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# ‘Fair Trade’ Coffee and the Mitigation of Local Oligopsony Power

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**'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, but most notably for coffee. We argue that coffee is grown under conditions that might well subject growers to the market power of intermediaries. Using an approach designed to evaluate the impact of state trading enterprises, we develop an oligopsony model of intermediaries. In this model, 'Fair Trade' firms optimize a welfare function that includes the producer surplus of growers. This concern for growers' welfare among some intermediary firms helps to alleviate the market power distortion. We calibrate the model to price data reported by a fair trade organization, and consider the counterfactual removal of fair trade behavior by intermediaries and customers downstream. As expected, the income of coffee growers (in aggregate) is reduced, though the effects are quite small.

Key words: coffee, fair trade, oligopsony

JEL classification: F12, F13, F14, L21

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

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. We argue that the circumstances of many coffee farmers in developing countries leave them plausibly exposed to the market power of intermediaries.[1] We adapt a modelling framework that is used to assess the impact of state trading enterprises in other agricultural markets; fair trade intermediaries maximize 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 conventional market share, a small difference in intermediaries' mark-ups in the two sectors, and the idea of sizable oligopsony power in the conventional market. Our calculations suggest that it is indeed possible that fair trade intermediaries can raise the incomes of coffee farmers, but these effects are quite small. For a wide range of plausible parameterizations of the model, we calculate that the existence of a fair trade channel can raise the income of coffee farmers by less than 2.5 percent.[2]

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.

**Market conditions in the coffee supply chain**

The conventional coffee market employs a number of intermediaries that link farmers and consumers of coffee. We begin by describing the conventional market channel. Coffee trees produce 'berries' which the farmers harvest and sell to private intermediaries. These intermediaries then transport the berries to processing plants, where the berries are processed 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 organization, with those certified by the Fair Trade Labelling Organization (FLO) as the most prominent examples.[3] The conditions imposed by FLO 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 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 growers the greater of the market price and the fair trade minimum price plus, in each case, a premium of US$0.10 per pound (FLO, 2008b).

Fair trade organizations make a number of claims about their beneficial impact on farmers. The transfer of technology and market information, the smoothing of farm incomes over the season, and insurance against downward price risk are all plausible sources of benefits to farmers that go beyond the scope of this paper. We focus on the specific claim that such organizations reduce the market power of coffee-buying intermediaries. We find this claim plausible, at least in its qualitative form. Market conditions in coffee are such that: a) the supply of coffee beans is highly inelastic; and b) competition among intermediaries is plausibly imperfect.

<u>Growing conditions</u>

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). These climactic conditions ensure that coffee is most often produced in developing countries in Asia, Latin America and Africa.

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, thereby limiting 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 its 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.[4]

The combination of slow maturation, long harvesting lives, and a lack of economically viable substitute cash crops imply an inelastic supply of coffee berries.[5] 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 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.

<u>Ownership structure and the potential for oligopsony power</u>

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 intermediaries is a running theme in agricultural economics, in developed and developing countries alike.[6] Responses by governments to such market power have often included encouragement of the formation of cooperatives or the creation of 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. Such figures typically include freeze-dried markets and/or lower quality Robusta beans. Given the focus of the fair trade movement on the fresh, higher-quality Arabica market, we do not wish to lean on concentration in this larger market 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.[7] 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 stylized fact, and develop a suitable theoretical model to represent it.

**Literature on Fair Trade Coffee**

The fair-trade movement is most visible at the ends of the coffee supply chain. Fair trade organisations interact with small growers of coffee berries and focus their appeals to consumers of coffee at the retail level. Several 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 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 behavior by a subset of coffee growers (e.g., Milford (2004)). Becchetti and Adriani (2004) and Richardson and Stähler (2007) consider both ends of the supply chain.

The conclusions to be drawn from those authors who investigate behavior 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.

One of the key assertions of the fair trade movement is that the market power of intermediaries (e.g., processors) reduces the effective demand for growers' 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 in 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. 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 behavior by the incumbent, profit-maximizing firm. This imitation has the desired pro-competitive effect.

