Market Power in Commodity Crisis

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Abstract

This paper shows that changes in market power explain one of the major commodity crises in recent history. I estimate coffee bean demand and then use the estimates jointly with a model of supply side to recover the effectiveness of the export quota agreement. Of the 73.7% price decline between 1988 and 2001, 53.7% points are attributed to the 1989 cartel breakdown. Growing exports from Vietnam and other supply/demand shocks explain further 10.5% points and 9.0% points. The results suggest the potential for cross-fertilization between competition, international trade, and foreign aid policies.

1 Introduction

Despite caffeine, coffee can be depressing. Between 1988 and 2001, the price of coffee beans dropped by 73.7%.

Exporting countries and producers around the globe suffered the consequences.\footnote{ICO Indicator Price, deflated by US CPI.}

\footnote{Between 1988 and 1994, real GDP grew by only 0.96% annually in countries where the majority of exports is in coffee, while the figure is 3.19% for non-coffee exporters. The ensuing waves of sovereign defaults cost over $162 billion to the taxpayers in richer countries (total debt relief for 51 coffee exporting}

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Episodes abound on crises due to dropping commodity prices. While the effects of commodity crises are well documented, few studies have analyzed their causes. This gap partly reflects the common belief that commodity prices are volatile and therefore unpredictable. Not always so. This study shows that changes in market power explain one of the major commodity crises in recent history. Specifically, the breakdown of the exporters’ cartel accounts for most of the drop in coffee prices, while the entry of a new producing country, Vietnam, is responsible for much of the rest.

I focus on the coffee market because: (i) coffee beans are one of the most heavily traded commodities in the world, second only to crude oil; (ii) the market saw typical rise and fall of a cartel arrangement; and (iii) the impacts have been far-reaching. Contrary to popular beliefs, cartel and imperfect competition are prevalent among the producers of major commodities traded in international exchanges.

My general strategy is to estimate coffee bean demand, and then use the estimates jointly with a model of supply side, to recover the effectiveness of the quota agreement, i.e., the degree of competition/collusion among countries except Vietnam, the new entrant. We can measure the impact of the cartel breakdown in 1989 by comparing the actual price after 1989 to the counterfactual with a functioning cartel. To separately identify the impact of the Vietnamese beans on the coffee price, the study exploits the fact that Vietnam started and expanded coffee production unilaterally, on the back of the foreign aids from the World Bank and the US-AID.

The results suggest that, of the 73.7% drop in coffee prices between 1988 and 2001, the

\[ \text{countries, 1990-2007). In Colombia, the plight of the coffee industry fueled the intensifying violence (Dube and Vargas, 2008). In Rwanda, where 69\% of exports come from coffee, the commodity crisis contributed to exacerbating ethnic conflicts and the subsequent humanitarian disasters. The coffee-growing states of Oaxaca and Chiapas are homes to many Mexican migrants in the US.} \]

\[ \text{3See Deaton (1999), Catao and Sutton (2002), and Varangis et al. (2003), among others.} \]

\[ \text{4For example, the OPEC controls a sizable proportion of the world’s crude oil exports. The diamond market saw successful exercise of monopoly power by De Beers. Slade and Thille (2006) analyze cartel arrangements in the base metals markets (aluminium, copper, lead, nickel, tin, and zinc). Gilbert (1996) presents historical assessment of the international commodity agreements on cocoa, coffee, rubber, sugar, and tin. Apparently, cartel and imperfect competition are rather the norm than exception in many commodity markets.} \]

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breakdown of the cartel in 1989 is responsible for 53.7% points. The expansion of production in Vietnam and other supply/demand shocks explain further 10.5% points and 9.0% points, respectively.

My empirical approach builds on the industrial organization literature on the identification of the market power (Bresnahan 1982, Bresnahan 1989, Ellison 1994, Genesove and Mullin 1998). The study extends the scope of market power analysis to the internationally traded commodity as an industry, and to the export quota agreement as a form of collusion. After estimating the market power parameter among the exporting countries (excluding Vietnam, the new entrant), I take it as a structural parameter of the cartel agreement, upon which my counterfactual analysis is based.

