part of the supply chain, e.g., consumer price premiums paid for fair-trade product (e.g., Poret and Chambolle (2007) and Pierre (2007)); market power amongst processors (e.g., Ronchi (2006)); and cooperative behaviour by a subset of coffee growers (e.g., Milford (2004)). By contrast, Becchetti and Adriani (2004) and Richardson and Stähler (2007) consider both ends of the supply chain.[9]

One of the key assertions of the fair trade movement is that the market power of processors reduces the effective demand for coffee berries. The corollary is that fair trade mechanisms countervail this market power and increase the demand for coffee berries from those growers who sell berries into the fair-trade supply chain. In this context, Imhof and Lee (2007) assess the benefits of fair trade using a case study of Bolivian coffee producers. They conclude that, under certain conditions, non-fair-trade farmers can also benefit from the pro-competitive effect of fair trade. This conclusion is consistent with the observation of Bowen (2001) who noted that the

[9] The conclusions to be drawn from those authors who investigate behaviour at the retail consumer level may be summarised as follows. Poret and Chambolle (2007) conclude that the retailer’s decision is based on how much those consumers who like fair trade are willing to pay, not on how many consumers are willing to pay for fair trade products. Pierre (2007) finds that consumers’ awareness of fair trade makes no difference to the market share of fair trade and concludes that supermarkets use fair trade only to 'clean wash' their reputation.

existence of fair trade processors, by reducing the supplies available to commercial processors, causes them to increase their buying price.

Milford (2004) studies coffee input markets in a setting of competition between a monopsonist and a coffee growers' cooperative and concludes that coffee cooperatives can have a positive effect on local markets by restoring competition among private intermediaries. Becchetti and Solferino (2003) show that if consumers' perception of ethical costs is sufficiently high, entry to the supply chain by a fair trader can lead to imitation of its behaviour by the incumbent, profit-maximising firm.[10] This imitation has the desired pro-competitive effect.

We adapt the modelling framework that McCorriston and MacLaren (2007) used to assess the effects of state trading enterprises on markets for agricultural commodities. These authors develop a model in which a state trading enterprise maximises an objective function that combines its own profit with the producer surplus of the growers who supply it. In our model, the objective function of the fair-trade processor is exactly the same. Using this approach we evaluate, both theoretically and quantitatively, the possible welfare improvement for growers of coffee that results from the existence of a fair-trade processing firm that competes with profit-maximising processors.

[10] These authors define ethical features of firms as selling products at zero profit and transferring a "free margin" *s* (obtained after paying the monopsony wage, the duty and operating costs) to finance investment in public goods and education in the South. So ethical responsibility has costs being related to the transfer *s*.

3. The Model

The model consists of two types of processing firm, each of which operates under imperfect competition in the procurement market for coffee berries. Coffee berries are produced by perfectly competitive growers. The first type of processor is a commercial firm that is assumed to maximise only its own profit. This profit arises from buying coffee berries from growers, processing them and selling green coffee to international traders.[11] While these commercial processing firms can influence the price that they pay for berries, their selling price of green coffee is assumed to be fixed, i.e., they are price takers when selling to downstream buyers.[12]

The second type of processing firm is one that is part of the fair trade movement. We might consider this firm to be one of the farmers' cooperatives that engage in the initial processing of fair trade coffee berries. The firm's objective is to maximise not only its own profit but also the welfare of the growers of fair trade coffee berries, as measured by their producer surplus. Thus, it would be expected that its procurement price would exceed that of the commercial processing firm, i.e., a firm that fully exploits its buying power.

It is assumed that the growers of coffee berries can choose whether to supply commercial processing firms or fair trade firms. If they sell to the former, they may

[11] It will be noted that the supply chain being modelled here is much simpler than the one described earlier. However, the only part of this chain that is of relevance here is the stage immediately beyond "the farm gate" and its economic relationship with coffee growers.

[12] We abstract from the possibility that these firms may also have selling power in order to allow us to concentrate on the effects of their buying power and the influence that may be exerted on that buying power by fair trade processors. Both fair trade and conventional processors are competing on a world market for processed coffee, so it is quite reasonable to assume them to be price takers in their selling behaviour.

receive a lower price but they also incur lower costs than if they sell to the latter. If they sell to the latter, although they may receive a higher price (including a fair trade premium), they also incur additional costs in meeting the standards of the fair trade movement. Each type of coffee berry has its own inverse supply curve, which is defined by an increasing marginal cost of production for each type of berry. The farmers' behaviour is summarised by these inverse supply curves.

Let the fixed downstream (world) price for commercial, processed green coffee beans be P_C and its counterpart for fair trade, processed green coffee beans be P_F. Both commercial and fair trade processors have two sources of costs: (i) the costs of procuring berries; and (ii) the costs of processing berries into green coffee plus the transportation costs incurred in shipping berries (from farms to the processing plant and/or from the plant to the port of export). It is the first of these that is the exclusive focus in this section.

To allow for buying power for both types of processing firms, and for increasing marginal costs of supply, we let the inverse supply functions of coffee berries be upward sloping. In particular, let the inverse supply function of commercial coffee berries be

$$p_C^s = \gamma_0 + \gamma_1 Q_C + \gamma_2 Q_F \qquad (1)$$

and the inverse supply function of fair trade coffee berries be

$$p_F^s = \phi_0 + \phi_1 Q_F + \phi_2 Q_C \qquad (2)$$

where: Q_C and Q_F are the total quantities of commercial and fair trade coffee berries procured, respectively; p_C^s is the procurement price for commercial berries and p_F^s is the procurement price of fair trade berries; with $\gamma_1 > \gamma_2$ and $\phi_1 > \phi_2$ to ensure that the own-price effect is larger than the cross-price effect.

We assume that the marginal cost of processing coffee berries into green coffee beans and transporting them can be expressed as a constant percentage of the green coffee price. Let τ_F and τ_C denote these marginal costs associated with the price of fair trade and commercial green coffee, respectively. Then the price of green coffee net of processing and transport costs received by commercial processors is $p_C = P_C(1-\tau_C)$ while the corresponding price for fair trade green coffee is $p_F = P_F(1-\tau_F)$.[13]

It is assumed that both types of coffee berries will be supplied (i.e., $p_C > \gamma_0$ and $p_F > \phi_0$), and that growers can choose which type of processor they wish to supply prior to making their production decisions.

