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HAVE WE BEEN MUGGED? MARKET POWER IN THE WORLD COFFEE INDUSTRY

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Have we been Mugged?
Market Power in the World Coffee Industry

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Abstract

The coffee industry is highly concentrated both at the retail and export stages. A number of recent commentaries have suggested that this concentration translates into monopolistic and monopsonistic pricing to the detriment of both consumers and farmers. Using time series data for eight major coffee-consuming countries and nine coffee exporters, we find that both retail and export markets have increased in competitiveness over recent decades. Retail markets in traditional coffee-consuming countries are close to being fully competitive but there is evidence of exercise of monopoly power in the non-traditional Japan and UK markets. On the export side, market liberalization has reduced the exercise of monopsony power in most, but not all, exporting countries.

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1. Introduction

Coffee is a tropical tree crop commodity. There are two principal varieties – arabica and robusta – the beans from which give coffees with very different characteristics. Robusta coffees, which can be grown at low altitudes, have less flavor but greater strength than arabicas, which are grown at higher altitudes and often on volcanic soils. Arabica beans can either be wet or dry-processed. Wet processing, used throughout Spanish speaking America and in most of East Africa, results in mild arabica coffee which is ideally suited to filter coffees. Dry processing, which is the standard practice in Brazil and Ethiopia, gives a more bitter coffee which is particularly suited to the preparation of espresso. Arabica is more difficult to grow and costly than robusta, and quality variations are much more considerable. Some high quality arabicas fetch large market premia, in particular from the specialty coffee retailers. By contrast, most major manufacturers blend coffees from different origins in order to obtain a quality which is consistent over time. The blends typically use arabica for flavor with robusta as a filler, the relative proportions of the two determining the overall cost of the blend.

Coffee processing is known as roasting. The final product is either canned or packeted roast coffee, soluble coffee or (in Japan) canned liquid coffee. Roasting is a concentrated activity. In 1998, the two largest roasters accounted for 29% of total world coffee roasting, and the top six roasters for 60% (van Dijk *et al*., 1998). The United States is the single largest coffee-consuming nation. In recent USDA research, Leibtag *et al* (2007) report that Folgers (Proctor and Gamble) had a U.S. market share of 38% by volume while Maxwell House (Kraft) followed with 33%. Sara Lee was third with 10%. Nestlé was reported as having a 56% share of the United Kingdom market in 1989 (Monopolies and Mergers Commission, 1989). It is generally believed that these high concentrations are principally the result of branding. Brands are often heavily promoted and this gives rise to a barrier to market entry. Economies of scale are present but are only a dominant factor in the production of soluble coffees.

On the supply side, coffee is produced in a mixture of smallholdings, larger farms and estates. Smallholdings dominate in Africa and much of Asia, but Central and Southern America sees coexistence of large and small producers. Large farms can benefit from mechanization but there

is some suggestion that quality may be superior in small, family-run, holdings. In any case, production is very fragmented relative to coffee roasting.

The general structure of the supply chain is that coffee is roasted in consumer and not producer countries. This is partly for historical reasons and partly because roasters choose to blend beans from different origins to maintain a consistent taste across crop years while minimizing the cost of purchasing the beans required. There are exceptions. Brazil is the second largest coffee-consuming nation as well as the largest producer and has a large domestic roasting industry. Colombia, which has succeeded in establishing a national brand in the world market, exports a significant proportion of its beans in processed form. And all coffee producing countries retain some (often low quality) beans to be roast for domestic consumption.

Exporters purchase beans in the producing country, usually at the port or railhead but sometimes up-country, and arrange for transportation and sale in a consuming country. Institutional arrangements for exporting differ across producing countries and have also varied within countries over time. In the nineteen fifties and sixties, many producing countries established or inherited government or parastatal agencies which controlled exports. These agencies often also set pan-national producer prices, and in certain instances, were also monopsony purchasers of coffee. These arrangements were justified in terms of ensuring fair and also predictable prices to producers. From 1962, they were underwritten by the sequence of International Coffee Agreements which, with the consent and active cooperation of developed country government, including that of the United States, regulated the overall supply of coffee to developed country consumer markets. Implementation of International Coffee Organization (ICO) quotas formed part of the responsibility of the national agencies. These arrangements terminated in 1989 leaving world coffee prices to be determined by market and not political forces. Intervention in domestic markets ceased to be necessary and came to be seen as shielding inefficiencies in the supply chain, discouraging innovation and imposing unnecessary costs on farmers. The liberalization process, in part pushed by the multilateral aid agencies and in part through domestic political agendas, has seen the elimination of much of this interventionist apparatus over the period since 1989. See Gilbert (1996) on the ICO control regime and Akiyama (2001) on the coffee liberalization process.

There is now free entry into exporting in most coffee producing countries. In this context, three factors favor large multilateral companies at the expense of small exporters: first, transport is subject to significant economies of scale; second, exporters require access to low cost credit and third, they also need to manage the risk of adverse price movements, an activity which itself depends upon access to hard currency credit. The consequence is that coffee exporting has also become relatively concentrated, although precise numbers are difficult to obtain. In some cases, the large coffee roasters themselves export either through a direct purchasing presence in the producing country or through a local subsidiary or partner.

World coffee prices fell to very low levels at the turn of the new century, largely as the result of major expansions in production in Brazil and Vietnam which took place against a backdrop of stagnant or only slowly growing demand in the main consuming markets. The low prices of the "coffee crisis" years (there has since been a modest recovery) provoked comments which suggested that market concentration may have been a partial cause of the situation. Daviron and Ponte (2005, p.123), for example, state that "the proportions of generated income were relatively fairly distributed between consuming and producing countries" under the ICO regime, but that, starting from the 1990s, farmers have been "squeezed" (*ibid*, p. 209) with the result that value has been "transferred from farmers to consuming-country operators" (*ibid*, p. 246). In a similar vein, Robbins (2003, p.16), contrasting the general decline in producer prices for a range of tropical commodities with rising retail prices for the processed products in the consumer countries, states that much of the difference "has been reflected in the profits of the giant multinational trading companies that dominate the processing, distribution and trade in these commodities". Shepherd (2004, p.4) states that "some intermediate agents [in the coffee market] are big enough to make price manipulation possible" although he does not evaluate whether such manipulation has in fact taken place. Finally and most influentially, Oxfam (2002), in a report entitled "Mugged: Poverty in your coffee cup", contrasts the low prices obtained by coffee farmers and intermediaries in producing countries with the allegedly high margins and large profits made by the major coffee roasters.[1]

[1] The Oxfam document emphasizes the importance of brand power but does not state explicitly state that high profits are made through the exercise of monopoly or monopsony power

In summary, the popular and academic literature both contain innuendo linking market power to monopolistic and/or monopsonistic practices. However, little evidence has been produced which supports these suggestions. In its 1991 report on the UK market for soluble coffee, in which the dominant producer (Nestlé) enjoyed a 48% share by volume, the Monopolies and Mergers Commission (MMC) failed to find any "weaknesses in price competition to justify intervention" (MMC, 1991). Three recent academic studies of the continental European roasting industry reach similar conclusions:

- Germany: Feuerstein (2002) failed to find evidence for "overshifting" of production costs in the German roast coffee industry.
- The Netherlands: Bettendorf and Verboven (2002) found that changes in Dutch coffee prices resulted from changes in marginal production cost, not changes in margins.
- Sweden: Durevall (2004) found evidence for only a small degree of market power in the Swedish market for roasted coffee in the short run and none at all in the long run.

Finally, based on detailed industry data, a USDA study has concluded the US price of roast coffee adjusts one-to-one with the price of green coffee beans (Leibtag *et a*l., 2007). Evidence for producer markets is more sparse, but Krivonos (2004) argues that market liberalization has generally improved the transmission of world prices to producer markets.

In general, therefore, the available evidence suggests that, despite high market concentration, the world coffee market behaves competitively. This conclusion derives from diverse studies relating to different countries and adopting very different methodologies. In some respects, this diversity of approach is a strength, but what is lacking is a comprehensive view of the entire range of consuming and producing markets. The objective of this paper is to fill that gap. Have the major coffee roasters and exporters mugged coffee farmers and the coffee-drinking public?

2. The economic model

The oligopoly-oligopsony theory we use is standard but – see, for example, McCorriston *et al* (1998). We adopt a version of this standard model developed by Bettendorf and Verboven (2000) to analyze the Dutch coffee market.

Most of the current literature considers either the retail or the producer market. Here, we consider both. In that context, the coffee futures markets play a crucial role in separating consumption and export decisions. This separation permits independent analysis of the export and retail markets. Independent analysis of the retail and export markets is standard in this literature but the conditions under which it is valid have not been discussed.

Arabica coffee is traded in New York (on the New York Board of Trade, NYBOT) and robusta on the Euronext-LIFFE market in London.[2] Futures markets facilitate hedging and speculation, but crucially for our concerns, these markets also furnish reference prices for international commerce. The consequence is that almost all cross-border commerce in coffee is "basis" the relevant NYBOT or LIFFE price. The coffee roaster in Hamburg sees himself as buying robusta coffee from Uganda basis the LIFFE price and arabica from Kenya basis the NYBOT price. He does not need to know anything about producer prices in either country which are irrelevant to his calculations. Similarly, the Ugandan robusta exporter sells to roasters in Germany and the UK basis the same LIFFE price. Retail coffee price in the two countries are irrelevant to him. The implication is that we can consider the producer and retail markets separately. This would not be true for exports of bananas or pineapples where there are no terminal markets. It will also not be valid in coffee where roasters source from their own plantations or where "fair trade" arrangements are negotiated which override world prices. We suppose that these arrangements are insufficiently important to violate this separation.

A second important consequence of the separation of the export and retail markets is that we may take both roasters and exporters as price-takers on the terminal market. This is a likely rather than a necessary consequence of futures trading. It follows from the fact that these markets allow delivery to or sourcing from exchange warehouses. These possibilities allow exporters to circumvent any attempt by roasters to limit purchases, or for roasters to do the same if exporters limit supplies. Any attempt to manipulatively create an artificial price through the direct exercise monopoly or monopsony power on the exchange will be illegal under futures

[2] Arabica is also traded in Sao Paulo and Tokyo, but these markets are primarily of regional importance.

market regulation.[3] In what follows, we assume all agents are price takers on the coffee terminal markets.

Consumer demand D_{jt} in country j, year t, is represented by $D_{jt} = D^{j}\left(p_{jt}, t\right)$ where p_{jt} is the retail price of coffee in country j measured in domestic currency and deflated by the consumer price index (CPI).[4] The inverse demand function is $p_{jt} = P^{j}\left(X_{jt}, t\right)$ where X_{jt} is total output of roasted coffee in (j,t). The implicit equation $D_{jt} = X_{jt}$ supposes no stockholding or trade in roasted coffee, the former assumption being more reasonable than the latter.