Three methodological caveats are in order. First, to focus on the cartel’s market power and its changes, my model abstracts from product differentiation among coffee beans.\(^5\) Although the prices of “different” beans follow each other quite closely (correlations are higher than .93), the results are indicative at best regarding highly differentiated brands such as Jamaican Blue Mountain or Hawaii Kona. Finer data will allow more sophisticated demand

\(^5\)Coffee beans are commonly classified into the following four categories in the world’s commodity exchanges: Colombian Mild Arabica, Other Mild Arabica, Brazilian Natural Arabica, and Robusta.
analysis in this direction.

Second, the characterization of exporting countries as “firms” ignore the interaction between governments and coffee farms (usually rural households). During most of the periods under study, national governments were indeed the single most important decision makers regarding production and exporting, with national coffee boards as coordination device. Nevertheless, institutional details at sub-national level might be potentially important, especially as a political-economy issue.

Third, the current framework is static. Due to data availability, the analysis does not incorporate potentially interesting dynamics of inventory or capacity adjustment. Likewise, a systematic investigation into the exact functioning of the coffee cartel, possibly employing dynamic game frameworks (e.g., Fershtman and Pakes 2000, and Doraszelski and Pakes 2007), is also left for future extensions.

As for public policy implications, the study points to the potential of cross-fertilization between competition, international trade, and foreign aid policies, on the following three fronts. First, foreign aid can be an effective antitrust tool in countering international cartels. When the World Bank and the US government funded the development of coffee farming in Vietnam, the aim was to encourage farmers to substitute away from heroine poppy cultivation. As a byproduct, this aid policy effectively reduced the market power of the traditional coffee exporting countries.

Alternatively, market power can be used as a lever for development assistance. In the case of the coffee export cartel, a big importing country like the US could help the enforcement of the quota agreement. Hence, international trade and competition policies can play the role of foreign aids.6

Third, it is important to explicitly acknowledge the above relationships between competition/trade policies and development aids. The US assistance to Vietnam was, presumably, not meant to punish Brazil, fuel violence in Colombia, boost Mexican migration to the US, trigger misery in Rwanda, or waste taxpayers’ money on defaulted sovereign debts: unintended consequences. The assessment of product-market impacts should be an integral part

6Somewhat differently, “fair trade” schemes also enhance the market power of commodity producers by artificially creating rooms for product differentiation, another source of market power.
of foreign aid design process.

2 Model

The framework of product market competition is due to Bresnahan (1982 and 1989). For the traditional coffee exporters, consider $N$ firms producing homogeneous goods (coffee beans). Firm $i$ in period $t$ chooses output ($q_{it}$) to maximize its profit:

$$\pi_{it} = (P_t - mc_{it}) q_{it},$$

(1)

where the output price $P_t$ is determined by the demand function $Q (P_t)$. Here I specify a linear demand function:

$$Q_t = \alpha_0 + \alpha_1 P_t + \alpha_2 X_t + \varepsilon_t,$$

(2)

where $X_t$ is the demand shifter and $\varepsilon_t$ is the i.i.d. shock. For now I assume constant marginal costs on the supply side:

$$mc_t = \gamma_0 + \gamma_1 W_t + \eta_t,$$

(3)

where $W_t$ is the cost shifter and $\eta_t$ the i.i.d. shock. Later (in the future version of the paper) I aim to use alternative, more flexible specifications.

The first order conditions of firm $i$'s profit maximization is:

$$P_t + \frac{\partial P}{\partial Q} \theta_{it} q_{it} = mc_{it},$$

(4)

where $\theta_{it} \equiv \left(1 + \frac{\partial Q_{i,t}}{\partial q_{i,t}}\right)$ parameterizes firm $i$'s conjecture about the other firms’ response to a change in its output. Given the specifications above, we can express $\theta_{it}$ as elasticity-adjusted markup:

$$\hat{\theta}_{it} = \frac{Q_t / q_{it}}{\hat{\alpha}_1} = \begin{cases} \frac{Q_t}{q_{it}} & \text{if perfect collusion,} \\ 1 & \text{if Cournot competition,} \\ 0 & \text{if Bertrand/perfect competition.} \end{cases}$$

(5)