Richardson and Stähler (2007) analyze the structure of a farmers' cooperative, focusing on the interaction of growers' incentives, market power and a 'warm-glow effect' that represents consumers' additional utility from raising farmers' wages. A conventional processing firm and a fair-trade firm compete in the market for high-quality beans, while the conventional firm also purchases low-quality beans. In this setting, the vertically integrated fair trade firm returns all surplus to its growers and faces a moral hazard problem because of the pre-specified and incomplete contract. They conclude that the vertical integration of fair trade firm limits its size compared to that of its rivals.

Becchetti and Adriani (2004) model both ethical consumers and fair traders. In their setting, Northern consumers are willing to pay a premium for fair trade products.

The product is considered to be fair if workers receive wage equal to their marginal product. The monopsonist faces an upward sloping labor supply curve in the South, and can set a low wage there when producing unfair products, but takes price as given when selling goods in the perfectly competitive North market. The fair trader, on the other hand, cannot make a profit and may have some constraint on his size. The firms compete in prices. Becchetti and Adriani (2004) show that in equilibrium the existence of fair trade can lead to both types of firms paying the value of the marginal product to their workers generating a welfare improvement while the absence of fair trade, with ethical preference of consumers solely, reduces welfare.

In our approach to assessing the likely economic effects of the fair-trade movement in the international coffee market, we limit ourselves to the link in the supply chain at which coffee growers and processing firms interact. In particular, we assess the effects of processors in the fair-trade supply chain on the producer surplus of those growers who participate in it and those that do not. Our framework is most similar to Becchetti and Adriani (2004). We differ from them in using Cournot, rather than Bertrand competition. We also calibrate the model in order to provide a quantitative context for evaluating our theoretical claims.

We adapt the modelling framework used in the assessment of state trading enterprises by McCorriston and MacLaren (2007). These authors develop a model in which a state trading enterprise maximizes 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 which competes with profit-maximizing processors.

**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, and the more numerous, 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.[8] While these processing firms can influence the price that they pay for berries, their selling price of green coffee is assumed to be fixed. In other words, we are abstracting 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 exerted on that buying power by fair trade processors.

The second type of 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.[9] 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 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.

Let the fixed price for commercial, green coffee be $P_C$ and the fixed price for fair trade, green coffee 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 transportation costs. 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 the 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

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

and the inverse supply function of fair trade coffee berries be

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

where $Q_C$ and $Q_F$ are the total quantities of commercial and fair trade coffee berries procured, respectively.

The cost of processing coffee berries into green coffee is taken to be a constant percentage of the price of green coffee. The price of green coffee net of processing and transport costs received by commercial processors is $p_C = P_C(1-\tau_C)$, and the corresponding price for fair trade green coffee is $p_F = P_F(1-\tau_F)$, where $P_k\tau_k$ $(k = C, F)$ is the constant unit cost of processing and transport. It is probable that these costs will be greater for the fair trade processors than for the commercial firms.

It is assumed: (i) that both types of coffee berries will be supplied, i.e., $p_C > \gamma_0$ and $p_F > \phi_0$; (ii) that the responsiveness of price to own-quantity supplied and to the other quantity supplied may differ across the two inverse supply functions, i.e., $\gamma_k \neq \phi_k, k = 1, 2;$ (iii) that the marginal cost function of fair trade berries lies above that of commercial berries, i.e., $\phi_0 > \gamma_0$; and (iv) that growers can choose which type of processor they wish to supply.

Let the *i*th commercial processor $(i = 1, 2, \ldots, n)$ 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 firm is assumed to maximise profit with respect to the quantity of berries bought and green coffee sold, and it plays a Cournot game with $n-1$ commercial firms and with *m* fair trade firms.