There are F_j roasters in country j. Firm f produces output x_{fjt} of roasted coffee in year t. It faces two cost components – the cost of the green coffee beans which it purchases at terminal market price q_{jt}, converted into domestic currency and deflated by the CPI, and a processing cost $C_{fjt} = C^{fj}\left(x_{fjt}, t\right)$. Aggregate output in country j is $X_{jt} = \sum_{f=1}^{F_j} x_{fjt}$ In each period t, firm f seeks to maximize its static profit

$$\pi_{fjt} = \frac{1}{1+\tau_{jt}} P^{j}\left(X_{jt}, t\right) x_{fjt} - \left[\left(1-\delta\right) q_{jt} x_{fjt} + C^{fj}\left(x_{fjt}, t\right)\right] \qquad (1)$$

where τ_{jt} is a taxation wedge and δ is the proportion of the weight of the green coffee lost in roasting. Maximization of expression (1) gives

$$\frac{1}{1+\tau_{jt}}\left[p_{jt} + x_{fjt}\frac{\partial p_{jt}}{\partial X_{jt}}.\frac{\partial X_{jt}}{\partial x_{fjt}}\right] = \left(1-\delta\right) q_{jt} + \frac{\partial C_{fjt}}{\partial x_{fjt}} \qquad (2)$$

Write the elasticity of demand as $\eta_{jt} = -\frac{p_{jt}}{X_{jt}}.\frac{\partial X_{jt}}{\partial p_{jt}}$ and marginal processing cost $c_{jt} = \frac{\partial C_{fjt}}{\partial x_{fjt}}$ which we assume to be both constant and the same for all firms in j. Now define the elasticity $\theta_{jt} = \frac{x_{fjt}}{X_{fjt}}.\frac{\partial X_{fjt}}{\partial x_{fjt}}$. θ_{jt} measures the proportionate response in industry output resulting from a

[3] The relevant legislation is the Commodity Exchanges Act in the United States and the Financial Services Act in the U.K.

[4] Bettendorf and Verboven (2000) introduce consumer income and the price of tea as explicit arguments to the demand function. We find little evidence of income effects in the demand for coffee, except in Japan, and are impressed by arguments that sodas, rather than tea, are the main substitute for coffee.

proportionate change in the output of a particular firm and may be interpreted as a measure of "industry conduct". The symmetry assumption, reflected in the absence of a firm subscript, supposes no price leadership.[5] Under monopoly, $\theta_{jt} = 1$ while under perfect competition it would be zero. Under symmetric costs, the Cournot assumption implies $\theta_{jt} = \frac{1}{F_j}$. Using these definitions, we may rewrite equation (4) as

$$p_{jt} = \frac{1+\tau_{jt}}{1-L_{jt}}\left[(1-\delta)q_{jt} + c_{jt}\right] \tag{3}$$

where L_{jt} is the Lerner Index $L_{jt} = \frac{\theta_{jt}}{\eta_{jt}}$.

The producer side of the market may be modeled in a parallel manner. The supply function for green coffee in exporting country j, year t, is $S_{jt} = S^j\left(r_{jt}, t\right)$ where r_{jt} is the retail price of coffee in country j measured in domestic currency and deflated by the country's GDP deflator. The inverse supply function is $r_{jt} = R^j\left(X_{jt}, t\right)$ where X_{jt} is now total exports of green coffee in (j,t). The implicit equation $S_{jt} = X_{jt}$ supposes no stockholding of green coffee at origin and no domestic consumption. Both are strong assumptions but it does not seem worth complicating the model to take these factors into account.

There are G_j exporters in country j. Firm g exports z_{gjt} of green coffee in year t which it sells at the terminal market price q_{jt}. It faces two cost components – the cost of the green coffee beans which it purchases from farmers and an intermediation cost $K_{gjt} = K^{gj}\left(z_{gjt}, t\right)$. As previously,

[5] This assumption is almost certainly too simple but is the best we can do without resort to firm-level data. Roberts (1984) analyzed price-setting behavior in the U.S. roasting industry using a sample of 52 roasters. He found that the smallest 50 roasters were price takers, but that competition between the two largest roasters as not easily described by any of the standard models. Bresnahan (1982) argued that the degree of monopoly power is only identifiable from quantity and product price information if the slope of the demand curve shifts over time or in response to some exogenous variable. This identification problem is absent from our model because we observe a component of marginal cost (the price of green coffee) in addition to the quantity and the retail price

aggregate exports from country j are $Z_{jt} = \sum_{g=1}^{G_j} z_{gjt}$ In each period t, exporter g seeks to maximize its static profit

$$\pi_{gjt} = \frac{1}{1+\tau_{jt}} q_{jt} z_{gjt} - \left[R^j\left(Z_{jt}, t\right) z_{gjt} + K^{gj}\left(z_{gjt}, t\right) \right] \tag{4}$$

where τ_{jt} is an export taxation wedge. Maximization of expression (4) gives

$$\frac{q_{jt}}{1+\tau_{jt}} = \left[r_{jt} + z_{gjt} \frac{\partial r_{jt}}{\partial Z_{jt}} . \frac{\partial Z_{jt}}{\partial z_{gjt}} \right] + \frac{\partial K_{gjt}}{\partial z_{gjt}} \tag{5}$$

Write the elasticity of supply as $\varepsilon_j = \frac{r_{jt}}{Z_{jt}} . \frac{\partial Z_{jt}}{\partial r_{jt}}$ (which we take as constant over time) and marginal intermediation cost $k_{jt} = \frac{\partial K_{gjt}}{\partial z_{gjt}}$ which we again assume to be constant and the same for all exporters in j. As previously, we suppose symmetric relationships between all exporters and define the elasticity $\varphi_{jt} = \frac{x_{fjt}}{X_{fjt}} . \frac{\partial X_{fjt}}{\partial x_{fjt}}$. Equation (5) now becomes

$$r_{jt} = \frac{1}{1+M_{jt}} \left[\frac{q_{jt}}{1+\tau_{jt}} - k_{jt} \right] \tag{6}$$

where M_{jt} is the Lerner Index for coffee purchases, $M_{jt} = \frac{\varphi_{jt}}{\varepsilon_{jt}}$.

This theory supposes short-run profit maximization on the part of the monopolist-monopsonist. This assumption may fail on the retail market if the demand function depends on lagged as well as current prices or on price volatility, both of which would induce forward-looking behavior.[6] Similar issues may exist on the producer market, but a more serious problem is the presence of monopsony-monopoly marketing boards and similar institutions which either directly determine (or determined) producer prices or export quantities. Such institutions were present throughout

[6] The U.K. Monopolies and mergers Commission (MMC) noted "In making price changes, Nestlé [the dominant producer] was influenced by the need to avoid price volatility that could confuse the customer and be difficult for the trade to manage. Secondly, Nestlé aimed to smooth price increases to avoid sharp changes that could damage the confidence of the consumer" (MMC (1991) also quoted in Leibtag *et al*. (2007)).

much of the coffee industry in the earlier part of our (1980-2005) sample but have typically either been eliminated or seen reductions in their powers as the result of market liberalization processes, in part at the behest of the national and multilateral development agencies and in part as the consequence of the need to cut costs in the face of falling coffee prices – see Akiyama (2001) and Krivonos (2004) for surveys of these developments.

It is clear that such agencies exercised monopsony power, and indeed, this the purpose for which they had been established. The intention, however, was that the monopsony power should be exercised benevolently, ensuring that producers obtained "fair" prices and also stabilizing producer prices over time so that farmers could be confident about the returns from their labor supply and investment decisions. The historical record is more mixed. On the one hand, governments have been prone to use the surpluses generated by monopsony marketing boards as a source of fiscal revenue,[7] while on the other hand, government agencies have often been sluggish in responding to changes in market realities resulting in "stabilization" at optimistically high prices. Knudsen and Nash (1990) discuss these arrangements. They were particularly important in the coffee sector since, prior to 1989, it was through these agencies that governments of producing countries administered their ICO export quotas.

The producer price model expressed in equation (6) regards tax revenues, which accrue to governments, and monopsony profits, which accrue to the monopsonist, as separate items. That distinction ceases to be clear when the monopsonist is the government itself or a parastatal agency. It would be possible to extend the models set out earlier in this section go allow for the possibility of stabilization of both retail and producer prices through the introduction of a term reflecting the "cost" of changing prices. Optimization would give a standard Euler equation in which retail and producer prices this period relate to their levels last period and their expected levels next period. This is a promising avenue for future research but we do not pursue it here. Instead, we note that stabilization of retail prices requires the exercise of monopoly power and that of producer prices requires monopsony power, but that interpretation of our results in terms

[7] Bauer (1954, p.316) went so far as to assert that "Suggestions that [the marketing boards in the British colonies in West Africa] are devised for price stabilization … only obscure their nature and function".

of Lerner Indices must be qualified if there is evidence that these powers have been used to stabilize prices.

3. The empirical model

Equations (3) and (6) are symmetric. It is also immediate that neither implies either a unit cent-for-cent or percentage pass-through. From equations (3) and (6),

$$\frac{\partial p_{jt}}{\partial q_{jt}} = \frac{\left(1+\tau_{jt}\right)\left(1-\delta\right)}{1-L_{jt}} \tag{7}$$

$$\frac{\partial r_{jt}}{\partial q_{jt}} = \frac{1}{\left(1+M_{jt}\right)\left(1+\tau_{jt}\right)} \leq 1 \tag{8}$$

Both expressions depend on the extent of monopoly-monopsony power. By contrast, the percentage pass-throughs are independent of monopoly power and depend solely on the share of coffee in total production costs:

$$\frac{\partial \ln p_{jt}}{\partial \ln q_{jt}} = \frac{\left(1-\delta\right)q_{jt}}{\left(1-\delta\right)q_{jt}+c_{jt}} < 1 \tag{9}$$

$$\frac{\partial \ln r_{jt}}{\partial \ln q_{jt}} = \frac{q_{jt}}{q_{jt}-\left(1+\tau_{jt}\right)k_{jt}} > 1 \tag{10}$$

Equations (9) and (10) demonstrate that the percentage pass-through is uninformative about the extent of monopoly or monopsony power but instead relates to the share of raw material costs in total costs. In the model set out in section 2, monopoly power will lead to a high percentage mark-up which, however, will be unaffected by changes in input costs. Analogously, monopsony power in exporting will result in high percentage price mark-downs in the producer price which will be unaffected by changes in the terminal market price.

These observations have two implications for the specification of empirical models of pass-through. First, the ratio $\frac{c_{jt}}{q_{jt}}$ of non-coffee production costs to the green coffee price and $\frac{k_{jt}}{q_{jt}}$ of intermediation costs to terminal market prices will both vary inversely with the coffee price, implying non-constancy of the elasticities (9) and (10). The percentage pass-through to retail prices will be low when coffee prices are low while the percentage pass-through to producer

prices will be higher the lower the producer price. Since these ratios can vary enormously, parameter variation is likely to be large.

Second, economists are trained to specify relationships as logarithmic both to ease interpretation and often also because it is thought that elasticities are more likely than slopes to be invariants. This advice is inappropriate in looking at price pass-through. If the economist observes the complete set of cost data it makes sense to regress the logarithm of price on the logarithm of total costs,[8] but in the more normal case in which one is looking at the pass-through form a particular price, it is the linear specification that is likely to be structurally invariant. Further, as is clear from equations (7) and (8), within the context of the simple model set out in section 2, it is the linear specification that will be informative about monopoly or monopsony power.[9] In what follows, we estimate all pass-through equations as linear in levels.