I call $\theta_{it}$ (and its variants) market power parameter(s) in what follows, since it summarizes the market power or the degree of competition.\footnote{Alternatively, it is called “conjectural variations” or “conduct parameters” in the literature.}
If we know each firm’s marginal cost over time \( mc_{it} \), we can estimate the price-elasticity of demand \( \hat{\alpha}_1 \) and recover the market power parameter, \( \hat{\theta}_{it} \). As I will describe in the next section, the data contains a reasonable proxy for \( mc_{it} \), which allows us to take the simplest approach explained here. Alternatively, we can estimate the average market power parameter(s) \( \hat{\theta}_t \) over certain periods, if we choose not to use data on \( mc_{it} \) and simultaneously estimate these marginal costs.\(^8\)

Since individual firms’ \( \hat{\theta}_{it} \)s are hard to interpret, I will instead estimate its “average” over cartel members, \( \hat{\theta}_t \). This calculation uses the cartel’s total output, \( Q_{ct} \equiv \sum_{i \neq v} q_{it} \), and the output-weighted average marginal cost, \( \bar{mc}_{ct} \), instead of \( q_{it} \) and \( mc_{it} \).

Vietnam emerged as a major coffee producer during the 1990s. Apparently, Vietnam’s entry and expansion happened outside the quota agreement among the incumbent producers. I model Vietnam as a unilateral first-mover, in relation to the cartel of the traditional producers, because the move was greatly helped by the foreign aids, and cannot be viewed as a potential entrant’s genuine response to the market conditions. The traditional coffee exporters, meanwhile, collectively respond as a cartel to Vietnam’s output decision.

In summary, there are \( N + 1 \) producers (the \( N \) traditional exporters plus Vietnam), each of whom chooses output \( q_{it} \in [0, \infty) \) and receives profit \( \pi_{it} \) defined in (1). In each period \( t \):

1. Vietnam is endowed with some exogenously determined amount of coffee beans \( q_{vt} \),
   all of which it dumps on the international market.\(^9\)

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\(^8\)Corts (1999) criticizes this market power identification approach. His central concern is misspecification when some dynamic collusion is at play. In other words, the market power estimation rests upon a static conception of firm behavior.

I aim to conduct a systematic investigation into the exact functioning of the coffee cartel, possibly employing a repeated game framework, in the future extensions. For now, I take my empirical analysis as a static approximation to what might have been happening in the coffee market competition. We can later evaluate the usefulness of the model in light of industry characteristics, estimation results, and policy implications.

\(^9\)This simple setup reflects my characterization of the Vietnamese coffee production, during the early period of expansion, as follows: (i) Vietnam’s production capacity is determined exogenously by the availability of arable lands and the amount of foreign aids to develop new farms; and (ii) Vietnam’s marginal cost
2. Knowing \( q_{vt} \) and the price-elasticity of demand, the cartel of traditional exporters decides how much to export \( Q_{ct} \equiv \sum_{i \neq v} q_{it} \). In responding to Vietnam, however, the cartel does not necessarily behave as a monolithic second-mover in a typical duopoly setting. That is because the tightness of collusion among the cartel members may not be perfect. Instead, the extent of coordination (or market power), \( \hat{\theta}_t \), will be estimated from data.

3. Given the total output, \( Q_t = q_{vt} + Q_{ct} \), the international price is determined by the inverse demand function, \( P(Q_t) \). Each country receives payoff \( \pi_{it} \) in (1).

Thus, the game is a tailored version of Stackelberg competition. The first mover, Vietnam, is non-strategic. The second mover, the cartel, contains in itself the strategic interactions among numerous traditional exporters, which is characterized by \( \hat{\theta}_t \).

### 3 Data

The International Coffee Organization (ICO) compiles data on the international price \( (P_t) \), each country’s exports \( (q_{it}) \) and the price paid to the growers \( (mc_{it}) \). Although monthly data is available, I use annual data because the production decisions are made on an annual basis. Also, the annual data is less noisy. Data on some variables exist for the years prior to 1977, but apparently not for \( mc_{it} \). Since I rely on this variable for the subsequent estimation, I use the annual data from 1977 to 2007, at this moment.\(^\text{10}\)

The supply shifter, \( W_t \), is used as the instrument for \( P_t \) in demand estimation. Weather is the most important shock to coffee bean supply. I construct the following supply-shifter dummy variables from the trade publication, *The CRB Commodity Yearbook*:

1. Major frosts and droughts in Brazil’s coffee producing regions \( (Frost_t) \), which damage coffee trees and reduce the harvest;

\( (mc_{vt}) \) is so low that it does not care how much the rest of the world will export or how much the Americans or Germans or Japanese will drink.