Let the *i*th commercial processor $(i = 1, 2, ..., n)$ have a profit function

$$\pi_{C,i} = (p_C - p_C^s)q_{C,i} \tag{3}$$

where $q_{C,i}$ is the quantity of coffee berries procured by it. The conventional firm plays a Cournot game with $n-1$ commercial firms and with *m* fair trade firms. The firm maximises profit with respect to the quantity of berries bought and green coffee sold, taking other players' quantities as given. It is assumed in what follows that the second-order and the stability conditions are satisfied (see Tirole (1988, section 5.7)).

Maximisation of equation (3) gives

$$\frac{\partial \pi_{C,i}}{\partial q_{C,i}} = p_C - \gamma_0 - (n+1)\gamma_1 q_{C,i} - \gamma_2 m q_{F,j} \tag{4}$$

[13] The alternative specification is that marginal cost of processing is a constant and enters into total cost in an additive way (i.e. $p_c = P_c - \tau_c$). With P_C and P_F assumed constant at their respective world prices, the two specifications are equivalent; the calibration and counterfactual results in the numerical exercise are exactly the same.

where n is assumed fixed, and $mq_{F,j}$ is the aggregate quantity of fair trade coffee berries procured. At the optimum, $(n+1)\gamma_1 q_{C,i} + \gamma_2 m q_{F,j} - p_C + \gamma_0 = 0$. Multiplying through by n gives the total quantity of coffee berries procured by the commercial processors:

$$(n+1)\gamma_1 Q_C + n\gamma_2 Q_F - n(p_C - \gamma_0) = 0 \tag{5}$$

where $Q_C = \sum_{i=1}^{n} q_{C,i}$ and $Q_F = \sum_{j=1}^{m} q_{F,j}$.

Let the objective function of the jth fair trade processor (j = 1, 2, …, m) take into account its own profits and the producer surplus of those growers that sell into the fair trade supply chain. Then,

$$\begin{aligned} W_{F,j} &= \alpha PS_F + \pi_{F,j} \\ &= \alpha[p_F^s Q_F - \int_0^{Q_F} p_F^s(z)\mathrm{d}z] + (p_F - p_F^s)q_{F,j} \end{aligned} \tag{6}$$

where: PS_F is the producer surplus of the growers selling to the fair trade processors; $\alpha > 0$ is the weight placed by fair trade processors on fair trade growers' welfare relative to that placed on fair trade processors' profit. The jth fair trade processor plays a Cournot game with n commercial processors and m – 1 fair trade processors.

The jth fair trade processor maximises equation (6) with respect to the quantity procured, $q_{F,j}$ which gives

$$\frac{\partial W_{F,j}}{\partial q_{F,j}} = -\phi_1[1 + m(1-\alpha)]q_{F,j} - \phi_2 Q_C + p_F - \phi_0 \tag{7}$$

Multiplying through by m (assumed fixed) and setting $\partial W_{F,j} / \partial q_{F,j} = 0$, at the optimum,

$$-\phi_1[1 + m(1-\alpha)]mq_{F,j} - m\phi_2 n q_{C,i} + m(p_F - \phi_0) = 0 \tag{8}$$

The effect of α is to rotate clockwise the perceived marginal expenditure function of the fair trade processor, thereby causing it to procure more and to pay a higher procurement price, *ceteris paribus*. Note that if m = 1 and $\alpha = 1$, i.e., there is a single fair trade processor that is concerned about the welfare of its suppliers, then equation (8), when re-arranged as $\phi_0 + \phi_1 q_{F,j} + \phi_2 n q_{C,i} = p_F$, has a left-hand side that is identical with equation (2). Therefore, such a firm will procure along the average expenditure function, not the marginal expenditure function, and will earn zero profits ($p_F = p_F^s$). Moreover, if α = 1, then m > 1 leads to negative profits for fair trade firms.[14]

The consolidated FOCs for the n commercial firms and the m fair trade firms are

$$\begin{bmatrix} (n+1)\gamma_1 & n\gamma_2 \\ m\phi_2 & \phi_1[1+m(1-\alpha)] \end{bmatrix} \begin{bmatrix} Q_C \\ Q_F \end{bmatrix} + \begin{bmatrix} n(\gamma_0 - p_C) \\ m(\phi_0 - p_F) \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \tag{9}$$

Solving these conditions for the optimal quantities, gives

$$\begin{bmatrix} Q_C^* \\ Q_F^* \end{bmatrix} = \frac{1}{\Delta} \begin{bmatrix} \phi_1[1+m(1-\alpha)] & -n\gamma_2 \\ -m\phi_2 & (n+1)\gamma_1 \end{bmatrix} \begin{bmatrix} n(p_C - \gamma_0) \\ m(p_F - \phi_0) \end{bmatrix} \tag{10}$$

where $\Delta = \gamma_1\phi_1(n+1)[1+m(1-\alpha)] - nm\gamma_2\phi_2 > 0.$[15]

We now investigate the effect of α on these optimal quantities and the corresponding procurement prices. Then we evaluate its effect on producer surplus for each set of growers, on the profits earned by commercial and fair trade processors and total welfare in the fair trade channel. Totally differentiating equation (9) (evaluated at the optimum quantities) with respect to α and rearranging gives

$$\begin{bmatrix} (n+1)\gamma_1 & n\gamma_2 \\ m\phi_2 & \phi_1[1+m(1-\alpha)] \end{bmatrix} \cdot \begin{bmatrix} \mathrm{d}Q_C^*/\mathrm{d}\alpha \\ \mathrm{d}Q_F^*/\mathrm{d}\alpha \end{bmatrix} = \begin{bmatrix} 0 \\ m\phi_1 Q_F^* \end{bmatrix} \tag{11}$$

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[14] With $\alpha = 1$ and m = 1, equation (8) becomes $p_F = \phi_0 + \phi_1 q_{F,j} + \phi_2 Q_c$. However, for m > 1, $Q_F = mq_{F,j} > q_{F,j}$ and, therefore, $p_F < p_F^s = \phi_0 + \phi_1 m q_{F,j} + \phi_2 Q_c$.

Then, using Cramer's rule, equation (11) can be solved to give

$$\frac{\mathrm{d}Q_C^*}{\mathrm{d}\alpha} = -mn\phi_1\gamma_2\Delta^{-1}Q_F^* < 0 \tag{12}$$

$$\frac{\partial Q_F^*}{\partial\alpha} = m(n+1)\phi_1\gamma_1\Delta^{-1}Q_F^* > 0 \tag{13}$$

Thus, as the fair trade processing firms place more weight on the welfare of their coffee growers, the optimal quantity that they procure increases and the optimal quantity procured by commercial processing firms decreases.