It remains that we do not observe other cost components for either production of roast coffee or the intermediation of green coffee. One approach in the literature is to suppose the former set of costs can be proxied by labor costs as measured by wage or earnings indices – see, for example, Durevall (2006). We experimented with this approach but with little success. Our preference is therefore to model these costs as flexible functions of time, on the basis that they are likely to evolve much slower than the price of world price of coffee itself which is notoriously volatile. It remains possible that estimates of the coffee pass-through coefficient may suffer from omitted variables bias but this supposes that the unmeasured cost variables are correlated with the coffee price. This seems unlikely.

On the retail side, the basic estimating equation

[8] Parsley and Wei (2007) relate the price of Big Macs to eight cost components using a panel of 34 major world cities using a linear specification as here. They note the importance of non-food inputs, in particular labor, in the overall Big Mac price.

[9] The interpretation of results of previous studies is made more difficult by the fact that a number of authors do not state whether they are using prices in levels or logarithms. This is true of both Krivonos (2004) and Shepherd (2004). Leibtag *et al* (2007) follow standard practice in using a logarithmic pass-through specification but correctly note that this can give rise to problems. They record (p.11) that both the mark-up of prices over marginal costs and the "wedge" between the coffee price and marginal cost arising from the presence of other variable inputs imply that "full pass-through, in percentage terms, differs substantially from cent-to-cent pass through".

$$p^*_{jt} = m_{jt} q_{jt} + f^j(t) + u_{jt} \tag{11}$$

where $p^*_{jt} = \dfrac{p_{jt}}{(1+\tau_{jt})(1-\delta)}$, i.e. the retail price adjusted for weight loss in roasting and for taxation. Similarly, the basic estimating equation on the supply side is

$$r^*_{jt} = n_{jt} q_{jt} + g^j(t) + v_{jt} \tag{12}$$

where $r^*_{jt} = (1+\tau_{jt}) r_{jt}$, i.e. the tax-adjusted producer price. u_{jt} and v_{jt} are disturbances. We are interested in how the retail mark-ups m_{jt} and the producer mark-downs n_{jt} have evolved over time. We take the view that parameter changes of this sort are likely to be smooth, even when these result from policy changes such as market-liberalization. This motivates specification of the mark-up m_{jt} and the mark-down n_{jt} as logistic-type expressions

$$m_{jt} = (1+\alpha_{j2})(1+e^{-\alpha_{j1} t}) \tag{13}$$

$$n_{jt} = \frac{1-\beta_{j2}}{1+e^{-\beta_{j1} t}} \tag{14}$$

If $\alpha_{j1} = 0$, the retail mark-up in country j ($m_{jt} - 1$) is constant at $2(1+\alpha_{j2}) - 1 = 1 + 2\alpha_{j2}$, and similarly if $\beta_{j1} = 0$, the producer mark-down in country j ($1 - n_{jt}$) is constant at $1 - \frac{1}{2}(1-\beta_{j2}) = \frac{1}{2}(1+\beta_{j2})$. A positive value for α_{j1} implies that the country j retail mark-up declines asymptotically to α_{j2} while a positive value for β_{j1} implies that the country j producer mark-down declines asymptotically to β_{j2}.[10] If in turn $\alpha_{j2} = 0$ (respectively $\beta_{j2} = 0$), the retail (producer) market is asymptotically perfectly competitive.[11]

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[10] The natural generalization of the logistic here might appear to be $m_{jt} = (1+\alpha_{j2})(1+e^{\alpha_{j0}+\alpha_{j1} t})$ and $n_{jt} = \dfrac{1-\beta_{j2}}{1+e^{-(\beta_{j0}+\beta_{j1} t)}}$. The restrictions $\alpha_{j0} = 0$ and $\beta_{j0} = 0$ imply that we are positioning the point of inflexion of the logistic at the pre-sample observation. In practice, α_0 and β_0 are poorly identified and free estimation often failed to give convergence.

[11] In the case that $\alpha_{j1} = 0$ (respectively $\beta_{j1} = 0$), perfect competition corresponds to the value $\alpha_{j2} = -1$ ($\beta_{j2} = -1$). To maintain constancy of interpretation, conditional on acceptance of the hypothesis $\alpha_{j1} = 0$, we modify equation (13) to $m_{jt} = 1 + \alpha_{j2}$, and similarly, conditional on acceptance of the hypothesis $\beta_{j1} = 0$, we modify equation (14) to $n_{jt} = 1 - \beta_{j2}$.

We estimate using annual data on the basis that our focus is on the evolution of retail mark-ups and producer mark-downs over time and that these may be confused by price dynamics in higher frequency data. Our analysis therefore contrasts with much of the recent literature which uses monthly nor quarterly price data to examine issues of speed of transmission and symmetry of response (i.e. are upward price movements faster than downward) on which we are silent.[12] We have already noted the claim that roasters may attempt to smooth retail prices over the short term, resulting in long and possibly variable lag relationships with higher frequency data. We further note the likely presence of seasonality in the relationship between producer prices and world coffee prices. Use of annual data substantially reduces these complications.

The estimated retail mark-up and producer price mark-down functions allow the Lerner Indices L_{jt} and M_{jt} to be inferred directly. These indices may be interpreted as measuring the impact of monopoly and monopsony power respectively. Those impacts depend on two factors – the extent to which output of purchase reductions by one firm are offset by other firms (θ_{jt} and φ_{jt} for the monopolist and monopsonist respectively), and the elasticity of the demand and supply (η_{jt} and ε_{jt}) facing the actors. Looking at the Dutch retail coffee market, Bettendorf and Verboven (2000) assume that the output elasticity θ_{jt} is constant over time but that the demand elasticity η_{jt} is time-varying. We make the reverse assumption on the basis first that we are interested in analyzing the evolution of monopoly power over time and second because both demand and supply elasticities are poorly determined in the data and show little evidence of change over time.[13] This allows us to infer time-varying estimates of the monopolistic and monopsonistic conduct variables θ_{jt} and φ_{jt}.

It is worth commenting again on the simplification resulting from the presence of terminal markets for these two products. Coffee roasters typically blend beans from a number of different origins in order to obtain the taste they seek. Blends may vary over time reflecting changes in the

[12] Bettendorf and Verboven (2000), Feuerstein (2002), Krivonos (2004), Shepherd (2004), Durevall (2006) and Leibtag *et al* (2007).

[13] Contrast Genesove and Mullin (1998) who estimate time-varying price elasticities for U.S. sugar demand. Corts (1999) argued that time varying conduct parameters like θ_{jt} and φ_{jt}. will be endogenous and estimate "average conduct parameters" may therefore be inconsistent. Although we specify as time-varying, the variation is deterministic The Corts problem therefore does not arise in our context.

prices and qualities of beans from different origins. Correspondingly, coffee-producing countries export to many different countries. Absent terminal markets, we would be obliged to compare retail prices in each consuming market with producer prices in each origin. The microeconomic theory in relation to firms buying from and selling into a range of different markets is unclear. It might conceivably be possible to identify the degree of monopoly and monopsony power in each market if we knew the trade matrices linking exporters to consumers, but the task would be complex and, without a clear theoretical framework, the results would be difficult to interpret. The presence of terminal markets in coffee allow us to cut through these problems to obtain clear and interpretable results.

4. Econometric analysis – retail coffee prices

We apply the theory developed in section 3 to eight major coffee-consuming countries. The pricing model is given by equations (11) and (13). We generalize these equations slightly to allow terminal market prices to affect retail prices with a one year lag. The resulting estimation equations are

$$p^*_{jt} = \left(1+\alpha_{j2}\right)\left(1+e^{-\alpha_{j1}t}\right)\left[\alpha_{j3}q_{jt} + \left(1-\alpha_{j3}\right)q_{j,t-1}\right] + \alpha_{j4} + \alpha_{j5}t + \alpha_{j6}t^2 + u_{jt} \qquad (15)$$

u_{jt} is an error term. For certain countries, we add a number of additional variables (log exchange rate changes, log changes in GDP growth, real wage levels and log changes in real wages) to eliminate error autocorrelation. For the UK the coefficient α_1 in equation (15) was estimated as negative implying an exponentially increasing Lerner Index. We therefore modify equation (15), for the UK only, to

$$p^*_{jt} = \left(1+\alpha_{j2}\right)\left(1+e^{-\frac{\alpha_{j1}}{t}}\right)\left[\alpha_{j3}q_{jt} + \left(1-\alpha_{j3}\right)q_{j,t-1}\right] + \alpha_{j4} + \alpha_{j5}t + \alpha_{j6}t^2 + u_{jt} \qquad (16)$$

The parameters of interest are α_{j1} $\alpha_{j2}$and α_{j3}. The remaining parameters may be regarded as nuisance parameters. Estimation is by nonlinear least squares. The hypothesis $H_{j0}:\alpha_{j1}=0$ tests whether monopoly power is constant over time in country *j*. If that hypothesis is accepted, the model becomes linear. The hypothesis $H^*_{j0}:\alpha_{j2}=0$ tests whether monopoly power is tending to zero in country *j*. Failure to reject both H_{j0} and H^*_{j0} implies that market in country *j* was

competitive, in the sense that no firm exercised monopoly power, over the sample period. All tests are based on the likelihood ratio.

We take the world prices q_{jt} as the ICO Composite Price Index, which is measured in current US dollars, converted into national currency using average dollar exchange rates and deflate by national GDP deflators. Retail prices p_{jt} are also reported by the ICO in current US dollars. We convert these to national currency using the same exchange rates and deflators. Tax rates for the six European Union countries are taken from European Commission (2007). These have varied considerably over the sample period 1980-2005. Feuerstein (2002) gives details of the additional coffee excise tax in Germany. The Japanese tax rate is taken as constant at 5%. The US tax rate is problematic since indirect taxes are determined at state, county and city level rather than on a federal basis. Since, it is beyond the scope of this paper to estimate an average US coffee tax rate time series, we set this rate to a uniform value of 5%. Conversion of the retail prices p_{jt} to the measure p_{jt}^{*} required by the specification (13) also requires an estimate of the roasting loss factor δ which we take to be constant at one sixth (16.7%).

Estimation results are reported in Table 1. Equation fit is generally good, the two exceptions being the equations for Italy and Japan. The data fail to reject the hypothesis $H_{j0}:\alpha_{j1}=0$ (column 1) for Italy, Sweden and the USA. As already noted, the UK shows a rising margin. For the remaining four countries, evidence is consistent with the view that the margin appears was constant over the sample period. The data reject the hypothesis $H_{j0}^{*}:\alpha_{j2}=0$ (column 2) for Italy, the Netherlands, Sweden and the UK. Taken in conjunction with the results on H_{j0}, this implies constant unit pass-through for France and Germany, and pass through tending asymptotically to unity for the USA. The estimated $\hat{\alpha}_{j2}$ coefficients are positive for both the Netherlands and Sweden, implying a constant and greater than unit pass-through, but negative for Italy suggesting a less than unit pass-through, at least asymptotically. These results are confirmed by the joint test of the two hypotheses (column 3) except for Japan and Sweden where the joint hypothesis is rejected despite failure to reject either H_{j0} or H_{j0}^{*} individually. In Japan, we elect to set $\alpha_{j1}=0$ but to leave α_{j2} unrestricted on the basis of superior fit while in the

Sweden, the fit criterion implies α_{j1} unrestricted but $\alpha_{j2} = 0$. The result is that Japan is seen as sharing the feature of a constant and greater than unit pass-through with the Netherlands while Sweden is classified with the USA as witnessing pass-through declining towards unity. Estimated coefficients for the resulting restricted specifications are given in columns 5-7 of the table. (We postpone discussion of the test outcomes reported in column 4 to the end of this section).