\(^\text{10}\)I aim to estimate the marginal costs in the future version of the study, in which case I will employ data from the earlier periods, too.
2. Biennial production cycle in Brazil \((\text{Cycle}_t)\), which results from its peculiar composition of trees;

3. El Niño and La Niña phenomena \((\text{Niño}_t)\), which trigger droughts or heavy rainfall in Colombia, Central America, and some other countries; and

4. The presence or absence of the cartel \((\text{Cartel}_t)\), which is set to 1 for the years up to 1988 and 0 afterwards.

Finally, the basic profile of the producer countries are as shown in Table 1.
Table 1: Coffee Exporters

<table>
<thead>
<tr>
<th>Country</th>
<th>Exports (million bag)</th>
<th>Market Share (%)</th>
<th>Rank</th>
<th>Coffee/Export (%)</th>
<th>Country</th>
<th>Exports (million bag)</th>
<th>Market Share (%)</th>
<th>Rank</th>
<th>Coffee/Export (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>18,090</td>
<td>25.40</td>
<td>1</td>
<td>9</td>
<td>Togo</td>
<td>0.271</td>
<td>0.38</td>
<td>28</td>
<td>10</td>
</tr>
<tr>
<td>Colombia</td>
<td>10,632</td>
<td>14.93</td>
<td>2</td>
<td>47</td>
<td>Paraguay</td>
<td>0.264</td>
<td>0.37</td>
<td>29</td>
<td>–</td>
</tr>
<tr>
<td>Indonesia</td>
<td>5,339</td>
<td>7.50</td>
<td>3</td>
<td>4</td>
<td>C. African R.</td>
<td>0.255</td>
<td>0.36</td>
<td>30</td>
<td>26</td>
</tr>
<tr>
<td>Mexico</td>
<td>3,608</td>
<td>5.07</td>
<td>4</td>
<td>3</td>
<td>Haiti</td>
<td>0.231</td>
<td>0.32</td>
<td>31</td>
<td>16</td>
</tr>
<tr>
<td>Cote d’Ivoire</td>
<td>3,048</td>
<td>4.28</td>
<td>5</td>
<td>19</td>
<td>Cuba</td>
<td>0.225</td>
<td>0.32</td>
<td>32</td>
<td>–</td>
</tr>
<tr>
<td>Guatemala</td>
<td>2,671</td>
<td>3.75</td>
<td>6</td>
<td>39</td>
<td>Angola</td>
<td>0.191</td>
<td>0.27</td>
<td>33</td>
<td>–</td>
</tr>
<tr>
<td>Uganda</td>
<td>2,609</td>
<td>3.66</td>
<td>7</td>
<td>96</td>
<td>Venezuela</td>
<td>0.185</td>
<td>0.26</td>
<td>34</td>
<td>–</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>2,198</td>
<td>3.09</td>
<td>8</td>
<td>31</td>
<td>Zimbabwe</td>
<td>0.164</td>
<td>0.23</td>
<td>35</td>
<td>–</td>
</tr>
<tr>
<td>El Salvador</td>
<td>2,082</td>
<td>2.92</td>
<td>9</td>
<td>64</td>
<td>Panama</td>
<td>0.118</td>
<td>0.17</td>
<td>36</td>
<td>6</td>
</tr>
<tr>
<td>India</td>
<td>1,696</td>
<td>2.38</td>
<td>10</td>
<td>–</td>
<td>Sierra Leone</td>
<td>0.107</td>
<td>0.15</td>
<td>37</td>
<td>16</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1,681</td>
<td>2.36</td>
<td>11</td>
<td>10</td>
<td>Bolivia</td>
<td>0.106</td>
<td>0.15</td>
<td>38</td>
<td>–</td>
</tr>
<tr>
<td>Kenya</td>
<td>1,592</td>
<td>2.23</td>
<td>12</td>
<td>32</td>
<td>Guinea</td>
<td>0.089</td>
<td>0.12</td>
<td>39</td>
<td>–</td>
</tr>
<tr>
<td>Zaire (Congo)</td>
<td>1,564</td>
<td>2.20</td>
<td>13</td>
<td>14</td>
<td>Liberia</td>
<td>0.069</td>
<td>0.10</td>
<td>40</td>
<td>–</td>
</tr>
<tr>
<td>Cameroon</td>
<td>1,452</td>
<td>2.04</td>
<td>14</td>
<td>13</td>
<td>Malawi</td>
<td>0.068</td>
<td>0.10</td>
<td>41</td>
<td>–</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>1,445</td>
<td>2.03</td>
<td>15</td>
<td>67</td>
<td>Sri Lanka</td>
<td>0.037</td>
<td>0.05</td>
<td>42</td>
<td>–</td>
</tr>
<tr>
<td>Honduras</td>
<td>1,378</td>
<td>1.93</td>
<td>16</td>
<td>28</td>
<td>Benin</td>
<td>0.032</td>
<td>0.04</td>
<td>43</td>
<td>–</td>
</tr>
<tr>
<td>Peru</td>
<td>1,141</td>
<td>1.60</td>
<td>17</td>
<td>–</td>
<td>Gabon</td>
<td>0.023</td>
<td>0.03</td>
<td>44</td>
<td>–</td>
</tr>
<tr>
<td>Papua N.G.</td>
<td>1,046</td>
<td>1.47</td>
<td>18</td>
<td>15</td>
<td>Congo, Rep.</td>
<td>0.019</td>
<td>0.03</td>
<td>45</td>
<td>–</td>
</tr>
<tr>
<td>Madagascar</td>
<td>0.843</td>
<td>1.18</td>
<td>19</td>
<td>37</td>
<td>Jamaica</td>
<td>0.016</td>
<td>0.02</td>
<td>46</td>
<td>–</td>
</tr>
<tr>
<td>Tanzania</td>
<td>0.742</td>
<td>1.04</td>
<td>20</td>
<td>44</td>
<td>Ghana</td>
<td>0.010</td>
<td>0.01</td>
<td>47</td>
<td>–</td>
</tr>
<tr>
<td>Vietnam</td>
<td>0.649</td>
<td>0.91</td>
<td>21</td>
<td>–</td>
<td>Nigeria</td>
<td>0.010</td>
<td>0.01</td>
<td>48</td>
<td>–</td>
</tr>
<tr>
<td>Rwanda</td>
<td>0.646</td>
<td>0.91</td>
<td>22</td>
<td>69</td>
<td>Zambia</td>
<td>0.009</td>
<td>0.01</td>
<td>49</td>
<td>–</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>0.605</td>
<td>0.85</td>
<td>23</td>
<td>41</td>
<td>Trin. Tobago</td>
<td>0.008</td>
<td>0.01</td>
<td>50</td>
<td>–</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.576</td>
<td>0.81</td>
<td>24</td>
<td>–</td>
<td>Equ. Guinea</td>
<td>0.005</td>
<td>0.01</td>
<td>51</td>
<td>–</td>
</tr>
<tr>
<td>Burundi</td>
<td>0.512</td>
<td>0.72</td>
<td>25</td>
<td>84</td>
<td>Guyana</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Dominican R.</td>
<td>0.491</td>
<td>0.69</td>
<td>26</td>
<td>13</td>
<td>Laos</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.380</td>
<td>0.53</td>
<td>27</td>
<td>–</td>
<td>Yemen</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Note: “Exports” is 1987-1989 average. The “Market Share” is the country’s share in the world coffee bean export. “Coffee/Export” is the 1985-1987 average share of coffee in country’s export.