The effect on procurement prices of an increasing weight being placed on the welfare of growers of fair trade coffee is obtained by differentiating equations (1) and (2) with respect to α and making use of equations (12) and (13) to give

$$\frac{\mathrm{d}p_C^{s*}}{\mathrm{d}\alpha} = m\phi_1\gamma_1\gamma_2\Delta^{-1}Q_F^* > 0 \tag{14}$$

$$\frac{\mathrm{d}p_F^{s*}}{\mathrm{d}\alpha} = \phi_1 m\Delta^{-1}Q_F^*[\phi_1\gamma_1(n+1) - \phi_2\gamma_2 n] > 0 \tag{15}$$

noting from above that, by assumption, the own-price effect is larger than the cross-price effect ($\phi_1 > \phi_2, \gamma_1 > \gamma_2$). Larger values of α raise the quantity procured through the fair trade channel (equation (13)) and the additional procurement raises the procurement price that has to be paid to their suppliers (equation (15)). The effect of this action on commercial processors and their suppliers is to reduce procurement from growers who supply commercial processors (equation (12)) but to raise the procurement price that they have to offer (equation (14)). This outcome is consistent with the observation by Bowen (2001) noted above (section 2) that the presence of fair trade processors causes commercial processors to increase their procurement

[15] The proof is in the Appendix.

price. In effect, as α increases, the buying power of the commercial processors is diminished.

The effect of α on producer surplus is as follows. The producer surplus of growers supplying the commercial processors, at the optimal level of procurement, is

$$PS_C^* = p_C^{s*} Q_C^* - \int_0^{Q_C^*} p_C^{s*}(z)\mathrm{d}z$$

Differentiating this equation with respect to α and making use of equations (12) and (14) gives

$$\frac{\mathrm{d}PS_C^*}{\mathrm{d}\alpha} = -mn\phi_1\gamma_1\gamma_2\Delta^{-1}Q_C^* Q_F^* < 0 \tag{16}$$

Producer surplus of growers supplying the fair trade processors is

$$PS_F^* = p_F^{s*} Q_F^* - \int_0^{Q_F^*} p_F^{s*}(z)\mathrm{d}z$$

Differentiating this equation with respect to α and making use of equations (13) and (15) gives

$$\frac{\mathrm{d}PS_F^*}{\mathrm{d}\alpha} = m(n+1)\phi_1^2\gamma_1\Delta^{-1}(Q_F^*)^2 > 0 \tag{17}$$

As expected, the welfare of those growers supplying the fair trade firms increases with the increased weight being placed on that welfare. The gain is realised because, as α increases, more is procured from the fair trade growers and they receive a higher procurement price. On the other hand, the welfare of the growers supplying the commercial processors is reduced: the reduction in quantity procured not being offset sufficiently by the increase in the procurement price.

The effect of increasing α on total welfare in the fair trade channel is given by

$$\begin{aligned} \mathrm{d}W_F / \mathrm{d}\alpha &= \mathrm{d}[\alpha PS_F + \pi_F]/\mathrm{d}\alpha \\ &= PS + m\phi_1\Delta^{-1}Q_F[\alpha(n+1)\phi_1\gamma_1 Q_F + \gamma_1(n+1)(p_F - p_F^s - \phi_1 Q_F) + n\phi_2\gamma_2 Q_F] \end{aligned} \tag{18}$$

which is positive.[16] The marginal effect of *m* on the effect of α is obtained by taking the second-order cross-partial derivative of the last expression. It too is positive, meaning that the more fair trade processors there are, the more influence does increasing the weight on the producer surplus of the suppliers have on total welfare in that channel.

Finally, it is useful to determine the sign of the change in the level of optimal profits of the commercial processing firms when α increases.

$$\begin{aligned} \pi_C^* &= (p_C - p_C^{s*})Q_C^* \\ \frac{\mathrm{d}\pi_C^*}{\mathrm{d}\alpha} &= -m\phi_1\gamma_2\Delta^{-1}[(p_C - p_C^{s*})n + \gamma_1 Q_C^*]Q_F^* < 0 \end{aligned} \tag{19}$$

This result is consistent with the others, i.e., the influence of the fair trade processors is to reduce the oligopsony power of the commercial processors.

These comparative static results are consistent with one claim of the fair trade movement, namely, that it exists to moderate the perceived exploitation of the growers of coffee berries by commercial processing firms and, thereby, to increase the incomes of those growers of coffee berries that supply the fair trade supply chain. However, by reducing the buying power of the commercial processors, the fair trade processors also cause a welfare loss for the suppliers of commercial berries as well as a reduction in the profits of the commercial processors. The net effect of fair trade on growers is explored quantitatively in the next section.

4. Calibration

In the previous section we show that the behaviour of fair trade intermediaries affects the price and quantity of coffee berries in the fair trade and conventional channels. In this section we calibrate the model in order to understand the quantitative implications

[16] The proof is in the Appendix.

of fair trade behaviour for farm revenues.[17] We calibrate our theoretical model to illustrative data on prices, quantities, and a number of structural parameters. We then consider counterfactual scenarios, simulating the elimination of fair-trade behaviour. The results indicate that fair trade behaviour raises coffee growers' revenues in our model, but this effect is small. Within our Cournot framework, at least, it is difficult to reconcile: a) the relatively small observed gap in price margins between conventional and fair-trade intermediaries; b) the relatively small market share of fair trade coffee; and c) any sizable effect on conventional markets flowing from the behaviour/existence of fair trade firms.

Our calibration strategy is similar to that of McCorriston and MacLaren (2007) and therefore to Dixit (1988), though the firms in our model have oligopsony, rather than oligopoly, power. We also extend Dixit’s calibration technique by bringing the first-order conditions of the processors into the calibration.[18] We use data on prices at the farm gate, and at the developing country port, from Pierre (2007), who provides cost breakouts for a Swiss FLO, *Max Havelaar*.[19] We vary relative traded quantities

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[17] We use farm revenues as a proxy for farmers' welfare, as it is easy to aggregate price and quantity changes across the two markets in terms of revenue. Measures of producer surplus rely on extensions of the calibrated supply curves well away from equilibrium, so results can be sensitive to the calibration process. Given that supply curves are highly inelastic, the difference between revenue and producer surplus represents a relative small share of farm revenues. We therefore view farm revenue as a suitable measure of welfare.