Our interest is in the estimated pass-through $\hat{m}_{jt} = \left(1+\hat{\alpha}_{j2}\right)\left(1+e^{\hat{\alpha}_{j1}t}\right)$ which may be interpreted as one plus the monopolistic margin. These are estimated as constant for six of the eight countries but non-constant in Italy, Sweden and the UK and the USA. Table 2 expresses the estimated margins in terms of the Lerner Index. The countries fall into four groups:

a) France, Germany and the Netherlands: The Lerner Indices are seen as constant at, or slightly above, zero,
b) Sweden and the USA: The table shows the average value of the Lerner Indices over the entire sample and the estimated values in the initial and final five year periods. The indices are seen as declining, moderately in Sweden but dramatically in the USA.
c) Japan and the UK: These two countries show very high Lerner Indices, estimated as constant in Japan but increasing in the UK.
d) Italy: The estimated margin is negative which is incompatible with the model. The Lerner index cannot be calculated.[14]

Interpreted in relation to the model developed in section 6, the results reported in Tables 1 and 2 show that coffee roasters have been able to exert no or very little monopoly power in France and Germany and only modest amounts in the Netherlands and Sweden.[15] However, monopoly power appears to have been and to remain considerable in Japan and the UK. It is perhaps relevant that both are traditional tea-drinking countries with no tradition of local roasters. The

[14] De Fraja and Staderini (1996), who estimated Bertrand and collusive models for the Italian market in roasted coffee, were also unable to find interpretable coefficients linking the international coffee price to Italian retail prices.

[15] Our estimated Lerner Index for the Netherlands is almost identical to the Bettendorf and Verboven (2000) estimate of 0.069 on the basis of a quadratic demand function but lower than their estimates based on either linear or log-linear demand. Durevall (2004) reports a Lerner index of 0.10 for Sweden, close to our estimate. Roberts (1984) estimated the Lerner Index for the USA at 0.06, lower than our estimate for that time.

USA shows an initial modestly high element of exercised monopoly power being eroded over the period we have examined, with the result that the US coffee market appears now to be as competitive as those in continental Europe.

As underlined in section 3, the model summarized in equation (15) is based on the hypothesis that developed country coffee roasters need only concern themselves with the world price of coffee, which we have taken as the ICO Composite Index, and not the producer prices at origin. It is important to test this hypothesis. The complication is that there is a large number of origins each with different producer prices. The task of checking whether the retail price in each consuming country is independent of the producer price in each origin would be complicated and subject to data-mining concerns. We have simplified by taking the leading principal component of eight dollar producer prices to be analyzed in section 6 and which are available over the entire sample period. This component is then converted into the currency unit of the consuming country and deflated by the local CPI. This gives a set of eight producer price components π_{jt}, one for each consuming country, expressed in terms of national units.[16] Equation (17) augments the earlier model (15) with the current and lagged values of these components.

$$\begin{aligned} p_{jt}^{*} = &\left(1+\alpha_{j2}\right)\left(1+e^{-\alpha_{j1}t}\right)\left[\alpha_{j3}q_{jt}+\left(1-\alpha_{j3}\right)q_{j,t-1}\right]+\alpha_{j4} \\ &+\alpha_{j5}t+\alpha_{j6}t^{2}+\alpha_{j7}\pi_{jt}+\alpha_{j8}\pi_{j,t-1}+u_{jt} \end{aligned} \tag{17}$$

The specification is tested by the likelihood ratio test of the hypothesis $H_0^{**}:\alpha_{j7}=\alpha_{j8}=0$.[17]

Test results are reported in the fourth column of Table 1. The data fail to reject H_0^{**} in seven of the eight countries considered, the exception being Germany. (The result is borderline for Italy and the UK). The test outcomes are emphatic for four countries – France, Japan, Sweden and the USA. We interpret this outcome as generally favorable to the modeling strategy but note that caution is required in interpreting the result for Germany.

[16] This excludes the Brazilian robusta producer price and the Vietnamese price which are only available for sub-periods. Prices are deflated by the US Producer Price Index (all items). As is to be expected, the first principal component is simply a weighted average of the eight prices. The weights are Brazil (arabica) 18.7%, Colombia 16.6%, Côte d'Ivoire 19.6%, Guatemala 9.9%, Indonesia 9.9%, Kenya 6.2%, Tanzania 9.5% and Uganda 9.5%. The national prices π_{jt} are calculated by scaling the dollar principal component by the ratio of the US producer price index to the national CPI.

[17] The tests are performed on equations simplified as the result of the outcome of earlier hypothesis tests.

5. Market power in coffee roasting

Equation (3) shows that the margins listed in Table 2 may be seen as resulting from two factors: the extent θ to which different roasters follow each others output decisions and the demand elasticity η. The former parameter in effect measures the extent of monopoly and the latter the potential for monopolistic price rises. A high monopolistic margin is the consequence of effective monopolistic coordination in conjunction with a low demand elasticity. To proceed, we therefore need estimates of the demand elasticities η_j.

Coffee consumption is not precisely measured at a national level, but the ICO publishes figures on "disappearances" derived from import statistics. Note that no developed country is a significant coffee producer.[18] Disappearances differ from consumption as the result of unobserved stock movements. On an annual basis, these are likely to be small but there is a danger that stock dynamics might result in residual serial correlation in estimated demand equations.

We estimate demand elasticities by logarithmic regression of disappearances D_{jt} on retail prices $\tilde{p}_{jt}$ converted into national currency and deflated by the national consumer price index (CPI).[19] Trends in coffee consumption are captured through a quadratic time trend. Conditional on inclusion of this trend, we have been unable to obtain an estimate of the impact of income (measured by real GDP), suggesting that coffee consumption in mature coffee-drinking economies is driven by advertising more than income levels.[20] The disappearance equations take the form

$$\ln D_{jt} = \gamma_{jo} + \gamma_{j1} \ln \tilde{p}_{jt} + \gamma_{j2} t + \gamma_{j3} t^2 + v_{jt} \qquad (18)$$

The demand elasticities η_j are estimated by the coefficients γ_{j1}. As with the price equations (15), we include other variables to eliminate residual serial correlation. Estimation is by Instrumental

[18] There is a small volume of US production in Hawaii.

[19] The prices p_{jt} in the results reported in Tables 1 and 2 are deflated by the GDP deflator as a measure of processing costs throughout the entire national economy. Here we use the CPI to reflect comparison with the more restricted consumption basket.

[20] Vogelvang (1988) reports the same result. We also experimented using real consumers' expenditure with similar results.

Variables (IV) to allow for possible endogeneity of the prices $\ln \tilde{p}_{jt}$ (except for Italy where the price enters with a one year lag).[21]

The estimated demand elasticities are reported in Table 3. The elasticities are generally well determined, exceptions being those for Italy and the Netherlands. There is evidence of serial correlation in the equations for Italy and Japan with the statistic for France taking a borderline value. As noted above, this may reflect unmeasured stock dynamics. The Sargan instrument validity test is satisfied at the 5% level for all seven IV equations, although the statistic for the U.S. equation is borderline. All equations are structurally stable implying that there is little basis for inferring any change in demand elasticities.[22]

We may use the estimated demand elasticities from Table 3 to calculate the parameters θ_j which measure the extent to which roasters' production decisions tend to be associated. We can do this either using the estimated elasticity for each country or using the median elasticity across the sample of countries (0.17) on the basis that none of the estimated elasticities differ significantly (on an individual basis) from the median. The resulting estimates of the extent of roaster monopoly power are given in Table 4.

Estimated roaster monopoly power in continental Europe is seen as zero or very low.[23] By contrast, there appears to be higher levels of monopoly power in Japan, Sweden and the UK.[24]

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[21] Instruments are $\ln q_{jt}$, $\ln q_{jt-1}$, $\ln r_{jt}$ and $\ln r_{j,t-1}$ where r_{jt} is the ratio of the CPI to the GDP deflator in country j, year t.

[22] These elasticity estimates our comparable to those reported in other studies. The US elasticity is the most precisely determined at 0.22, very close to the value of 0.25 reported by Roberts (1984). The estimate for Germany of 0.34 exceeds that of 0.18 in Feuerstein (1988) while the estimate for the Netherlands of 0.16 is slightly lower than that given by Bettendorf and Verboven (2000), but in neither case is the difference statistically significant. Using quarterly data from 1972 (or 1976, depending on the country) Vogelvang obtained somewhat higher estimates as did Herrmann (1986) and Akiyama and Varangis (1990), using annual data. The median estimate is very close to the estimate of 0.186 reported by Akiyama and Duncan (1982) and that of 0.237 reported by Adams and Behrman (1976), both using rather earlier samples.

[23] Bettendorf and Verboven (2000) report a number of conduct estimates for the Netherlands, depending on the demand specification. The estimate given here for the Netherlands is close to the lowest of their estimates which derives from a quadratic demand specification.

[24] The estimates of the conduct parameter for Sweden are somewhat higher that of 0.040 reported by Durevall (2004).

The estimated extent of monopoly power in the USA at the start of the sample is comparable to that in the UK and Sweden but now appears to have declined to continental European levels. Roasters in the non-traditional markets of Japan and the UK appear to retain significant monopoly power.

Other things being equal, a high degree of monopoly power will tend to imply a higher roaster margin and hence a lower value share for coffee in the retail price. Importantly, however, the value share will also be influenced by the processing costs which may differ across countries, both because of differences in the prices of factors and other inputs and because of adoption of different processing technologies – see Gilbert (2007). Table 5 lists the ratio of the ICO Indicator Price to the retail price (converted into US dollars) for each of the countries considered. The ratios are much lower for Japan and the UK than for the remaining six countries. The share has fallen across all eight countries over the sample, averaging 42.8% in the group of six traditional coffee-consuming countries over 1980-84 and 18.9% over 2001-05. There is a moderately strong inverse correlation between the shares, averaged over the entire period but this correlation becomes positive if Japan and the UK are excluded. The only reliable conclusion from these correlations is therefore that the coffee value shares in Japan and the UK differ from the traditional coffee consuming countries. It is notable that these two countries have the lowest coffee value shares and are also the only countries in which estimated pass-through is substantially above unity. Although it is possible that the low British and Japanese coffee value shares are partly a consequence of extra costs arising from the production and retailing of coffee in soluble and liquid rather than roasted form, the results also suggest the these low shares are, at least in part, due to the exercise of monopoly power.