Let the objective function of the *j*th 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,

$$\begin{aligned} W_F^j &= \alpha PS_F + \pi_F^j \\ &= \alpha[p_F^S Q_F - \textstyle\int_0^{Q_F} p_F^S \mathrm{d}z] + [p_F - p_F^S] Q_F^j \end{aligned} \tag{4}$$

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

The *i*th commercial firm maximises equation (3) with respect to $Q_C^i$

$$\begin{aligned} \frac{\partial \pi_C^i}{\partial Q_C^i} &= p_C - p_C^S + Q_C^i [\frac{\partial p_C}{\partial Q_C^i} - \frac{\partial p_C^S}{\partial Q_C^i}] \\ &= p_C - \gamma_0 - (n+1)\gamma_1 Q_C^i - \gamma_2 Q_F \end{aligned} \tag{5}$$

At the optimum,

$$(n+1)\gamma_1 Q_C^i + \gamma_2 Q_F - p_C + \gamma_0 = 0$$

where $n$ is assumed fixed, and $Q_F = mQ_F^i$ is the aggregate quantity of fair trade coffee.[10] Multiplying through by $n$ gives the total quantity of coffee berries procured by the commercial processors:

(6) $$(n+1)\gamma_1 Q_C + n\gamma_2 Q_F - np_C + n\gamma_0 = 0$$

The $j$th fair trade processor maximises equation (4) with respect to the quantity procured, $Q_F^j$ which gives

(7) $$\begin{aligned}\frac{\partial W_F^j}{\partial Q_F^j} &= \alpha[p_F^S \frac{\partial Q_F}{\partial Q_F^j} + Q_F \frac{\partial p_F^S}{\partial Q_F^j} - p_F^S \frac{\partial Q_F}{\partial Q_F^j}] + p_F - p_F^S + Q_F^j[\frac{\partial p_F}{\partial Q_F^j} - \frac{\partial p_F^S}{\partial Q_F^j}] \\ &= -\phi_1[1+m(1-\alpha)]Q_F^j - \phi_2 Q_C + p_F - \phi_0\end{aligned}$$

Multiplying through by $m$ (assumed fixed), at the optimum,

(8) $$\phi_1[1+m(1-\alpha)]Q_F + m\phi_2 Q_C - mp_F + m\phi_0 = 0$$

The effect of $\alpha$ is to rotate clockwise the perceived marginal expenditure function of the fair trade processor, thereby causing it to procure more, *ceteris paribus*.

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

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

Solving these conditions for the optimal quantities, gives

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

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

We now investigate the effect of $\alpha$ on these optimal quantities and the corresponding procurement prices, and then we evaluate its effect on producer surplus for each set of growers. Differentiating equation (9) (evaluated at the optimum quantities) with respect to $\alpha$ and rearranging gives

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

Then, using Cramer's rule,

$$(12) \qquad \begin{aligned} \frac{\partial Q_C^*}{\partial\alpha} &= \frac{\begin{vmatrix} 0 & n\gamma_2 \\ m\phi_1 Q_F^* & \phi_1[1+m(1-\alpha)] \end{vmatrix}}{\Delta} < 0 \text{ and} \\ \frac{\partial Q_F^*}{\partial\alpha} &= \frac{\begin{vmatrix} (n+1)\gamma_1 & 0 \\ m\phi_2 & m\phi_1 Q_F^* \end{vmatrix}}{\Delta} > 0 \end{aligned}$$

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

$$(13) \quad \frac{\partial p_C^{S*}}{\partial\alpha} = \phi_1\gamma_1\gamma_2 m\Delta^{-1}Q_F^* > 0; \text{ and } \frac{\partial p_F^{S*}}{\partial\alpha} = \phi_1 m\Delta^{-1}Q_F^*[\phi_1\gamma_1(n+1) - \phi_2\gamma_2 n] > 0$$

The action of the fair trade processors to increase the welfare of their growers raises their procurement price but it also raises the procurement price of the commercial processors. Although from equation (12), the quantity procured by the commercial processors falls with increasing $\alpha$, this effect is more than offset by the increase in procurement from fair trade growers. The combined effect of the price and quantity changes is measured through the change in producer surplus.