[18] These additional equations allow us to make model-consistent inferences about intermediaries’ marginal (processing + transport) costs τ in each sector, and the net-of-marginal-cost prices p_C and p_F received by the firm.

[19] The actual cost structure of intermediaries must certainly vary substantially across coffee-growing regions. In particular, the transportation costs of moving goods from the farm to the developing country port will depend greatly on the infrastructure and institutions of specific coffee-growing

in each sector across calibrations, with the fair-trade share ranging from 0.001 to 0.10. Our calibration employs a system of seven equations (five of them counterparts to those in Dixit, and the two first-order conditions) to translate price and quantity data, two elasticity parameters, and conjectures about the number of firms and the α parameter, to calibrate an operational model that follows equations (1), (2), (4) and (7).[20]

The counterfactual exercise we wish to imagine is the removal of fair trade status from the coffee berries that are currently sold under fair trade mechanisms. We retain the notion that the two types of berries are differentiated in production; the inverse supply curves are parameterised the same in both benchmark and counterfactual calculations. We provide a quantitative estimate of the effect of the fair trade status of berries on their prices by removing downstream fair-trade behaviour in the counterfactual exercises. We consider two possible counterfactual scenarios that we intend as plausible lower and upper bounds for the overall effect of fair trade. In one counterfactual, we simply re-parameterise the fair trade intermediaries' welfare function, setting $\alpha = 0$. In the second counterfactual, we also remove the fair trade premium in the FOB price paid to the intermediary. This premium might reflect the mark-up that fair-trade coffee receives in downstream markets.[21] The counterfactual

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countries. Our application uses data that can plausibly be treated as representative of the general problem. It does not evaluate any specific geographic market.

[20] We adjust these equations slightly to facilitate calibration, and to allow firms to exit the market when counterfactual price changes are sufficiently large.

[21] Some part of this premium probably measures quality, or some other characteristic that might not disappear if fair trade status were removed. To the extent that consumers value organically grown coffee, for example, and associate that characteristic with fair trade channels, only a portion of the premium should be removed.

removal of fair trade status does not affect a) the cost schedule for producing this 'type' of coffee bean, and b) any cost (dis)advantage that the fair-trade intermediary retains in transportation/processing.[22]

4.1 Calibration procedure and the counterfactual model

Our behavioural model for counterfactual analysis is a variational inequality model based on equations (4) and (7). The variational inequality implies that either these first order conditions hold with equality, or there is no output of the associated coffee types. We rewrite these equations as follows:

$$\gamma_0 + (n+1)\gamma_1 q_{C,i} + \gamma_2 Q_F \geq (1-\tau_C)P_C \;\perp\; q_{C,i} \geq 0 \quad (4a)$$

$$\phi_0 + \phi_2 Q_C + \phi_1[1+m(1-\alpha)]q_{F,i} \geq (1-\tau_F)P_F \;\perp\; q_{F,i} \geq 0 \quad (7a)$$

where $\perp$ indicates complementary slackness. These conditions capture the economic behaviour of the model specified in the previous section, while at the same time allowing firms to exit if the marginal revenues do not exceed marginal expenditures on the first unit of coffee.[23]

Dixit (1988) describes a process for calibrating Cournot models of strategic behaviour, and McCorriston and MacLaren apply it in an assessment of STEs.[24] We convert Dixit's approach for use with our oligopsony model. The process maps data

[22] In short, we are assuming no cost efficiencies arise within the fair trade sector when we remove fair trade status from the beans. Any efficiencies of this nature would further dilute the beneficial impact of fair trade distribution channels, which we already estimate to be quite small.

[23] Exit becomes an issue in the second counterfactual, where the price paid to fair trade intermediaries is reduced in counterfactual analysis. Under many parameterisations, the fair trade intermediaries shut down altogether as a result.

[24] Dixit's (1988) calibration method requires the parametric restriction $\gamma_2 = \phi_2$, and this restriction is applied in what follows.

on p_C^s, p_F^s, Q_C, Q_F, an (estimated) elasticity of supply, and an (assumed) elasticity of production substitution into a parameterised version of equations (1) and (2).[25] Given data on P_C and P_F, and values for n and α, equations (4) and (7) can be used with (1) and (2) to back out model-consistent values of τ_F and τ_C in the benchmark. At the benchmark, where $\alpha = 1$, $Q_C = nq_{C,i} > 0$ and $Q_F = mq_{F,i} > 0$, (4a) and (7a) hold with equality, and we can rearrange them to solve for τ_F and τ_C:

$$\tau_C = 1 - \frac{\gamma_0 + (n+1)\gamma_1 q_{C,i} + \gamma_2 Q_F}{P_C} \tag{4b}$$

$$\tau_F = 1 - \frac{\phi_0 + \phi_2 Q_C + \phi_1[1 + m(1-\alpha)]q_{F,i}}{P_F} \tag{7b}$$

The role these equations play in the calibration is to allocate the $\frac{P_C}{p_C^s}$ and $\frac{P_F}{p_F^s}$ margins into model-consistent values of profit margins and marginal costs of processing/transport. Calculating model-consistent values of τ_F and τ_C with (4b) and (7b) produces values of p_F and p_C that are consistent with both the data and the model.[26]

4.2 Price and quantity data

We take price data from Pierre (2007), who reproduces illustrative data from a Swiss FLO, *Max Havelaar*. The 2005 data are reported in Swiss Francs, though we convert

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[25] The idea is to convert non-linear estimates of supply responses into parameters that define the linear inverse supply functions in equations (4a) and (7a)..

[26] The assumption of proportional trade costs is in no way critical to what follows. An otherwise identical approach to calibration and counterfactual analysis, but that employs additive rather than proportional trade costs, produces exactly the same results.

them to US Dollars at an exchange rate of 1.25 SFr/USD. These data put the price of fair trade and conventional coffee beans at \$1.26/lb and \$1.15/lb, respectively. *Max Havelaar* reports these as FOB prices, and we take them to be inclusive of any processing and or transport costs that the intermediaries have incurred in reaching the developing country port. We treat the FOB prices as given by the world market, and therefore not affected by the behaviour of the intermediaries.[27] Thus, in the calibration P_C = \$1.15 and P_F = \$1.26. The reported farm-gate prices paid to farmers in the *Max Havelaar* data are \$0.88/lb for fair trade and \$0.69/lb for conventional coffee berries, which appear in the calibration as p_F^s and p_C^s, respectively.