Previous academic studies of coffee roasting have failed to look at non-traditional coffee consuming markets. Brand power is the single source of monopoly power in traditional markets for roast coffee and one may conjecture that this power is limited by the possibility of non-brand competition, perhaps most obviously from small locally-based roasters. By contrast the technologies underlying the British soluble market and the Japanese market for processed coffee are both subject to economies of scale which will reinforce brand power and limit the potential

challenge from fringe roasters.[25] While the findings of this study are, by themselves, insufficient to warrant the assertion that roasters do exert significant monopoly power in non-traditional coffee markets, they do suggest that this hypothesis should be examined in greater depth.[26]

The discussion in Oxfam (2002), Robbins (2003) and Daviron and Ponte (2005), reviewed in section 1, suggests that roaster monopoly power may be one factor which accounts for the low coffee price during the "coffee crisis" years (1999-2003). At one level, this suggestion is incorrect. We have found that, with the exception of the UK, roaster monopoly power remained constant or declined over the two and a half decades from 1980. Had this not happened, prices would have been even lower during the coffee crisis. Despite this, it is worth asking how much higher prices would have been if retail markets had been completely competitive. This calculation indicates that, total disappearances, summed over the eight consuming countries we have considered, would have been on average 4.9% higher over the period 2001-05. Using the median estimated consumption and production elasticities calculated here and in section 6 (below), the world price would have needed to be 12.9% higher on average to meet this additional demand. Although this would have generated useful extra revenue for coffee farmers, the calculation should be put into context by noting that over 2001-05 the ICO Indicator Price (deflated by the US Producer Price Index) averaged just 32% of its average over the final five complete years of ICO controls (1984-88).

6. Econometric analysis – producer prices

We now apply the theory developed in section 3 to nine major coffee exporting countries. The determination of retail coffee price and issues of possible monopoly have received considerable attention from economists over the past two decades. Much less attention has been devoted to the same issues in producer countries.[27]

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[25] This is at variance with that reached by MMC (1991) with respect to the UK. Oxfam (2002, p.26) records "For Nestlé, the rich markets of the UK and Japan are particularly important".

[26] An important extension of this work would be to be look for evidence of asymmetries in price responses. Feuerstein (2002) finds that German retail coffee prices adjust faster upwards than downwards, but Leibtag *et al*. (2007) arrive at the opposite conclusion for US prices. If retail prices are slower to fall in response to declining green coffee prices than to rise when the world coffee price goes up, this would indicate an ability to exercise monopoly power in the short run.

[27] Exceptions are Lopez and You (1993) who quantify the exercise on monopsony power in the Haitian coffee sector and Moss and Guerra Golinda (2001) who look at market power in Mexico. Krivonos

The empirical model follows the same lines as those pursued for the retail market in section 4. As in that case, the analysis relies on the premise that coffee futures markets separate the producer and the retail market – see section 2. In the producer context, this implies that exporters need only concern themselves with world (terminal market) prices and that, conditional on that information, retail prices are irrelevant. Combining equations (12) and (14), we model the tax-adjusted producer price $r^*_{jt} = \left(1+\tau_j\right) r_{jt}$ in country *j*, year t, as

$$r^*_{jt} = \frac{1-\beta_{j2}}{1+e^{-\beta_{j1} Lib_{jt}}}\left[\beta_{j3} q_{jt} + \left(1-\beta_{j3}\right) q_{j,t-1}\right] - \beta_{j4} + v_{jt} \qquad (19)$$

where v_{jt} is an error term and q_{jt} is the terminal market price expressed in terms of local currency divided by one plus the rate of export taxation τ_{jt} in country *j*, year *t*. The variable Lib_{jt} is defined and discussed below. The parameters of interest are β_{j0}, β_{j1}, β_{j2} and β_{j3}. The remaining parameters may be regarded as nuisance parameters. As in the retail case, estimation is by nonlinear least squares. The hypothesis $H_{j0} : \beta_{j1} = 0$ tests whether monopsony power is constant over time in country *j*. If that hypothesis is accepted, the model becomes linear. The hypothesis $H^*_{j0} : \beta_{j2} = 0$ tests whether monopsony power is tending (for positive β_{j2}) to zero in country *j*. Failure to reject both H_{j0} and H^*_{j0} implies that market in country *j* was competitive, in the sense that no exporter exercised monopsony power, over the sample period.

We consider two alternative approaches to modeling market liberalization.

a) Krivonos (2004, appendix) provides a summary of the liberalization process in a number of major coffee exporting countries. We use that information to identify a single date for each country which corresponds to the most important changes.[28] Our first candidate for the liberalization dummy $Lib1_{jt}$ is zero prior to that date, 0.5 in the year of the change, and one thereafter. A second candidate $Lib2_{jt}$ augments by one every year after the change.

(2004) and Shepherd (2004) both consider the effects of coffee market liberalization on price transmission across a range of producer countries using a VAR-based approach.

[28] Brazil 1990, Colombia 1995, Kenya 1993, Tanzania 1994, Uganda 1992. We augment this list by Côte dc'Ivoire, 1999. We are not aware of any liberalization in Guatemala or Vietnam while the market in Indonesia has always been liberal.

b) Market liberalization is often a complex and not necessarily unidirectional process. It may therefore be difficult to assign precise dates to liberalization in the way suggested above. Jarmillo (1990) has suggested that pricing behavior may have changed after the 1989 ending of ICO controls. Prior to 1989, producing country governments had an incentive to restrict production in line with ICO export quotas, implying a relatively low producer price. Post-1989, governments will have wished to encourage production requiring a higher price – see also Bohman and Jarvis (1990). This motivates our third candidate for the liberalization dummy $ICO1_{jt}$ is zero prior to 1989, 0.5 in 1989 itself,[29] and one thereafter. A second candidate $ICO2_{jt}$ augments by one every year after 1989.

The ICO publishes data on dollar producer prices in coffee exporting countries. It is not always entirely clear what these prices represent. In regulated environments, these will have been official prices or official minimum prices although in practice such prices were often regarded as maxima and hence may exaggerate the prices farmers actually obtained. In free markets, prices will differ across different regions depending on transport costs, bean quality etc. Furthermore, it is possible that markets are competitive in major producing zones but much less so in remote or less important localities. Official producer prices cannot reflect this diversity. However, these are the only prices available on a consistent aggregate basis, so it is these, converted into local currency and deflated by the national GDP deflator, that we analyze.

As in section 4, we take world prices from the ICO but here differentiate between arabica and robusta prices. The ICO publishes a single robusta price index and we use this for the five robusta producers we consider. There are however, three arabica price indices – those for Brazilian and Other Naturals, Colombian Milds and Other Milds. We use the ICO Colombian Milds Index for Colombia, the Other Milds Index for Guatemala, Kenya and Tanzania and, after some experiment, the ICO Composite Index for Brazil.[30]

In order to estimate equation (19) we require a set of tax rates τ_{jt}. There does not appear to be either a common framework or any comprehensive and consistent set of measures of taxation in

[29] "Independence Day" for coffee (the ending of ICO controls) was 4 July 1989.
[30] The ICO Brazilian and Other Naturals Index is not based on a futures quotation. It may be less representative that the other ICO indices.

coffee-producing countries. For example, some authors regard the entire difference between the fob price and the producer price as taxation on the basis that, where there were state-run marketing boards or similar arrangements, government was able to capture the entirety of that wedge – see, for example, Bohman and Jarvis (1999). However, this is to ignore intermediation costs, which can be significant, and aggregates taxation with monopsony profits which will accrue to different actors in a market-based regime.

To overcome this lack of information, we estimate tax rates by regressing the logarithm of government tax revenues on the logarithm of revenues from coffee exports. The resulting regression coefficients may be interpreted as marginal tax rates.[31] The estimated rates range from 2.6% in Indonesia to 37.7% in Uganda. Brazil provides the median rate of 16.0%. Our estimation procedure is insufficiently precise to allow investigation of time varying rates. We therefore assume constancy across the sample despite some evidence that tax rates may have fallen after the 1989 end of ICO controls – see Jarmillo (1990) and Bohman and Jarvis (1999).

Table 6 reports estimates of the producer price equations (18) in the same form as those for the retail price equations in Table 1. Considering first the liberalization variables, which were selected on the basis of best fit, the country-specific time trends were preferred only for Tanzania and Uganda, while for Colombia, Guatemala, Kenya and Côte d'Ivoire, the important shift appears to have taken place in 1989 with the ending of ICO controls, as argued by Jarmillo (1990).

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[31] National currency Government tax revenues T_{jt} (source: IMF, *International Financial Statistics*) were deflated by the national CPI. Dollar coffee export revenues X_{jt} (source: FAO, *Trade Database*) were converted into national currency using annual average exchange rates and also deflated by the CPI. GDP volume Y_{jt} was used as a control. (Because coffee comprises a substantial share of GDP in some of the countries considered, this may result in an underestimate of tax rates). The regression took the form

$$\ln R_{jt} = \lambda_{j0} + \sum_{i=0}^{2} \lambda_{j1i} \ln X_{j,t-i} + \sum_{i=0}^{2} \lambda_{j2i} \ln Y_{j,t-i} + z_{jt}$$

where z_{jt} is an error term. The marginal tax rate is given by $\sum_{i=0}^{2} \hat{\lambda}_{j1i}$. The regression required at most two X and Y terms so at least one λ_{j1i} and λ_{j2i} were set to zero. Sample: 1980-2000 except Brazil (1980-98), Tanzania (1989-2000) and Uganda (1983-2000). Estimated tax rates (standard errors in parentheses): Brazil 16.0% (9.2%), Colombia 11.8% (6.7%), Guatemala 32.1% (14.1%), Indonesia 2.6% (4.6%), Kenya 14.6% (7.9%), Tanzania 34.3% (29.5%) and Uganda 37.7% (17.0%) Data were insufficient to allow estimation for Côte d'Ivoire (we substitute the estimated rate for Kenya) and Vietnam (we use the estimated Indonesian rate).

The coefficient β_{j3} is set to zero in those cases in which the unrestricted estimate exceeds unity (in each case, this is by a small and insignificant amount). Equation fit is perhaps best describes as adequate, the weakest equation being that for Uganda (residual serial correlation). We only fail to reject the hypothesis $H_{j0}:\beta_{j1}=0$ (column 1) for Guatemala. The positive estimated values of β_{j1} reported in column 5 show that pass-through has increased over the sample period for the remaining nine countries. We reject the hypothesis $H^{*}_{j0}:\beta_{j2}=0$ (column 2) in three instances: Guatemala and Côte d'Ivoire, where the estimated β_{j1} coefficient is negative (column 6) implying a tendency towards less than full pass-through, and Kenya, where the reverse is the case. The positive value for Kenya is difficult to reconcile with the theory set out in section 6. One possibility is that the premium obtained by Kenyan producers varies pro-cyclically.[32]

We follow the same procedure as in the case of the retail prices to test the maintained hypothesis that, conditional on world prices, producer prices are independent of retail prices in consuming countries. We take first principal component of the US dollar retail prices for the eight consuming countries considered in section 4 deflated by the US Producer Price Index (all items), and then convert this into national currencies at current exchange rates.[33] The resulting equation is

$$r^{*}_{jt}=\frac{1-\beta_{j2}}{1+e^{-\beta_{j1}t}}\left[\beta_{j3}q_{jt}+\left(1-\beta_{j3}\right)q_{j,t-1}\right]-\beta_{j4}+\beta_{j5}\pi_{jt}+\beta_{j6}\pi_{j,t-1}+v_{jt} \qquad (20)$$

The test reported in the fourth column of Table 6 is the likelihood ratio test for exclusion of the current and one year lagged values of this component, i.e. $\beta_{j5}=\beta_{j6}=0$. At the 5% level, the test gives rejections for Guatemala, Kenya and Vietnam. We have not been successful in isolating any common pattern which might account for these rejections.

[32] Kenyan arabica is classified as an "Other Mild" but it often fetches a price which differs markedly from those of Central American milds. This may because the bulk of Kenyan coffee is sold in northern Europe where it faces limited competition from other origins.