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

(14) $$PS_C^* = p_C^{S*}Q_C^* - \int_0^{Q_C^*} p_C^S \mathrm{dz}$$

Differentiating equation (14) with respect to $\alpha$ and making use of equation (13) gives

(15) $$\frac{\partial PS_C^*}{\partial \alpha} = \phi_1\gamma_1\gamma_2 m\Delta^{-1}Q_C^*Q_F^* > 0$$

Producer surplus of growers supplying the fair trade processors is

(16) $$PS_F^* = p_F^{S*}Q_F^* - \int_0^{Q_F^*} p_F^S \mathrm{dz}$$

Differentiating equation (16) with respect to $\alpha$ and making use of equation (13) gives

(17) $$\frac{\partial PS_F^*}{\partial \alpha} = \phi_1 m\Delta^{-1}Q_F^{*2}[\phi_1\gamma_1(n+1) - \phi_2\gamma_2 n] > 0$$

As expected, the welfare of those growers supplying the fair trade firms increases with the weight placed on that welfare but also so does the welfare of the growers supplying the commercial processors. The latter gain because as $\alpha$ increases, more is procured from the fair trade growers but this causes the procurement price of commercial berries to increase. In effect, as $\alpha$ increases, the buying power of the commercial processors is diminished.

Finally, it useful to determine the sign of the change in the optimal level of profit of the commercial firms when $\alpha$ increases.

(25) $$\begin{aligned}
&\pi_C^* = (p_C - p_C^{S*})Q_C^* \\
&\frac{\partial \pi_C^*}{\partial \alpha} = (p_C - p_C^{S*})\frac{\partial Q_C^*}{\partial \alpha} - Q_C^*(\frac{\partial p_C^{S*}}{\partial Q_C^*}\cdot\frac{\partial Q_C^*}{\partial \alpha} + \frac{\partial p_C^{S*}}{\partial Q_F^*}\cdot\frac{\partial Q_F^*}{\partial \alpha}) \\
&\qquad = (p_C - p_C^{S*})\frac{\partial Q_C^*}{\partial \alpha} - Q_C^*Q_F^*\phi_1\gamma_1\gamma_2 m\Delta^{-1}
\end{aligned}$$

The first term is strictly negative (from equation (12)) and the second term, making use of equation (15), is strictly positive. Therefore, $\frac{\partial \pi_C^*}{\partial \alpha} < 0$. 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 benefit the suppliers of commercial berries. The extent to which this moderation of oligopsony power is likely to be quantitatively significant in practice is pursued in the next section.

**Calibration**

In the previous section we show that the behavior of fair trade intermediaries affects the price and quantity of coffee berries in the fair trade and conventional channels. In this section we derive quantitative implications for farm revenues.[11] We calibrate our theoretical model to illustrative data on prices, quantities, and a number of structural parameters. We then consider counterfactual scenarios that eliminate fair-trade behavior by intermediaries and downstream customers. Our results indicate that fair trade behavior 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 behavior/existence of fair trade firms.

Our calibration strategy is similar to that of Dixit (1988), though the firms in our model have oligopsony, rather than oligopoly, power. We also improve the theoretic consistency of Dixit's calibration technique by bringing the first-order conditions of the intermediaries into the calibration.[12] 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*.[13] We vary relative traded quantities in each sector across calibrations, with the fair-trade share ranging from 0.001 to 0.03. 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 $\alpha$ parameter, to calibrate an operational model that follows equations (1), (2), (5) and (7).[14]

The counterfactual exercise we wish to imagine is the removal of fair trade status from the coffee berries that are currently sold under these mechanisms. We retain the notion that the two types of berries are differentiated in production; the inverse supply curves are parameterized the same in both benchmark and counterfactual calculations.[15] We provide a quantitative estimate of the effect of the fair trade status of berries on their prices by removing downstream fair-trade behavior in the counterfactual exercises. We consider two possible counterfactual scenarios, which we intend as plausible lower and upper bounds for the overall effect of fair trade. In one counterfactual, we simply reparameterize 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.[16] The counterfactual 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.[17]