Source: Bidarkota and Crucini (2000); International Coffee Organization.
4 Estimation

I take a simple estimation approach as follows. First, I estimate price-elasticity of demand by regressing total output on price, which is instrumented by the supply shifters. Second, I recover the cartel’s market power (or coordination) parameter from its output, marginal costs, and the demand elasticity estimated in the first step.

In the first step, I estimate demand parameters. The instrumental variables for $P_t$ are the supply shifters: $Frost_t$, $Cycle_t$, $Niño_t$, and $Cartel_t$. With $R^2 = .53$, they are not “weak” instruments:

\[
P_t = .55^{***} - .15 Frost_t + .14 Cycle_t - .21 Niño_t + 1.07^{***} Cartel_t,
\]

\[
R^2 = .53, \ N = 31,
\]

where robust standard errors are in parentheses and *** indicates significance at 1% level. Adding interaction terms does not alter the estimates much. Given the limited number of observations, I proceed with the more parsimonious set of IVs in the above.\textsuperscript{11}

Table 2 exhibits the demand estimates. The price coefficient is $-13.01$ by OLS and $-16.52$ by IV estimation. It is reasonable to see more elastic demand estimate in the IV result, since we expect the OLS estimate to be biased toward zero due to the endogeneity of price with respect to demand shocks.