[33] Weights are France 12.1%, Germany 11.8%, Italy 15.3%, Netherlands 17.2%, Sweden 15.3%, UK 5.9% and USA 22.3%. Japan was excluded because the series is not available over the entire sample.

We can use the estimated coefficients from Table 6 to calculate Lerner Indices, albeit in this case with respect to monopsony and not monopoly power. The results, reported in Table 7, show a decline in apparent monopsony power in all those countries considered with the exceptions of Guatemala, where the index is constant, and Kenya, where it is not defined. As discussed above, caution is necessary in the interpretation of these indices since they could reflect unmeasured reductions in taxation rather than changes in monopsony power. Nevertheless, the results indicate that, whatever the ancillary problems to which coffee market liberalization may have given rise (see Akiyama, 2001), it has been broadly successful in creating more competitive conditions for exporters.[34]

7. Market power in coffee purchasing

The Lerner Indices listed in Table 7 show the impact of the exercise of monopsony power, broadly defined, in squeezing down producer prices. As in the case of the retail market, we may split this effect into two components: the extent to which exporters actively compete with each other for supplies, measured by the parameters φ_j, and the supply elasticities ε_j, which translate these purchasing reductions into price declines.

This exercise requires a set of supply elasticities. As with the demand elasticities, we adopt a simple double logarithmic specification relating the logarithm of production x_{jt} in country j, year t, to the logarithm of the local currency producer price p_{jt} deflated by the national CPI. The specification is

$$\ln x_{jt} = \delta_{jo} + \delta_{j1} \ln p_{jt} + \delta_{j2} \ln x_{j,t-1} + \delta_{j3} t + \xi_{jt} \qquad (21)$$

where ξ_{jt} is an error term. The specification allows for trend increase or decrease in production not related to prices and for the possibility that current production is influenced by the previous year's production.[35]

[34] This accords with the conclusions reached by Krivonos (2004) but is contrary to those of Shepherd (2004).

[35] Coffee trees can become exhausted after a large crop resulting in negative autocorrelation in production levels. This is apparent in the estimated Brazilian production equation reported in Table 8. A positive coefficient (Colombia, Uganda) may either represent partial adjustment or indicate possible misspecification.

Estimation results are reported in Table 8. Equation fit is only modest (poor for Indonesia and Vietnam) and the elasticities are measured imprecisely. Nevertheless, there is no evidence of serial correlation nor of any structural break and the estimated elasticities are in line with those reported elsewhere in the literature. The median elasticity of 0.209 corresponds to the identical estimate obtained for Colombia and Uganda.

The apparent constancy of supply elasticities over the period of our sample implies that the general decline in the Lerner Indices reported in Table 7 should be attributed to a decline in the extent to which producers match each other's purchase decisions, i.e. to the parameters φ_j in equation (6). These are listed in Table 9 calculated both on the basis of the country's own price elasticity and on that of the median. In view of the imprecise character of the estimated elasticities, we concentrate on the second set of estimates. These show a general rise in competitiveness in coffee purchasing over the past two decades, with the markets in Brazil, Tanzania and Uganda seen as being close to perfectly competitive. Broadly defined monopsony power remains high in Côte d'Ivoire and, to a lesser extent in Colombia, Guatemala and Vietnam. These are all countries in which government (or parastatal agencies) maintain a significant role in setting producer prices.

Table 10 lists the producer shares in the relevant ICO prices indices over the same periods. These shares have risen, in some cases dramatically, in all countries considered except Tanzania and Vietnam. The correlation between these shares and the estimated extent of exporter monopsony power is stronger than the corresponding correlation on the retail side. The strongest correlation (r = - 0.71) results from taking the producer shares over the entire available period and relating these to monopsony power estimated over the entire period using a common supply elasticity. The cross plot, which is shown in Figure 1, has Brazil in the top left corner (high producer share, low monopsony power) and Côte d'Ivoire in the bottom right (low producer share, high monopsony power). There are no strongly influential observations. It is notable that the two countries where growth in production has been fastest (Brazil and Vietnam) both appear to have low monopsony power and high producer shares.

8. Conclusions

The contributions of this paper are both methodological and substantial. There are three methodological contributions. The first is to underline that, in the standard case in which only incomplete cost information is available, it is pass-through, not value shares, that are informative about the extent of monopoly and monopsony power. Second, pass-through regressions should be linear in levels, not in logarithms. This lesson is implicit in the discussion in both Bettendorf and Verboven (2003) and Leibtag *et al.* (2007) but many other contributors to this literature appear to have ignored it. Third, we have argued that it is the existence of terminal markets, reinforced by the coexistence of liquid futures markets, which makes it possible to independently analyze the retail and producer markets. We have also shown how this assumption may be tested. The tests show that the separation is reasonable for most, but not all, retail and producer markets.

At the substantive level, we find that the market for roasted coffee in traditional coffee consuming countries in the developed world appears highly competitive, and the degree of competition has been increasing over the most recent decades. This is most clearly the case in the United States, the largest market for roasted coffee, where the monopoly power which roasters enjoyed twenty years ago has been steadily eroded. These findings are in line with other recent academic and governmental studies of the coffee market. However, there are two exceptions which have not been noted in the literature, Japan and the UK, where there is evidence of substantial market power on the part of coffee manufacturers. It is notable that the share of green coffee in the retail price is particularly low in these two countries. This monopoly power has not been eroded over time and the evidence suggests that it has increased in the UK.

Previous studies of the retail coffee market have focused exclusively on traditional markets. The UK and Japan are both "tea culture countries" which lack a tradition of local coffee roasting. The competitive fringe is therefore likely to be smaller than in the traditional countries. Further, a higher proportion of coffee is retailed in a highly processed form – as soluble coffee in the UK and canned liquid coffee in Japan. It is possible that the technologies for producing these products exhibit greater economies of scale than does coffee roasting itself. Our results indicate that these non-traditional markets merit further research.

The producer side of the market is more complicated and has been less comprehensively studied. An important methodological issue arises in distinguishing between the exercise of monopsony power on the part of exporters for the extraction of private profit and the exercise of monopsony power on the part of governments or parastatal agencies for purposes of revenue raising and price stabilization. This difficulty complicates the interpretation of the econometric results. Despite this, there is clear evidence that extensive market liberalization in coffee-producing countries has tended to reduce the exercise of monopsony power however motivated or institutionalized. The markets in Brazil, Tanzania and Uganda appear now to be close to fully competitive although substantial monopsony power remains in other important markets, in particular Colombia, Côte d'Ivoire and Guatemala. Again, these results are in line with other recent research.

There is therefore little evidence that coffee consumers in the traditional coffee-consuming markets are being "mugged" (Oxfam, 2002), although this conclusion may not extend to non-traditional markets. On the producer side, coffee farmers remain at the mercy of their governments, but market liberalization does appear to have limited the extent to which farmers can be exploited. Low world coffee prices have not been caused by high roaster or export concentration, but complete elimination of roaster monopoly power would give a modest stimulus to both coffee consumption and price levels.

References

Adams, F.G., and J.R. Behrman (1976), *Econometric Models of World Agricultural Commodity Markets*, Cambridge (Mass.), Ballinger.

Akiyama, T. (2001), "Coffee market liberalization since 1990", in Akiyama, T., J. Baffes, D. Larson and P. Varangis eds., *Commodity Market Reforms: Lessons of Two Decades*, Washington D.C., World Bank.

Akiyama, T., and R.C. Duncan (1982), "Analysis of the world coffee market", *World Bank Staff Commodity Working Paper*, **7**, Washington D.C,, World Bank.

Akiyama, T., and P.N. Varangis (1990), "The impact of the International Coffee Agreement on producing countries", *World Bank Economic Review*, **4**, 157-73.

Bauer, P.T. (1954), *West African Trade*, Cambridge, Cambridge University Press.

Bettendorf, L. and F. Verboven (2003), "Incomplete transmission of coffee bean prices: evidence from the Netherlands", *European Review of Agricultural Economics*, **27**, 1-16.

Bohman, M. and L. Jarvis (1999), "The International Coffee Agreement: a tax on coffee producers and consumers?", *Working Paper* # 99-004, Department of Agricultural and Resource Economics, University of California, Davis.

Bresnahan, T.F. (1982), "The oligopoly solution concept is identified", *Economics Letters*, **10**, 87-92.

Corts, K.S. (1999), "Conduct parameters and the measurement of market power", *Journal of Econometrics*, **88**, 227-50.

Daviron, B., and S. Ponte (2005), *The Coffee Paradox*, London, Zed Books.

De Fraja, G. and A. Staderini (1996), "An empirical analysis of competition in brand differentiated oligopoly", *International Journal of the Economics of Business*, **3**, 57-67.

Durevall, D.J. (2006), "Competition in the Swedish coffee market, 1978-2002", available at http://ssrn.com/abstract=881746 .

European Commission (2007), *VAT rates applied in the member states of the European Community*, DOC/2137/2007 – EN, Brussels, European Commission.

Feuerstein, S. (2002), "Do coffee roasters benefit from high prices of green coffee", *International Journal of Industrial Organization*, **20**, 89-118.

Genesove, D., and W.P. Mullin (1998), "testing static oligopoly models: conduct and cost in the sugar industry, 1890-1914", *RAND Journal of Economics*, **29**, 355-77.

Gilbert, C.L. (1996), "International commodity agreements: an obituary notice", *World Development*, **24**, 1-19.

Gilbert, C.L. (2007), "Value chain analysis and market power in commodity processing with application to the cocoa and coffee sectors", *FAO Commodity Markets Review*, forthcoming.

Herrmann, R. (1986), "Free riders and the redistributive effects of the International Coffee Agreements: the case of coffee", *Journal of Policy Modeling*, **8**, 1-25.

Jarmillo, F. (1990), "Policy responses to the collapse of world coffee prices", Washington DC, World Bank.

Knudsen, O., and J. Nash (1990), "Domestic price stabilization schemes in developing countries", *Economic Development and Cultural Change*, **38**, 539-58.

Krivonos, E. (2004), "The impact of coffee market reforms on producer prices and price transmission", *Policy Research Working Paper*, **3358**, Washington DC, World Bank.

Leibtag, E., A. Nakamura, E. Nakamura and D. Zerom (2007), "Cost pass-through in the U.S. coffee industry", *Economic Research Report*, **38**, Washington D.C., USDA.

Lopez, R.A. and Z. You (1993), "Determinants of oligopsony power: the Haitian coffee case", *Journal of Development Economics*, **41**, 275-84.

McCorriston, S., C.W. Morgan and A.J. Rayner (1998), "Processing technology, market power and price transmission", *Journal of Agricultural Economics*, **49**, 185-201.

Monopolies and Mergers Commission (1991), *Soluble Coffee*, London, HMSO.

Moss, C.B., and G.A. Guerra Galindo (2001), "Quality differentiation and market power in the Mexican coffee market: theory and evidence", *Staff Paper*, **01-5**, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, processed.

Oxfam (2002), *Mugged – Poverty in Your Cup*, Oxford, Oxfam.
http://www.maketradefair.com/assets/english/mugged.pdf

Parsley, D.C. and S-J. Wei (2007), "A prism into the PPP puzzles: The micro-foundations of Big Mac real exchange rates", *Economic Journal*, **117**, 1336-56.