*Calibration procedure and the counterfactual model*

Our behavioral model for counterfactual analysis is a variational inequality model based on equations (5) 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:

$$(5a) \qquad \gamma_0 + (n+1)\gamma_1 Q_C^i + \gamma_2 m Q_F^i \geq (1-\tau_C)P_C \quad \perp \quad Q_C^i \geq 0$$
$$(7a) \qquad \phi_0 + n\phi_2 Q_C^i + \phi_1[1+m(1-\alpha)]Q_F^i \geq (1-\tau_F)P_F \quad \perp \quad Q_F^i \geq 0$$

where $\gamma_2 = \phi_2$ and $\perp$ indicates complementary slackness.[18] These conditions capture the economic behavior 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.[19]

Dixit (1988) describes a process for calibrating Cournot models of strategic behavior. We convert Dixit's approach for use with our oligopsony model. The process maps data 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 parameterized version of equations (1) and (2).[20] Given data on $P_C$ and $P_F$, and values for $n$ and $\alpha$, equations (5) and (7) can be used to back out model consistent values of $\tau_F$ and $\tau_C$ in the benchmark. At the benchmark, where $\alpha=1$, $Q_C^i > 0$ and $Q_F^i > 0$, (5a) and (7a) hold with equality, and we can rearrange them to solve for $\tau_F$ and $\tau_C$:

$$5b) \quad \tau_C = 1 - \frac{\gamma_0 + (n+1)\gamma_1 Q_C^i + m\gamma_2 Q_F^i}{P_F},$$

$$7b) \quad \tau_F = 1 - \frac{\phi_0 + n\phi_2 Q_C^i + [1 + m(1-\alpha)]\phi_1 Q_F^i}{P_F}.$$

*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 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 behavior of the intermediaries.[21]

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. In our model, the gaps between the price paid to farmers and the FOB price at the port must be attributed either to the intermediaries' costs or to a per unit profit margin.[22] The division of this margin is determined by the first order conditions in calibration, and varies over different parameterizations of the model.

The absolute quantities of fair trade and conventional coffee beans we use in calibration are unimportant, we focus on market shares.[23] The world market share of fair trade coffee is extremely small, about 0.55 percent.[24] 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 behavior 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 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 3 percent of the total local market for specialty coffee beans.

*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 more 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 consumer demand schedules for domestic and foreign automobiles, Dixit (1988) also employs an elasticity of substitution. In our case, this elasticity should measure the ability of coffee farmers to substitute between fair-trade and conventional supply. We know of no estimates of this parameter in the econometric 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.[25]

*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. In our preferred calibrations we assume a single fair-trade firm (i.e., $m = 1$). Given our interpretation of this as a market with limited geographic scope, we view this as appropriate. In sensitivity analysis we consider the impact of adding additional fair trade firms to the analysis.

*Inferred marginal transport/processing costs*

The data available to us on prices allows a comparison of the prices paid and received by conventional intermediaries to that of a fair-trade cooperative. 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 (5b) and (7b) to make model-consistent inferences about the size of these costs. We believe it likely that fair trade processing and transport costs are larger than those in the conventional sector.[26] 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.[27] 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 maximizing 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, so the entire FOB/farm gate price margin in the fair trade sector is attributed to processing/transport costs $\left(\tau_F = 1 - \frac{0.88}{1.26} = 0.302\right)$. Second, the fair trade marginal cost is generally greater than that of conventional firms, especially when conventional firm numbers are low.[28]

Finally, it is very difficult to associate the observed data with severe concentration in the conventional market. For firm numbers below 5, optimizing conventional firms would have to receive a per unit subsidy ($\tau_C < 0$) in order to choose large 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.