The absolute quantities of fair trade and conventional coffee beans we use in calibration are unimportant, we focus on market shares.[28] The world market share of fair trade coffee is extremely small, about 0.55 per cent.[29] We view this figure as not completely relevant, for two reasons. First, fair trade coffee berries compete most directly with specialty coffee berries sold through conventional channels. Most conventional coffee berries are eventually processed as freeze dried coffee. We treat the fair trade share as a share of the specialty coffee market, which should raise the benchmark fair trade share of the market considerably. Second, our thought experiment is meant to reflect market behaviour in a specific geographic market (i.e., a mountain valley in a developing country). This would seem to be an appropriate sense of the relevant market. In those areas where fair trade cooperatives are active, they will account for a somewhat larger share of the total activity than they do in the

[27] The fair trade price of \$1.26 in the data was the relevant price floor established by international FLOs in 2005. Our second counterfactual can be interpreted as the removal of this floor.

[28] Any absolute quantities can be scaled by an arbitrary normalization.

[29] See Ronchi (2006).

world market as a whole. We lack data on any specific market, so we choose arbitrary but sensible market shares. We vary the fair trade share from 0.1 to 10 per cent of the total local market for specialty coffee beans.

4.3 Elasticities

As noted above, empirical studies of coffee supply elasticities have demonstrated that the supply of coffee berries is quite inelastic, even over relatively long intervals. Akiyama and Varangis (1990) estimate supply elasticities over 2-, 5- and 10-year intervals for a number of coffee-producing countries. The simple averages of these estimates are 0.12, 0.21, and 0.35 respectively. We take the longest of these time frames as the most interesting one, as it suggests the farmers' susceptibility to oligopsony power is potentially sustainable over the medium-run. We therefore use 0.35 as our estimate of the supply elasticity.

In his calibration of oligopoly behaviour when consumers choose between domestic and foreign automobiles, Dixit (1988) employs an elasticity of substitution. In our oligopsony case, the relevant elasticity is an elasticity of producer substitution that measures the ability of coffee farmers to substitute between fair-trade and conventional supply, which we denote as σ. We know of no estimates of this parameter in the empirical literature, so we must choose one. Since we are assuming a relatively long time horizon (i.e., 10 years), we also choose this parameter to be quite high, 100.[30]

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[30] Because of the unequal market shares, the choice of this parameter has little substantive effect on the parameterization of the inverse supply curve for conventional coffee. The price response of fair trade coffee berries to changes in own quantities (ϕ_1) is the only parameter substantially affected by our choice of elasticity of substitution. Lower values of this parameter reduce the competition between the

4.4 The Fair Trade concern parameter α

Throughout most of our scenarios we choose $\alpha = 1$. This parameterisation is most favourable to the view that fair trade firms increase output, while still making their behaviour economically viable. As noted above, a fair trade monopsonist makes zero profits when $\alpha = 1$. For $\alpha > 1$, the firm would operate at a loss. We conduct sensitivity analysis for $\alpha < 1$.

4.5 Firm numbers

We conduct multiple calibrations of the model, fitting the price data and a series of quantity data to various numbers of conventional firms. Throughout our exercises we assume a single fair-trade firm (i.e., $m = 1$). Given a fair trade concern parameter $\alpha = 1$, setting $m > 1$ implies loss-making fair trade firms.

4.6 Inferred marginal transport/processing costs

The available data on prices allows a comparison of the prices paid and received by conventional intermediaries to that of the fair trade firm. The calibration procedure divides the gap between FOB and farm gate prices for each coffee type into two parts: a constant marginal (processing + transport) cost and a profit margin. Ideally, we would have direct data on the marginal costs, but we are not aware of such data. Instead, we use equations (4b) and (7b) to make model-consistent inferences about the size of these costs. We believe it likely that fair trade processing and transport costs

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two distribution channels, and so reduce the impact of fair trade coffee on farmers who supply the conventional channel. In sensitivity analysis we show that results are largely insensitive to the choice of the elasticity of production substitution.

are larger than those in the conventional sector.[31] Because these costs are a residual, of sorts, in our calibration, they also vary with the inputs into calibration, especially the number of firms.

Figure 1 shows the calibrated marginal costs for each type of intermediary.[32] The figure shows the proportion of the FOB price that is attributed to intermediaries' marginal costs, under the assumption that firms choosing observed price and quantity data are maximising their respective objective functions. Inferred costs vary with numbers of firms because the FOB/farm-gate mark-up (which is observed in the data) is fixed across calibrations. Larger numbers of conventional firms imply smaller profit margins, so larger numbers of conventional firms imply higher marginal costs.

[FIGURE 1]

There are three main lessons in Figure 1. First, the fair trade firm's inferred marginal cost is constant across calibrations. Our assumption that $\alpha = 1$ implies marginal cost pricing for the fair trade firm, so the observed price margin in the fair trade sector, p_F / p_F^s is attributed entirely to processing/transport costs $\left(\tau_F = 1 - \frac{0.88}{1.26} = 0.302 \right)$. Second, the implied fair trade marginal cost is generally greater than that of conventional firms, especially when conventional firm numbers are low.[33]

[31] There are plausible scale economies in both processing and transport, so the small, fair trade share of the transport market might generate these higher costs. Fair trade standards for treating workers (e.g., minimum/living wages) are also likely to raise the costs of processing and transport.

[32] These are the results for a 1 per cent fair trade market share. Initial market share makes little difference to the inferred marginal costs.

[33] The calibration has to reconcile a larger FOB/farm gate price gap in the fair trade sector, a small fair trade market share, and behavioural parameters that imply more aggressive market behaviour by the

Finally, it is very difficult to associate the observed data with severe concentration in the conventional market. For numbers of firms below 5, optimising conventional firms would have to receive a per unit subsidy ($\tau_C < 0$) in order to choose sizable market shares at the observed FOB/farm gate price margins. Since such subsidies are not observed in practice, we treat these parts of the parameter space as infeasible solutions. We limit our counterfactual results to those examples where conventional firms face positive marginal costs.[34]

4.7 Counterfactual analysis

We conduct two counterfactual analyses, each with a different interpretation of the behavioural effects of fair trade. In the first exercise, we simply change the behaviour of the fair trade intermediary, setting $\alpha = 0$ in the counterfactual. In the second exercise, we consider the joint effects of setting $\alpha = 0$ and removing the FOB price premium for fair trade coffee. This premium may reflect downstream customers' greater willingness to pay for fair trade coffee and/or the removal of the price floor on fair trade coffee. In any case, removal of fair trade status eliminates the premium.[35]

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fair trade firm. Under most parameterisations of the model, these can only be reconciled if marginal costs are higher in the fair trade sector.