Roberts, M.J. (1984), "Testing oligopolistic behavior", *International Journal of Industrial Organization*, **2**, 367-83.

Robbins, P. (2003), *Stolen Fruit*, London, Zed Books.

Shepherd, B. (2004), "Market power in international commodity processing chains: preliminary results for the coffee market", Groupe d'Economie Mondiale, Instiut d'Etudes Politiques de Paris, processed.

Vogelvang, B. (1988), *A Quarterly Econometric Model of the World Coffee Economy*, Amsterdam, Free University Press.

Table 1
Retail Price Equation Estimates

	Hypothesis Tests				Coefficient Estimates			Statistics	
	$\alpha_{j1}=0$ χ^2_1	$\alpha_{j2}=0$ χ^2_1	$\alpha_{j1}=\alpha_{j2}=0$ χ^2_2	$\alpha_{j7}=\alpha_{j8}=0$ χ^2_2	$\hat{\alpha}_{j1}$	$\hat{\alpha}_{j2}$	$\hat{\alpha}_{j3}$	R^2	DW
France	1.02 [31.2%]	0.18 [67.3%]	0.97 [61.5%]	0.36 [83.4%]			0.395 (0.195)	0.964	1.86
Germany	2.48 [11.5%]	2.99 [15.8%]	3.03 [22.0%]	8.53 [1.41%]			0.591 (0.089)	0.981	1.95
Italy	15.5 [<0.01%]	27.0 [<0.01%]	31.6 [<0.01%]	5.94 [5.14%]	0 .161 (0.282)	-0.371 (0.211)	0.720 (0.107)	0.961	1.61
Japan	3.55 [5.96%]	3.25 [7.12%]	14.5 [0.01%]	1.30 [52.2%]		1.442 (0.439)	0.753 (0.186)	0.920	1.18
Netherlands	1.36 [24.4%]	4.36 [3.68%]	2.18 [33.7%]	4.10 [12.9%]		0.078 (0.095)	0.725 (0.098)	0.965	2.10
Sweden	0.10 [75.5%]	1.73 [18.8%]	11.9 [0.26%]	0.62 [73.4%]	0.043 (0.019)		0.566 (0.103)	0.950	2.00
UK	14.9 [0.01%]	9.75 [0.18%]	33.5 [<0.01%]	5.66 [6.22%]	25.34 (10.40)	1.432 (0.311)	0.365 (0.090)	0.920	1.01
USA	9.02 [0.03%]	0.94 [33.1%]	13.9 [0.02%]	0.86 [64.9%]	0.117 (0.055)		0.655 (0.087)	0.916	1.82

The table reports hypothesis tests with respect to the estimates of equations (15) and (17) and the coefficients of interest in the accepted equation.
Sample: 1980-2005 except where indicated in the country notes.
Tail probabilities in "[]" parentheses, coefficient standard errors in "()" parentheses.

Country notes:

France: α_6= 0; additional variables – exchange rate change, lagged GDP growth, lagged wage level. We fail to reject $H_0:\alpha_1=0$, $H_0^*:\alpha_2=0$ and H_0 & H_0^* and so set both coefficients to zero.

Germany: Additional variable – lagged GDP growth. Specification choice: as France.

Italy: q enters lagged 1 and 2 instead of 0 and 1; additional variables – exchange rate change, lagged wage growth. We reject $H_0:\alpha_1=0$, $H_0^*:\alpha_2=0$ and H_0 & H_0^* and hence remain with the unrestricted specification.

Japan: Sample 1982 – 2005; additional variable – wage level. We fail to reject $H_0:\alpha_1=0$ and $H_0^*:\alpha_2=0$ but decisively reject H_0 & H_0^*. We choose the specification with $\alpha_1=0$ but α_2 unrestricted on the basis of fit.

Netherlands: We fail to reject $H_0:\alpha_1=0$ and H_0 & H_0^* although we do reject $H_0^*:\alpha_2=0$. Specification choice as Japan.

Sweden: We fail to reject $H_0:\alpha_1=0$ and $H_0^*:\alpha_2=0$ but decisively reject H_0 & H_0^*. We choose the specification with $\alpha_2=0$ but $\alpha_1$unrestricted on the basis of fit.

UK: Reported test statistics and parameters relate to equation (17) with α_6= 0 – see section 4.

USA: We reject $H_0:\alpha_1=0$ and H_0 & H_0^* but fail to reject $H_0^*:\alpha_2=0$. We hence restrict α_2 = 0 but leave α_1 unrestricted.

Table 2
Estimated Lerner Indices 1980-2005

France		0.000		1980-2005	0.669
Germany		0.000	UK	1980-84	0.606
Italy		-		2001-05	0.710
Japan		0.590		1980-2005	0.140
Netherlands		0.072	USA	1980-84	0.284
	1980-2005	0.322		2001-05	0.033
Sweden	1980-84	0.415			
	2001-05	0.224			

The table reports the estimated Lerner Indices $L_j = \hat{\theta}_j / \hat{\eta}_j$ on the basis of the coefficient estimates reported in Table 1. It is not possible to calculate an index for Italy.

Table 3
Estimated Demand Elasticities

	Price elasticity η	Instrument validity $\chi^2(3)$	Serial correlation $\chi^2(2)$	Structural break Chow
France	0.098 (0.048)	3.98 [26.4%]	5.55 [6.21%]	$F_{5,16} = 1.43$ [26.8%]
Germany	0.344 (0.131)	5.21 [15.7%]	2.22 [33.0%]	$F_{4,18} = 0.46$ [76.5%]
Italy	0.083 (0.121)	-	7.93 [1.90%]	$F_{3,20} = 0.32$ [81.2%]
Japan	0.206 (0.085)	0.20 [97.8%]	7.99 [1.84%]	$F_{4,16} = 0.23$ [91.5%]
Netherlands	0.159 (0.153)	4.21 [21.0%]	2.46 [29.3%]	$F_{4,18} = 0.49$ [74.6%]
Sweden	0.227 (0.062)	5.39 [14.5%]	0.42 [81.1%]	$F_{4,18} = 1.52$ [23.8%]
UK	0.078 (0.094)	6.44 [9.21%]	0.01 [99.4%]	$F_{4,18} = 1.06$ [42.5%]
USA	0.217 (0.039)	7.78 [5.07%]	0.33 [84.6%]	$F_{5,16} = 2.02$ [13.0%]
Median	0.172			

The table reports the estimated demand elasticity in equation (18) and tests for a structural break at the mid-point of the sample (between 1992 and 1993). Sample: 1980-2005 except where indicated in the country notes.
Estimation by IV except Japan.
The tests for instrumental validity, residual serial correlation and structural breaks are the Sargan, LM and Chow tests respectively. For degrees of freedom reasons, the Chow test is performed on the OLS estimates of the equation.
Tail probabilities in "[]" parentheses, coefficient standard errors in "()" parentheses.

Country notes:
France: Additional variable – lagged GDP growth rate.
Italy: Price lagged one year; estimation by OLS; γ_3 set to zero.
Japan: Sample 1982-2005 with structural break split between 1993 and 1994.
USA: Additional variable – lagged GDP growth rate.

Table 4
Estimated Roaster Conduct 1980-2005

Elasticity		own	common	Elasticity		own	common
France		0.000	0.000		1980-2005	0.052	0.115
Germany		0.000	0.000	**UK**	1980-84	0.047	0.104
Italy		-	-		2001-05	0.055	0.122
Japan		0.109	0.102		1980-2005	0.031	0.024
Netherlands		0.012	0.012	**USA**	1980-84	0.062	0.049
	1980-2005	0.073	0.055		2001-05	0.007	0.006
Sweden	1980-84	0.094	0.071				
	2001-05	0.051	0.038				

The table reports the industry conduct parameters $\hat{\theta}_j$ derived from Tables 2 and 3. The value is zero in a perfectly competitive industry and unity in a pure monopoly. The own elasticity is the estimated value $\hat{\eta}_j$ reported in Table 3. The common elasticity is the median of these estimated elasticities across all eight countries. The "entire period" is 1980-2005. No estimate is given for Italy since the estimated margins are inconsistent with the model.

Table 5
World Coffee Price as Share of Retail Price

	1980-2005	1980-84	2001-05
France	33.3%	42.1%	24.4%
Germany	26.2%	35.7%	18.4%
Italy	23.2%	41.1%	11.1%
Japan	9.7%	19.6%	7.1%
Netherlands	31.5%	45.9%	18.8%
Sweden	28.8%	42.7%	20.9%
UK	9.5%	15.9%	4.4%
USA	32.9%	49.5%	19.6%

The table reports the share of the world coffee price (ICO Composite Index) in the retail price in each country. All prices are measures in current US dollars. Source: ICO.

Table 6
Producer Price Equation Estimates

	Hypothesis Tests				Coefficient Estimates			Statistics	
	$\beta_{j1}=0$ χ^2_1	$\beta_{j2}=0$ χ^2_1	$\beta_{j1}=\beta_{j2}=0$ χ^2_2	$\beta_{j5}=\beta_{j6}=0$ χ^2_2	$\hat{\beta}_{j1}$	$\hat{\beta}_{j2}$	$\hat{\beta}_{j3}$	R^2	DW
Brazil (arabica)	18.6 [<0.01%]	0.76 [38.3%]	21.7 [<0.01%]	0.37 [83.2%]	0.169 (0.060)		1.000 (*)	0.826	1.51
Colombia	27.0 [<0.01%]	1.62 [20.3%]	90.1 [<0.01%]	0.63 [73.0%]	0.850 (0.114)		0.629 (0.052)	0.909	1.25
Guatemala	3.84 [5.01%]	7.46 [0.63%]	10.1 [0.64%]	16.7 [0.02%]		-0.280 (0.111)	1.000 (*)	0.854	1.20
Kenya	15.3 [0.01%]	15.4 [0.01%]	15.4 [0.04%]	12.2 [0.22%]	0.077 (0.017)	1.398 (0.167)	0.794 (0.077)	0.917	1.50
Tanzania	10.4 [0.13%]	0.35 [55.6%]	20.4 [<0.01%]	2.00 [36.7%]	0.781 (0.233)		0.885 (0.121)	0.876	1.39
Brazil (robusta)	19.9 [<0.01%]	0.16 [68.5%]	52.2 [<0.01%]	5.03 [8.08%]	0.379 (0.099)		0.874 (0.066)	0.974	1.35
Côte d'Ivoire	15.1 [0.01%]	38.5 [<0.01%]	85.9 [<0.01%]	0.40 [81.9%]	0.265 (0.115)	-0.556 (0.058)	0.213 (0.131)	0.935	1.24
Indonesia	8.61 [0.34%]	1.05 [30.6%]	29.4 [<0.01%]	0.25 [88.3%]	0.137 (0.029)		1.000 (*)	0.888	1.26
Uganda	21.7 [<0.01%]	2.55 [27.9%]	22.4 [<0.01%]	4.16 [12.5%]	0.997 (0.576)		1.000 (*)	0.730	0.91
Vietnam	6.12 [1.34%]	0.79 [37.3%]	23.8 [0.04%]	14.1 [0.09%]	0.085 (0.008)		1.000 (*)	0.985	1.77

The table reports hypothesis tests with respect to the estimates of equations (19) and (20) and the coefficients of interest in the accepted equation. The coefficient β_1 multiplies the modified trend t^* except where stated below. The upper panel relates to arabica producers and the lower panel to robusta producers.
Sample: 1980-2005 except where indicated in the country notes. Tail probabilities in "[]" parentheses, coefficient standard errors in "()" parentheses; "(*)" indicates a restricted coefficient.