*Counterfactual analysis*

We conduct two counterfactual analyses, each with a different interpretation of the behavioral effects of fair trade. In the first exercise, we simply change the behavior 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 reduces the premium.[29]

Figure 2 shows the results of the first counterfactual. In our calibrated model, changing the fair trade intermediaries' objective function to profit maximization alone reduces coffee farmers' total revenues by 0.01 to 1.98 percent. The more concentrated the conventional market, the more deleterious the effects of the behavioral change for 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 behavior 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 behavior on prices and quantities. The fair trade procurement price falls in each case, ranging from a 0.58 percent to a 2.29 percent reduction over the cases considered.[30] Reductions in fair trade quantities range from 56.22 percent to 88.38 percent.[31] The conventional supply price falls by between 0.01 percent and 1.45 percent.[32] Quantity increases in the conventional market range from 0.06 percent to 3.31 percent.[33]

[FIGURE 2]

We next consider the broader counterfactual. In addition to eliminating the fair trade intermediaries' 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 percent 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 behavior.[34] 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 the second counterfactual the fair trade intermediary shuts down in every scenario, as the absence of any price premium means an absence of compensation for the higher costs associated with processing fair trade coffee. The shut down of the fair trade sector altogether produces no measurably different effects on the conventional sector than do the large reductions in fair trade output that arise in the first counterfactual.[35]

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 parameterizations, 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.

Sensitivity

Our calibration study so far has relied upon a number of parameters that we selected. In particular, we parameterized the fair trade firm's concern parameter ($\alpha = 1$), the elasticity of producer substitution between fair trade and conventional berries ($\sigma = 100$), and the number of fair trade firms ($m = 1$). These parameters were chosen as plausible, but possibly extreme, values. In each case, less extreme choices would have reduced the impact of removing fair trade behavior in the counterfactual experiments.

Consider first the concern parameter $\alpha$. At the chosen value of $\alpha$ =1, the fair trade firm acts like a competitive firm, pricing at marginal cost (see equation (7)). When $\alpha$ is set to zero, the fair trade firm severely contracts output, so that it operates like a monopsonist in the fair trade market. When we select $\alpha < 1$, the fair trade intermediary withholds procurement to some degree in the benchmark equilibrium.[36] In this situation, its counterfactual response to setting $\alpha = 0$ is less severe than in our simulations above. Choosing $\alpha = ½$ 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 unchanged relative to the baseline. In most cases the fair trade firm exits when the FOB price falls, for both initial choices of $\alpha$.[37]

As noted earlier, we have chosen the producer substitution elasticity $\sigma$, 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 $\sigma$ 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 $\sigma$ in half, and rerun the model. Our results are virtually equivalent to simulations with larger values of $\sigma$.

We also consider changes in the value of *m*, the number of fair trade intermediaries. In our estimates above, where there is only one fair trade intermediary, the fair trade intermediary acts a monopsonist in the counterfactual exercise. It thus reduces its output choice substantially in the counterfactual, generating relatively large impacts on the farmers. For larger chosen values of $m$, the removal of fair trade behavior generates smaller reductions in purchases, so the effects of removing fair trade status on farmers are smaller. Choosing $m = 2$ reduces the impact of removing fair trade by about ¼, compared with the scenario with $m = 1$. The effects in the second counterfactual basically unchanged when $m = 2$.

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

**Conclusion**

A key claim of the fair trade coffee movement is that oligopsony power reduces the welfare of developing country coffee farmers. 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 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 behavior leads the firm to act less aggressively, reducing the deleterious effects of oligopsony power in the conventional market.

In order to evaluate the quantitative impact of the model, we calibrate the model to representative data on prices and quantities, along with plausible parameterizations of the models and other structural parameters. We focus on a particular parameterization that we view as especially favourable to the fair trade movement. Even in this case, the effects of fair trade on farm revenues are quite small.

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

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

[3] FLO is a certification body that verifies that coffee sold under its label has been produced and sold under particular conditions. It has 23 member organizations operating in 21 countries in Central and South America, Africa and Asia (FLO, 2008a).

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

[5] 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 labor. Ownership of specific factors can make farmers' welfare extremely sensitive to the coffee prices, and can limit the mobility of rural labor when coffee prices fall.

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

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

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

[9] This modelling technique has been used to evaluate state-trading enterprises, e.g., see McCorriston and MacLaren (2007).

[10] We denote the aggregate quantity of conventional coffee as $Q_C = nQ_C^i$.

[11] 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. Aggregating producer surplus requires extensions of the calibrated supply curves well away from our benchmark equilibrium, and so 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.