[34] One might be concerned that restricting the number of conventional buyers to $n > 4$ is potentially unrealistic, but it does not look to be. Ronchi (2006) reports 50 exporters (many of them vertically integrated with a coffee processor) in Costa Rica. While our hypothetical reference market might be a bit smaller than the entire country of Costa Rica, we think that the implication of the calibration is that n > 4 is not overly restrictive. In a sensitivity analysis below, we reparameterise the model so that n can take value as low as 2.

[35] As noted above, some part of the premium for fair trade coffee may reflect characteristics that can be separated from the fair trade status of the berries. In this sense, we are evaluating an upper bound.

Figure 2 shows the results of the first counterfactual. In our calibrated model, changing the fair trade intermediaries' objective function to profit maximisation alone reduces coffee farmers' total revenues by 0.01 to 7.73 per cent. The more concentrated the conventional market, the more deleterious the effects of the fair trade firm's behavioural change on coffee farmers. This result is consistent with intuition, and it suggests that fair trade intermediaries generate a (small) pro-competitive effect on the market for coffee berries. The response of farm revenues to fair trade behaviour is larger for larger initial fair trade market shares.

The revenue changes reported above subsume information on the effect of a change in fair trade behaviour on prices, quantities, and revenues that accrue to each group of farmers. The fair trade procurement price falls in each case, ranging from a 0.58 per cent to a 6.68 per cent reduction over the cases considered.[36] Reductions in fair trade quantities range from 56.22 per cent to 92.81 per cent.[37] Put together, these changes produce reductions in revenues to the suppliers of fair trade berries that range from 56.68 to 93.00 percent. The conventional supply price falls by between 0.01 per cent and 5.77 per cent.[38] Quantity increases in the conventional market range from 0.06 per cent to 12.48 per cent.[39] Revenues earned by suppliers of conventional berries rise by between 0.026 and 10.72 percent.

[36] Fair trade price reductions are largest when the initial fair trade share is large, and when there are small numbers of conventional firms.

[37] Fair trade quantity reductions are largest when the number of conventional firms and the initial fair trade market share are both large.

[38] Conventional price reductions are largest when the initial fair trade market share is high and the number of conventional firms is low.

[39] Conventional quantities increase most when the initial fair trade share is large and the number of conventional firms is large.

[FIGURE 2]

We next consider the broader counterfactual. In addition to eliminating the fair trade processors' concern for farmers' welfare, we also eliminate the FOB price gap between fair trade and conventional coffees. In the *Max Havelaar* data we employ, this means a nine per cent reduction in the fair trade FOB price. The results of this counterfactual analysis appear in Figure 3. The results are largely similar to those in the earlier experiment, with only slightly larger effects from removing fair trade behaviour.[40] The largest effects arise when the initial fair trade market share is relatively large and the conventional market is relatively concentrated (i.e., *n* is small). In this second counterfactual, the fair trade intermediary shuts down completely because the absence of any price premium means an absence of compensation for the higher costs associated with processing fair trade coffee.

[FIGURE 3]

We view the results of the calibrations as teaching us a few lessons. First, a model in which fair trade firms consider the welfare of upstream producers can generate beneficial net increases in revenue paid to coffee growers. However, for plausible market shares, and a wide variety of parameterisations, the presence of fair trade intermediaries and a downstream price premium have quite small quantitative impacts on the conventional coffee market. In this model, at least, high levels of oligopsony power are difficult to reconcile with small fair trade market shares and the relatively small gap between farm gate and FOB prices in the conventional market. Within the context of the Cournot model, these stylized facts can only be reconciled by much larger processing + transport costs in the fair trade sector.

[40] The removal of the fair trade premium tends to make the fair trade sector uneconomic; intermediaries in the fair trade sector choose zero quantities in the second counterfactual.

4.8 Sensitivity

Our calibration study so far has relied upon a number of parameters that we selected. In particular, we parameterised the fair trade firm's concern parameter (α = 1) and the elasticity of producer substitution between fair trade and conventional berries (σ = 100). These parameters were chosen as plausible, but possibly extreme, values. In this sub-section we consider the sensitivity of our conclusions to changes in α and σ.

Consider first the concern parameter α. At the chosen value of α = 1, the fair trade firm acts like a competitive firm, choosing quantity such that $p_F = p_F^s$. When α is set to zero in the counterfactual simulation, the fair trade firm severely contracts procurement, now operating like a monopsonist in the fair trade market. When we select α < 1 in the initial calibration, the fair trade firm's counterfactual response to setting α = 0 is less severe than in our simulations above. Choosing α = ½ in the benchmark reduces the impact of fair trade by approximately ½ in counterfactual scenario 1, relative to the baseline estimates. The effects in counterfactual 2 are virtually the same as when α is set to one in the calibrated equilibrium. In most cases the fair trade firm exits when the FOB price falls, for both initial choices of α.

As noted earlier, we have chosen the producer substitution elasticity σ, to be relatively large ($\sigma = 100$). Given the relatively long time frame considered (our supply elasticity is a 10-year estimate), we view a large value for σ as an appropriate choice. We are giving coffee farmers in our model substantial leeway to switch between fair trade and conventional production. Since this parameter affects the degree of competition between fair trade and conventional intermediaries, it may also affect counterfactual results. As a sensitivity check we reduce the assumed value of

σ in half, and re-run the model. Our results are virtually equivalent to simulations with the larger value of σ.

The results of our sensitivity analysis indicate that our baseline calibrations are fair to the claims of the fair trade movement. Plausible alternative parameterisations suggest smaller effects of removing fair trade behaviour. In short, we believe that our estimates are at the upper end of the distribution of plausible estimates. The model shows that the qualitative claim that fair trade behaviour reduces oligopsony power can be supported, but it is difficult to argue that these effects are quantitatively important.