I use [2] as the baseline result in what follows. The price coefficient of $-16.52$ implies the price-elasticity of demand at 0.21, which seems a little lower than for usual grocery food products. The lower elasticity is probably due to the fact that green bean costs account for only a small fraction of final retail prices. In other words, green beans are physically essential but financially negligible input for the final coffee products.

\textsuperscript{11}The first three instruments need to be improved. Since all the IVs are dummy variables that equal 1 whenever these factors should reduce supply, we expect all the coefficient estimates to be positive. That is not the case for $Frost_t$ and $Niño_t$. Moreover, $Cartel_t$ is highly significant, but the other three are not. I suspect some technical time lags between these three instruments and the actual price movements. That is because not all the weather shocks hit harvests in the same manner. For example, frosts in Brazil tend to damage crops in the harvest season contemporaneously, while El Niño-induced heavy rains in Colombia slow the growth of berries and therefore reduce the final yield in months ahead.
Table 2: Demand Estimates

<table>
<thead>
<tr>
<th>depvar: $Q_t$</th>
<th>Coef.</th>
<th>S.E.</th>
<th>Coef.</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_t$</td>
<td>-13.01***</td>
<td>1.83</td>
<td>-16.52***</td>
<td>2.33</td>
</tr>
<tr>
<td>constant</td>
<td>87.99***</td>
<td>2.12</td>
<td>91.39***</td>
<td>2.32</td>
</tr>
</tbody>
</table>

$R^2$ | .62 | .66 |

Note: *** indicates significance at 1% level. $P_t$ is instrumented by the supply shifters in [2].

In the second step, I use equation (5) to invert out the implied market power of the cartel, $\hat{\theta}_t$. Figure 2 plots the evolution of $\hat{\theta}_t$ over time. It is reasonable to see huge declines between 1988 and 1990 because the export quota agreement came to a halt in July, 1989.

The overall levels of the market power are fairly low. The measure should equal one, $\hat{\theta}_t = 1$, if the cartel acts as a monolithic decision maker, and $\hat{\theta}_t = 0$ if the member countries totally ignore the quota agreement to engage in perfect competition. The values in-between $\hat{\theta}_t \in (0, 1)$ can be understood as competition levels equivalent to some Cournot competition among $\frac{1}{\hat{\theta}}$ firms of symmetric size. If $\hat{\theta}_t = 0.33$, for example, the competition is as fierce as in a symmetric 3-firm Cournot game.

For the pre-breakdown period (1981-1988), the average is $\bar{\hat{\theta}}_{pre} = 0.1380$. This suggests the competition among the cartel members was as tough as in 7-firm Cournot game. Hence the cartel was not very tightly managed. Given the fact that there were over 50 exporting countries, however, the quota agreement did seem to bear some fruits. This is the key parameter estimate to be used in the counterfactual analysis in the next section.

After the demise of the agreement (1990-2007), the average becomes as low as $\bar{\hat{\theta}}_{post} = 0.0156$. This implies 64-firm quantity competition, which roughly correspond to the actual number of producing countries. Thus, the market power practically disappeared with the 1989 cartel breakdown. We can calculate the cartel effect, in terms of the market power
Note: Estimates of the average elasticity-adjusted markup ($\hat{\theta}_t$) among coffee exporters excluding Vietnam. The number equals 1 under perfect collusion, 0 under perfect competition, and $1/N$ under $N$-firm symmetric Cournot competition.