[12] These additional equations allow us to make model-consistent inferences about intermediaries' marginal costs in each sector.

[13] The actual cost structure of intermediaries must certainly vary substantially across coffee-growing regions. In particular, the transportation costs of moving goods from farm to the developing country port will depend greatly on the infrastructure and institutions of specific coffee-growing countries. Our application uses data that can plausibly be treated as representative of the general problem. It does not evaluate any specific geographic market.

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

[15] Our use of the terms "benchmark" and "baseline" is potentially confusing. We do multiple calibrations of the model, and compare the results of different comparative static results. The "benchmark" will always refer to the calibrated, data-based equilibrium that includes fair trade behavior. In sensitivity analysis, we will compare the results of counterfactual analyses under alternative parameterizations against counterfactual analyses using our standard parameterizations. Both sets of counterfactuals will depart from their respective benchmarks. We refer to the results from our standard parameterization as the baseline against which we compare the results from the sensitivity analysis.

[16] 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.

[17] 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.

[18] Dixit's (1988) calibration method requires the parametric restriction $\gamma_2 = \phi_2$.

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

[20] The idea is to convert non-linear estimates of supply responses into the linear inverse supply functions commonly employed in the Cournot model.

[21] 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.

[22] In the case of the fair trade intermediary, the profits might better be thought of as rents that go to the employees of the cooperative. Assuming $\alpha = 1$, as we do, leads the cooperative to price at marginal cost, so there are no such rents in the benchmark equilibrium.

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

[24] See Ronchi (2006).

[25] 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 ($\phi_1$) is the only parameter substantially affected by our choice of elasticity of substitution. Counterfactual results are largely insensitive to the choice of elasticity of substitution. Lower values of this parameter reduce the competition between the two distribution channels, and so reduce the impact of fair trade coffee on farmers who supply the conventional channel.

[26] 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.

[27] These are the results for a 1 percent fair trade market share. Initial market share makes almost no difference on the inferred marginal costs.

[28] The calibration has to reconcile a larger FOB/farm gate price gap in the fair trade sector, a small fair trade market share, and behavioral parameters that imply more aggressive market behavior by the fair trade firm. These can only be reconciled if marginal costs are higher in the fair trade sector.

[29] 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.

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

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

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

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

[34] 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. Since quantities chosen in the first counterfactual were already quite small, the marginal impact of FOB price changes on the results is limited.

[35]Price and quantity changes in the conventional market in the second counterfactual are within the rounding error of the results from the first counterfactual.

[36] One might argue that participants in the fair trade channel are earning rents through their participation in these activities. One could view these rents as the profits in the welfare function. $\alpha < 1$ implies some concern for these rents in the behavior of the fair trade intermediary.

[37] One could imagine a choice of $\alpha > 1$, implying a concern for farmer welfare that is greater than the concern for profits. In practice, such a welfare function implies pricing below marginal cost. This would imply exit, were we also to include zero-profit conditions. We thus view $\alpha = 1$ as the upper limit plausible parameterizations of this model.

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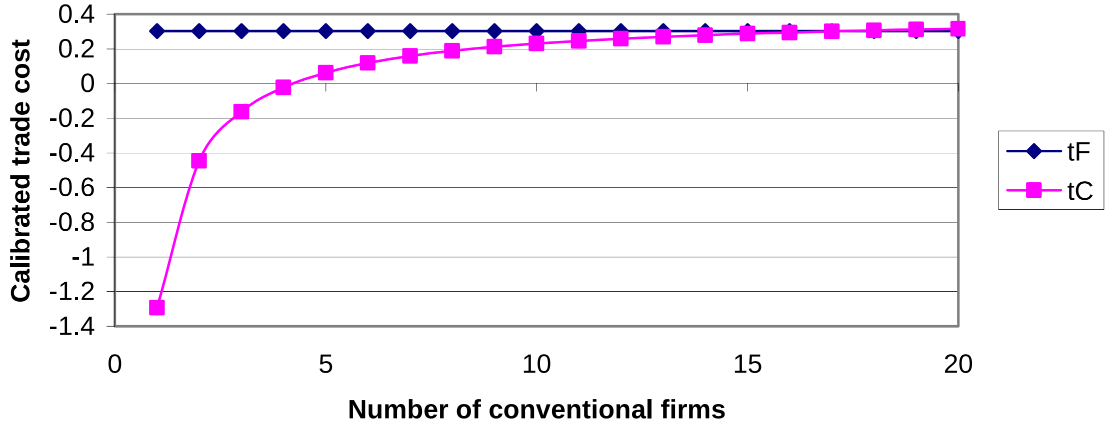