4.9 Parameterisation such that small n are consistent with the data

In the calibration above it was noted that one cannot replicate the data for very small numbers of conventional firms unless trade costs τ_C are allowed to be negative, implying a subsidy to conventional firms. In this context conventional firms are buyers of the raw coffee berries and/or are regional processors, and one need not presume that n is exceptionally small. Nonetheless, we ask how we can parameterise the model in a way that allows smaller n to be consistent with positive values of τ_C

As noted above, the reason that τ_C is negative for small n is that profit maximising oligopolists that earn the small margins observed in the data, and face a highly inelastic supply of beans, would choose to restrict output substantially beyond what is consistent with the market shares we employ (i.e., fair trade shares < 10 percent). One can solve this conundrum by making the supply elasticity substantially larger, thereby reducing the incentive to withhold output at observed margins. For example, a supply elasticity equal to 0.8, rather than the 0.35 reported in Akiyama and Varangis (1990), rationalizes values of n as low as 2. But larger supply elasticities also imply lesser abuse of market power by conventional firms, and so less benefit from fair trade.[41] Our view is that low elasticities of supply are consistent with many features of the market, and our preferred parameterisation of the supply elasticity are those taken from the empirical literature.

5. Conclusion

A key claim of the fair trade coffee movement is that oligopsony power reduces the welfare of coffee farmers in developing country. We review the growing conditions for coffee, as well as an econometric literature on the topic, and argue that this claim is plausible. Given that plausibility, one might ask whether fair trade channels are likely to be an *effective* solution to an oligopsony market distortion.

We develop a model in which a fair trade firm can alleviate the distortionary effects of oligopsony power. The fair trade firm includes the welfare of farmers in its objective function. This behaviour leads the firm to compete more aggressively, thus reducing the deleterious effects of oligopsony power of conventional firms.

In order to evaluate the quantitative impact of the model, we calibrate the model to representative data on prices, along with plausible parameterisations of the models, market shares, and other structural parameters. We focus on parameterisations that we view as favourable to the fair trade movement. Even in these cases, the effects of fair trade on farm revenues are quite small. We conclude that where fair trade firms consider the welfare of upstream producers, they can generate beneficial net increases in revenue paid to coffee growers. However, for

[41] In these simulations the maximum revenue loss from setting $\alpha = 0$, was 6.69 percent under this parameterization (for n =2), which compares the 7.73 percent maximum reduction when setting $\alpha = 0$ in our preferred parameterization.

plausible market shares, and a wide variety of parameterisations, the quantitative effects on farm revenues are likely to be small.

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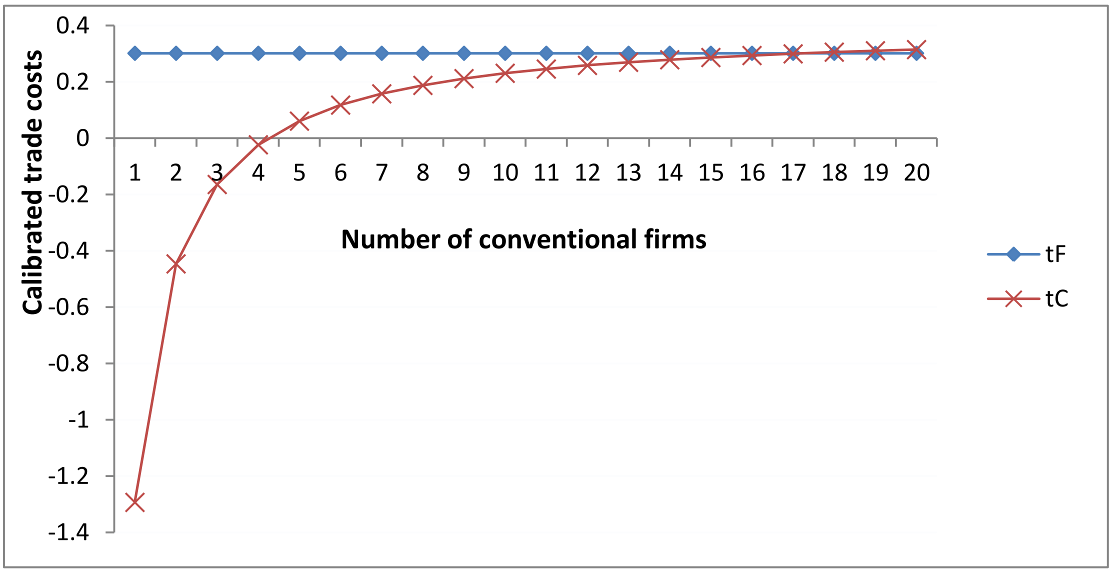
FIGURE 1

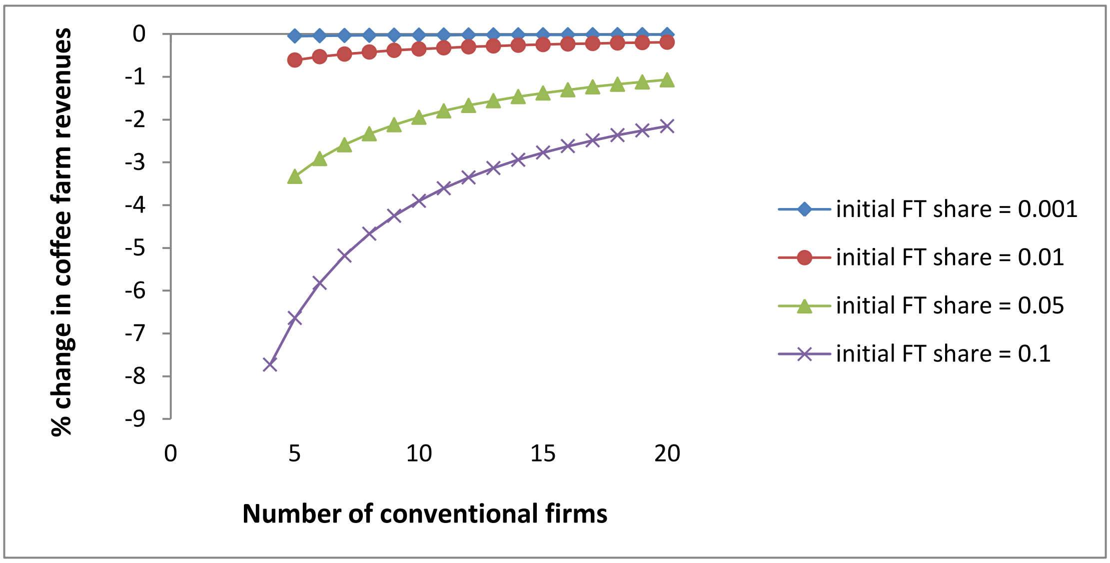
Calibrated marginal transport/processing costs



Note: Benchmark fair trade market share = 0.01. Marginal cost estimates are similar over all considered benchmark market shares. Marginal costs below zero indicate a per unit subsidy is needed for model consistency (because implied profit margins exceed those reported in available data).