Figure 2: Collusiveness among Traditional Exporters ($\hat{\theta}_t$)

An alternative explanation to the dropping coffee price might come from the demand side. Namely, a hike in the price-elasticity of demand would cause equilibrium prices to fall.\(^{12}\) To determine the extent of changes in price-sensitivity, we can estimate the price coefficient of demand for separate periods, which I will do in the future version of the study. A possible obstacle to this exercise is the quality of IVs. Currently, the most powerful instrument is \textit{Cartel}_t, which takes the value of 1 until 1988 and 0 afterwards. This IV will be useless

\(^{12}\)Underlying stories behind such changes in demand would be: (i) the introduction of substitutes such as bottled water and caffeinated energy drinks; (ii) the price wars between Coca Cola and Pepsi since the 1990s lowered the cola prices, arguably a close substitute; (iii) growing “health-consciousness” deterred many Americans from drinking coffee; and (iv) the increasing fraction of the world’s coffee drinkers now reside in emerging economies such as Brazil, Russia, India, or China. Each has some points, though not decisive in my view.
because it does not vary within the pre-1989 or post-1989 periods. Hence the improvement of IVs should accompany the evaluation of this alternative (though not mutually exclusive) hypothesis.

5 Counterfactual

To determine the price effects of the 1989 cartel breakdown and the explosion of the Vietnamese exports, I simulate counterfactual prices for the period since 1989. Specifically, I investigate three counterfactual scenarios as follows:

<table>
<thead>
<tr>
<th>Vietnamese Export:</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartel Breakdown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Scenario 1</td>
<td>Scenario 2</td>
</tr>
<tr>
<td></td>
<td>(“Best” case)</td>
<td>(No breakdown)</td>
</tr>
<tr>
<td>Yes</td>
<td>Scenario 3</td>
<td>Actual</td>
</tr>
<tr>
<td></td>
<td>(No Vietnam)</td>
<td>(“Worst” case)</td>
</tr>
</tbody>
</table>

Figure 3 displays the four price sequences. Scenario 1 is the best-case scenario for the traditional coffee exporters. The simulation is based on the following setup: (i) the traditional exporters maintain the degree of collusiveness at 0.138 (1981-1988 average) even after 1988; and (ii) Vietnam’s export is zero throughout the period.

Table 3: Counterfactual Prices for Selected Years

<table>
<thead>
<tr>
<th>Year</th>
<th>Scenario 1 (1982$/lb)</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Actual Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>0.9836</td>
<td>0.9802</td>
<td>0.9836</td>
<td>0.9802</td>
</tr>
<tr>
<td>1989</td>
<td>1.1008</td>
<td>1.0938</td>
<td>0.7420</td>
<td>0.7393</td>
</tr>
<tr>
<td>1990</td>
<td>1.0475</td>
<td>1.0391</td>
<td>0.5487</td>
<td>0.5473</td>
</tr>
<tr>
<td>1991</td>
<td>0.9682</td>
<td>0.9594</td>
<td>0.4919</td>
<td>0.4905</td>
</tr>
<tr>
<td>1992</td>
<td>0.9206</td>
<td>0.9064</td>
<td>0.3812</td>
<td>0.3803</td>
</tr>
<tr>
<td>2001</td>
<td>0.8953</td>
<td>0.7918</td>
<td>0.2634</td>
<td>0.2574</td>
</tr>
</tbody>
</table>

Source: International Coffee Organization; Author’s calculation.

Let us take the year 2001, when the real coffee price hit the bottom. The actual price $P_{2001}^A$ was $0.26 per pound, a 73.7% drop from the 1988 level of $0.98. I call the actual
Note: Scenario 1 is the best case based on (i) zero export from Vietnam in all years, and (ii) the traditional exporters maintain the degree of collusiveness at 0.138 (1981-1988 average) even after 1988. Scenario 2 assumes only (ii). Scenario 3 assumes only (i). Actual case saw both Vietnam’s export expansion and the cartel breakdown.

Source: International Coffee Organization; Author’s calculation.

Figure 3: Counterfactual Prices

drop as the total effect:

$$\Delta P_{total} \equiv P^{A}_{1988} - P^{A}_{2001} = \$0.7228.$$  

In the dream world of Scenario 1, in contrast, $P^1$ is $.90 per pound. The gap between $P^{A}_{1988}$ and $P^1$ is caused by the time-varying, unobserved demand/supply shocks:

$$\Delta P_{resid} \equiv P^{A}_{1988} - P^{1} = \$0.0849.$$  

Scenario 2 adds Vietnam to the picture. Now Vietnam produces as much as it did in reality. But the cartel responds to Vietnam in a relatively orderly manner because the member countries are assumed to cooperate at the collusion level $\bar{\theta}_{pre} = 0.1380$, not $\bar{\theta}_{post} = 0.0156$. As a result, the coffee price ($P^2$) is still respectable $0.79 per pound. I call the gap between the two counterfactual the Vietnam effect:

$$\Delta P_{viet} \equiv P^{1} - P^{2} = \$0.1035.$$
Scenario 3 is the opposite case of Scenario 2. Here I admit the cartel actually broke down in 1989, but dream of a world without Vietnam. With $P^3$ at $0.26$ per pound, the price is remarkably lower than in the previous two scenarios. I label as the cartel breakdown effect the following gap:

$$\Delta P_{cbd} \equiv P^2 - P^3 = \$0.5284.$$  

$P^3$ is almost identical to the actual price in 2001. With $\bar{\theta}_{post} = 0.0156$, the former cartel members compete as selfishly as they can against each other, so the hole left by Vietnam is quickly filled with aggressive supply increases by everybody else. This is because, in the quantity competition, the outputs are strategic substitutes. If Vietnam cuts down its export, the rest of the world increases it. Finally, the gap between $P^3$ and the actual price can be understood as the interaction between the Vietnam and the cartel breakdown effects:

$$\Delta P_{int} \equiv P^3 - P_{2001}^A = \$0.006.$$  

Taken together, we can decompose the total effect into: (i) temporary demand/supply shocks; (ii) the Vietnam effect; (iii) the cartel breakdown effect; and (iv) the interaction term, as follows,\footnote{This is not the only way to decompose the effects. For example, if we start from the actual price in 2001 as reference point, we might as well characterize $\Delta P_{viet}$ as the interaction term, and $\Delta P_{int}$ as pure Vietnam effect. My point is just to demonstrate that the combined effects of these changes in competition explains much of the total price drop.}

$$\Delta P_{total} = \Delta P_{resid} + \Delta P_{viet} + \Delta P_{cbd} + \Delta P_{int}, \text{ or}$$

$$\$0.72 = \$0.08 + \$0.10 + \$0.53 + \$0.01.$$  

Thus, the combined effects of the 1989 cartel breakdown and the emergence of Vietnam (as of 2001) can explain most of the coffee crisis.

6 Conclusion

The results from the counterfactual analysis suggest that, of the 73.7% drop in real coffee prices between 1988 and 2001, the breakdown of the cartel in 1989 is responsible for 53.7%.
points. The expansion of production in Vietnam explains further 10.5% points. Hence, at the root of the coffee crisis were the typical forces of product-market competition like collusion and new entry.

The study offers three public policy implications. First, foreign aid can be an effective antitrust tool in countering international cartels. Alternatively, market power can be used to leverage development assistance. Third, it is important to explicitly acknowledge the above relationships between competition/trade policies and development aids. Overall, this paper points to the potential of cross-fertilization between competition, international trade, and foreign aid policies.

To push the IO viewpoint a little further, we can think of “mergers and acquisitions,” or something analogous to it, as a strategy to enhance market power. It might be a profitable use of Brazil’s sovereign wealth funds, for instance, to buy out coffee farms (or “buy influence” via foreign aid) in other coffee-producing countries. Given the success of the European Union, such coffee M&A is not totally unrealistic as a matter of regional integration. Each of the 54 coffee exporters is located in one of the three regions: Latin America (20), Asia (9), and Africa (25). If the output decisions are made at this level, the market power will jump up to approximately $\theta = 0.33$ (equivalent to symmetric 3-firm Cournot competition) even without the cartel’s resurrection.

Three methodological caveats, as explained in the introduction, suggest directions for the future extensions of this research. First, my model abstracts from product differentiation among coffee beans. Finer data will allow more sophisticated demand analysis in the spirit of Berry, Levinsohn, and Pakes (1995) or Goldberg (1995). Second, the characterization of exporting countries as “firms” ignore the interaction between governments and coffee farms at sub-national level. Conditional on the availability of data and the accounts of institutional details, we might be able to gain insights into the interaction between competition, regulation, and political-economy. Third, the current framework is static. It would be interesting to incorporate dynamics of inventory or capacity adjustment. Likewise, an inquiry into the exact functioning of the export cartel might be fruitful, possibly with some repeated game framework.
References


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