Note: Benchmark fair trade market share = 0.01. Marginal cost estimates are very similar over all considered benchmark market shares. Marginal costs below zero indicate a per unit subsidy is needed for model consistency.

**Figure 1. Calibrated marginal transport/processing costs**

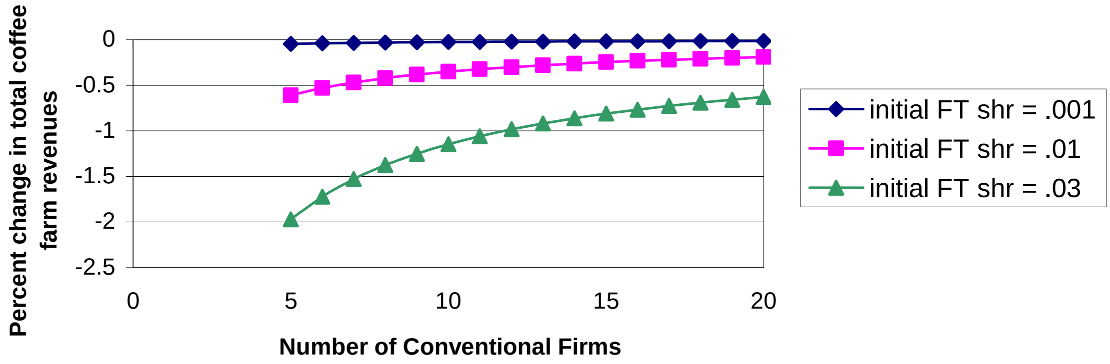
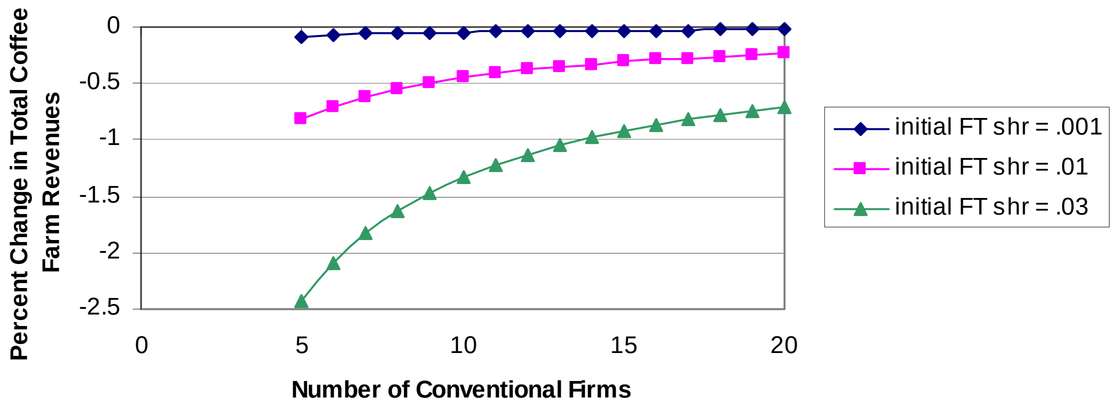



**Figure 2. Change in farm revenues when $\alpha = 0$**




Note: Counterfactual considers the joint impact of setting □ to zero and setting the FOB price of fair trade coffee at the FOB price for conventional coffee.

**Figure 3. Changes in farm revenues when $\alpha = 0$ and $P_F$ set equal to $P_C$**