FIGURE 2

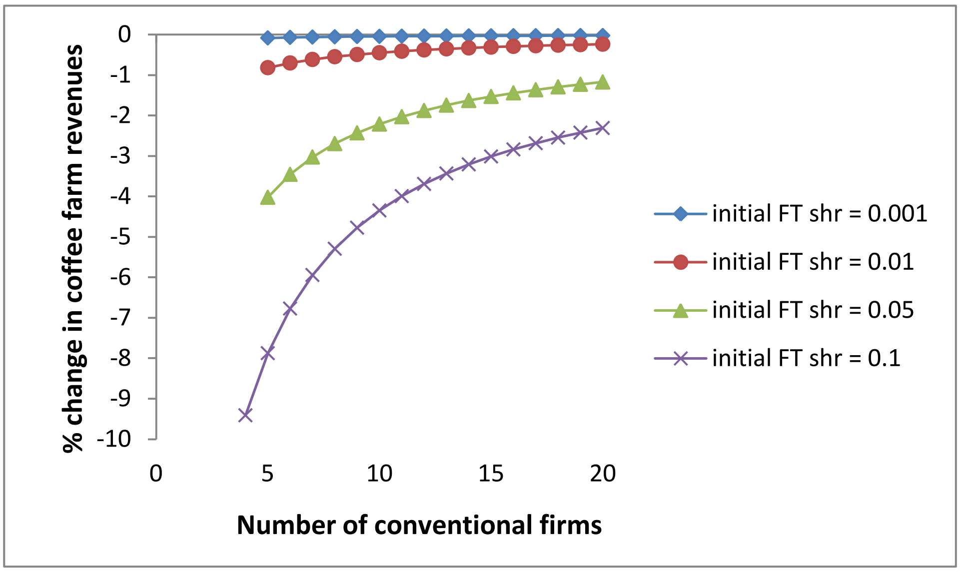
Change in farm revenues when $\alpha = 0$



Note: Counterfactual change in farm revenues when the fair trade processors' concern for the welfare of growers is removed. Results reported for different calibrated fair trade market shares, and different numbers of conventional firms. For sufficiently small numbers of such firms, the price gaps observed in the data imply a per unit subsidy for conventional firms. These are treated as infeasible and the results are not reported here.

FIGURE 3

Change in farm revenues when α set equal to 0 and P_F set equal to P_C



Note: Counterfactual change in farm revenues when downstream price premium for fair trade coffee is removed, along with the fair trade processors' concern for the welfare of growers.

Appendix

Equation (10), the determinant $\Delta = \gamma_1\phi_1(n+1)[1+m(1-\alpha)] - nm\gamma_2\phi_2 > 0$.

We are required to prove that $\gamma_1\phi_1(n+1)[1+m(1-\alpha)] > nm\gamma_2\phi_2$.

With $\gamma_1/\gamma_2 > 1, \phi_1/\phi_2 > 1,$ and $(n+1)/n > 1,$

$\dfrac{\gamma_1\phi_1(n+1)[1+m(1-\alpha)]}{mn\gamma_2\phi_2} > 1$ if $\dfrac{[1+m(1-\alpha)]}{m} > 1.$

Now $[1+m(1-\alpha)] > m,$ if $\alpha m < 1.$

Therefore, $\Delta > 0$ provided $\alpha m < 1,$ which is true for $0 \le \alpha < 1.$

Equation (10)

To prove that $Q_C^* > 0$ and $Q_F^* > 0$ we use equation (9), from which

$$Q_C^* = \frac{n(p_C - \gamma_0 - \gamma_2 Q_F^*)}{(n+1)\gamma_1} \quad \text{(A.1)}$$

$$Q_F^* = \frac{m(p_F - \phi_0 - \phi_2 Q_C^*)}{\phi_1[1+m(1-\alpha)]} \quad \text{(A.2)}$$

From equation (1), $p_C^s = \gamma_0 + \gamma_1 Q_C^* + \gamma_2 Q_F^* \Rightarrow -\gamma_0 - \gamma_2 Q_F^* = \gamma_1 Q_C^* - p_C^s$, so that equation (A.1) can re-written as

$$Q_C^* = \frac{n(p_C - p_C^s + \gamma_1 Q_F^*)}{(n+1)\gamma_1} \quad \text{(A.3)}$$

which is positive, if the commercial processor's selling price, p_C, is greater than the procurement price, p_C^s. Similarly, from equation (2), $-\phi_0 - \phi_2 Q_C^* = \phi_1 Q_F^* - p_F^s$, so that equation (A.2) can be re-written as

$$Q_F^* = \frac{m(p_F - p_F^s + \phi_1 Q_F^*)}{\phi_1[1+m(1-\alpha)]} \quad \text{(A.4)}$$

which is positive if the selling price of fair trade coffee, p_F, is larger than the procurement price, p_F^s.

Equation (18)

To show that $\mathrm{d}W_F \mathrm{d}\alpha > 0$, it is sufficient to show that $(p_F - p_F^s - \phi_1 Q_F) \geq 0$. Making use of equation (2), $(p_F - p_F^s - \phi_1 Q_F) = (p_F - \phi_0 - 2\phi_1 Q_F - \phi_2 Q_C)$, from which $p_F - \phi_0 = 2\phi_1 Q_F + \phi_2 Q_C$. From equation (8), $p_F - \phi_0 = (\phi_1 / m)[1 + m(1-\alpha)]Q_F + \phi_2 Q_C$. Therefore, we have to show that $(\phi_1 / m)[1 + m(1-\alpha)]Q_F^* + \phi_2 Q_C^* \geq 2\phi_1 Q_F^* + \phi_2 Q_C^*$ which, upon simplification, gives the condition that has to be satisfied as $1/m + (1-\alpha) \geq 2$. This condition can be re-written as requiring that $m\alpha \leq 1$, which is true if $\Delta > 0$. Therefore, $\mathrm{d}W_F / \mathrm{d}\alpha > 0$.