Country notes:
Brazil (arabica): β_1 multiplies t, β_3 restricted to unity; additional variable *ICO1*.
Colombia: β_1 multiplies *ICO2*.
Guatemala: β_1 multiplies *ICO1*, β_3 restricted to unity; additional variable *ICO1*.
Kenya: β_1 multiplies *ICO2*; additional variables t and t^2.
Tanzania: β_1 multiplies *LIB2*; additional variable t.
Brazil (robusta): β_1 multiplies *ICO2 ; s*ample 1987-2005.
Côte d'Ivoire: β_1 multiplies *ICO2 ;* additional variable t.
Indonesia: β_1 multiplies t; β_3 restricted to unity; additional variables t and t^2.
Uganda: β_1 multiplies modified trend *LIB2,* additional variable t; sample 1981-2005.
Vietnam: β_1 multiplies t; sample 1995-2005 ; β_3 restricted to unity.

Table 7
Estimated Supply (Production) Elasticities

	Price elasticity ε (= δ_1)	Lagged production δ_2	Instrument validity $\chi^2(3)$	Serial correlation $\chi^2(2)$	Structural break Chow
Brazil	0.163 (0.225)	-0.489 (0.144)	3.95 [26.7%]	0.51 [77.3%]	$F_{5,14} = 1.00$ [45.4%]
Colombia	0.209 (0.129)	0.418 (0.190)	5.26 [26.2%]	0.17 [91.8%]	$F_{3,20} = 0.62$ [60.9%]
Guatemala	0.479 (0.179)	-	0.17 [92.0%]	4.41 [11.0%]	$F_{3,19} = 1.81$ [17.9%]
Kenya	0.222 (0.131)	-	1.13 [76.9%]	1.60 [45.0%]	$F_{4,18} = 0.40$ [80.9%]
Tanzania	0.247 (0.147)	-	0.93 [81.8%]	0.08 [95.9%]	$F_{4,18} = 0.59$ [57.4%]
Côte d'Ivoire	0.279 (0.233)	-	2.55 [43.6%]	1.15 [56.4%]	$F_{4,17} = 0.99$ [43.9%]
Indonesia	0.008 (0.085)	-	2.22 [57.8%]	0.05 [97.8%]	$F_{4,17} = 0.98$ [42.3%]
Uganda	0.209 (0.113)	0.236 (0.235)	4.53 [20.9%]	3.92 [14.1%]	$F_{4,17} = 2.68$ [6.96%]
Vietnam	0.097 (0.090)	-	1.91 [59.1%]	0.47 [49.4%]	$F_{2,6} = 0.30$ [75.0%]
Median	0.209				

The table reports the estimated supply elasticity in equation (21) and tests for a structural break at the mid-point of the sample (between 1992 and 1993). The countries in the upper block are mainly or entirely arabica producers while those in the lower bock are mainly or entirely robusta producers.
Sample: 1980-2005 except where indicated in the country notes. Estimation by IV.
The tests for instrumental validity, residual serial correlation and structural breaks are the Sargan, LM and Chow tests respectively. For degrees of freedom reasons, the Chow test is performed on the OLS estimates of the equation.
Tail probabilities in "[]" parentheses, coefficient standard errors in "()" parentheses.

Country notes:
Brazil: production aggregates over arabica and robusta beans; sample 1981-2005.
Colombia: δ_3 set to zero; instrument validity test is $\chi^2(4)$.
Guatemala: δ_2 set to zero; additional regressor *DICO*; instrument validity test is $\chi^2(2)$.
Kenya: δ_2 set to zero; additional regressor t^2.
Tanzania: δ_2 set to zero; additional regressor t^2.
Côte d'Ivoire: δ_2 set to zero; additional regressor t^2 and civil ware dummy (zero before 2002, 0.5 in 2002, then 1).
Indonesia: δ_2 set to zero.
Uganda: δ_3 set to zero; sample 1982-2005.
Vietnam: δ_2 and δ_3 set to zero; sample 1996-2005 with structural break split between 1900 and 2000.; serial correlation test is first order and hence $\chi^2(1)$.

Table 8
Estimated Lerner Indices (Producers) 1980-2005

Brazil (arabica)	1980-2005	0.079	**Brazil (robusta)**	1987-2005	0.129
	1980-84	0.192		1987-89	0.326
	2001-05	0.009		2001-05	0.005
Colombia	1980-2005	0.271	**Côte d'Ivoire**	1980-2005	0.404
	1980-84	0.333		1980-84	0.438
	2001-05	0.230		2001-05	0.361
Guatemala	1980-2005	0.219	**Indonesia**	1980-2005	0.254
Kenya	1980-2005	-		1980-84	0.333
Tanzania	1980-2005	0.233		2001-05	0.108
	1980-84	0.333	**Uganda**	1980-2005	0.205
	2001-05	0.001		1980-84	0.333
				2001-05	0.000
			Vietnam	1995-2005	0.216
				1995-99	0.246
				2001-05	0.184

The table reports the estimated Lerner Indices $M_j = \hat{\varphi}_j / \hat{\varepsilon}_j$ on the basis of the coefficient estimates reported in Table 7. It is not possible to calculate an index for Kenya.

Table 9
Estimated Exporter Conduct 1980-2005

	Elasticity	own	common		Elasticity	own	common
Brazil (arabica)	1980-2005	0.013	0.017	**Brazil (robusta)**	1987-2005	0.021	0.027
	1980-84	0.031	0.040		1987-89	0.053	0.068
	2001-05	0.001	0.002		2001-05	0.001	0.001
Colombia	1980-2005	0.057	0.057	**Côte d'Ivoire**	1980-2005	0.113	0.084
	1980-84	0.070	0.070		1980-84	0.121	0.091
	2001-05	0.048	0.048		2001-05	0.101	0.076
Guatemala	1980-2005	0.105	0.046	**Indonesia**	1980-2005	0.002	0.053
Kenya	1980-2005	-	-		1980-84	0.003	0.070
Tanzania	1980-2005	0.057	0.049		2001-05	0.001	0.023
	1980-84	0.082	0.070	**Uganda**	1980-2005	0.043	0.043
	2001-05	0.000	0.000		1980-84	0.070	0.070
					2001-05	0.000	0.000
				Vietnam	1995-2005	0.021	0.045
					1995-99	0.024	0.052
					2001-05	0.018	0.039

The table reports the industry conduct parameters $\hat{\varphi}_j$ derived from Tables 7 and 8. The value is zero in a perfectly competitive industry and unity in a pure monopsony. The own elasticity is the estimated value $\hat{\varepsilon}_j$ reported in Table 8. The common elasticity is the median of these estimated elasticities across all nine countries. The "entire period" is 1980-2005. No estimate is given for Kenya since the estimated Lerner Indices are inconsistent with the model.

Table 10
Estimated Producer Price Shares 1980-2005

	1980-2005	1980-84	2001-05
Brazil (arabica)	72.7%	42.0%	83.2%
Colombia	64.2%	50.8%	77.3%
Guatemala	70.4%	68.1%	78.5%
Kenya	85.8%	89.6%	91.8%
Tanzania	58.6%	79.1%	40.7%
Brazil (robusta)	74.8%	48.7%	82.2%
Côte d'Ivoire	49.8%	37.5%	47.1%
Indonesia	55.5%	40.1%	53.5%
Uganda	63.2%	40.4%	92.1%
Vietnam	82.1%	110.1%	66.9%

The table reports the share of the producer price in the relevant ICO index (ICO Other Milds index for arabica producers and Robustas index for robusta producers except where noted below). The upper block relates to arabica producers and the lower block to robusta producers.
Country notes:
Brazil (arabica): ICO Indicator Price Index
Colombia: ICO Colombian Milds Index.
Brazil (robusta): 1987-2005, 1987-89 and 2001-05 respectively
Uganda: 1980-2003, 1080-84 and 2001-03 respectively.

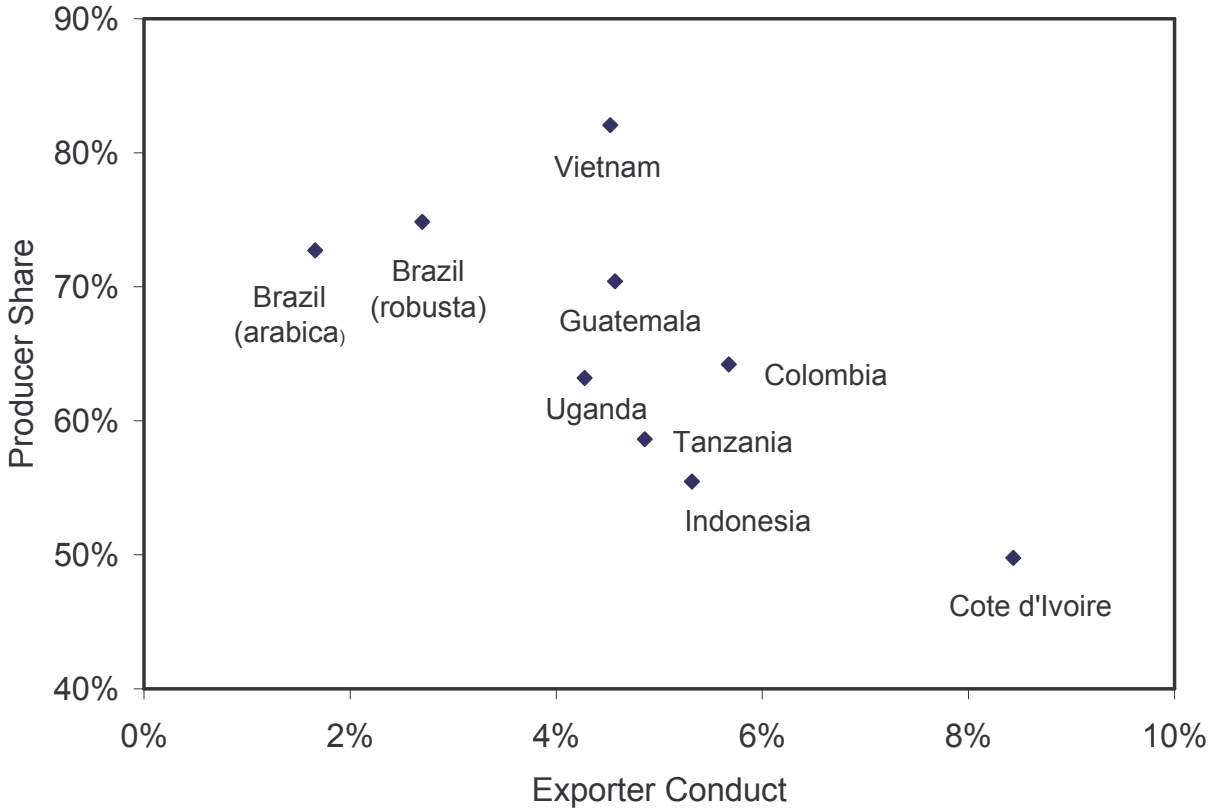

Figure 1: Average Producer Shares of World Coffee Prices and Estimated Exporter Monopsony Power, 1980-2005

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