THE WORLD BANK ECONOMIC REVIEW, VOL. 4, NO. 2: 157-173

The Impact of the International Coffee Agreement on Producing Countries

Takamasa Akiyama and Panayotis N. Varangis

Simulations of a global coffee model incorporating a vintage capital approach to production are run. Over the recent period of operation of the International Coffee Agreement's export quota system, the authors find that the quota system had a stabilizing effect on world coffee prices. The quotas reduced real export revenues for most small exporting countries, but large producers gained. Most small countries gained, however, in terms of risk reduction. If a brief suspension of the quota occurs from time to time, caused, for example, by adverse weather which results in a shortfall in world supply, the quota system works like a buffer stock scheme; on average, producing countries as a whole lose transfer benefits but gain risk benefits.

The International Coffee Agreement (ICA), which utilizes an export quota system, has had an important influence on the world coffee market in recent years. The export quota scheme succeeded in stabilizing world coffee prices in its most recent period of operation (October 1980–June 1989) in spite of wide fluctuations in world coffee production. Because of disagreements among members over economic clauses that were introduced into the ICA in October 1989, however, the quota system was suspended in July 1989. World coffee prices fell by more than 40 percent following the suspension of the quotas, which led to large declines in producers' incomes and in export and government revenues in most coffee-exporting countries. In spite of continuing negotiations, current prospects for the reintroduction of the quota system are bleak.

The main objective of this article is to analyze the impact of the ICA export quota system on the world coffee market, focusing on increases in real export revenues (transfer benefits) and reductions in income variability (risk benefits) in each exporting country. In pursuit of this objective, we make extensive use of a new global model of the coffee economy.

We begin with a brief description of recent developments in the world coffee market in section I, followed by a review of previous studies of the world coffee market in section II. In section III, a description of the model and its validation

The authors are economists in the International Economics Department of the World Bank. They would like to thank Ron Duncan for his valuable contributions to this article and the anonymous referees for their comments on an earlier draft.

are given. Ex-post simulation results from the model are presented in section IV, and section V gives our conclusions.

I. Recent Developments in the World Coffee Market and the ICA

The first International Coffee Agreement came into force in October 1963. It aimed to halt a declining price trend and stabilize prices above their free market level. That exporters supported the ICA should not be surprising, but most importers are also signatories to the ICA. Their compliance with ICA provisions designed to increase prices is more difficult to explain, since the support of prices above the free market level is a direct cost to importers. Fisher (1972), Krasner (1973), and Gordon-Ashworth (1984) argue that the consuming countries' participation in the ICA can be explained only by political motives, although a number of roasters in the United States and Western Europe said that they preferred stable prices even if at somewhat higher average levels. The United States, recognizing the strategic importance of Latin America, considered it necessary to raise and stabilize world coffee prices to promote political and economic stability in the region. The European Community had similar objectives with regard to Africa. Whatever their motivation, importers' membership in the ICA is strictly voluntary; there are no mechanisms to keep consuming countries in the agreement or to punish those who leave. In the early 1980s New Zealand and Israel did, in fact, withdraw from the ICA.

The ICA's main market regulatory instrument was an export quota system. The quota system was abandoned in 1973, however, because producing and consuming countries could not agree on the level of the support price and the level and allocation of quotas. World coffee prices were at historically low levels in the early 1970s, but when a serious frost hit Brazil in 1975, prices as measured by the ICA "Other Milds" indicator price skyrocketed to a peak of 317.68 U.S. cents per pound in April 1977. [This indicator price is the weighted average of major Central American fully washed arabica coffee ex-dock in New York (75 percent) and Bremen-Hamburg (25 percent)]. After 1977 prices declined sharply, prodding producing and consuming countries to negotiate a new agreement, which again contained an export quota system as its main economic provision.

The mechanics of this latest ICA export quota system are described in detail in Gilbert (1987); its key features were as follows. The global export quota, which was the total quantity sold by exporting members (covering more than 98 percent of world exports) to importing members (covering 85–90 percent of world imports), was adjusted to keep world coffee prices within an agreed-upon range. World coffee prices were proxied by the average of arabica and robusta prices, ex-dock in New York and Bremen-Hamburg and ex-dock in New York and Le Havre–Marseilles respectively. The target price range for the period October 1980–June 1989 was 120–140 U.S. cents per pound. In gen-

eral, when prices rose above this range for a sustained period, quotas were increased; when prices fell below the target range, quotas were reduced. Initial quotas for each exporting member were based on past export volumes and were supposed to be adjusted periodically to reflect production capabilities. In practice, few such adjustments were made. To enforce the quotas, the International Coffee Organization issued "export stamps" on a quarterly basis to each exporting member. Importing members agreed to import only coffee covered by these stamps. Exporting members were essentially free to sell any quantity of coffee to nonmember importing countries. This nonquota market consisted of New Zealand, the U.S.S.R., and other centrally planned economies of Eastern Europe except Yugoslavia, and all developing countries except Greece and Portugal. As Bohman and Jarvis (1989) point out, exporting members whose average production was considerably larger than the sum of export quotas and domestic demand had an incentive to export to the nonquota market even at large discounts. Although reliable data on prices in this market are unavailable, they were reported to be at a 30–50 percent discount relative to quota market prices. Exports to the nonquota market would have depressed prices in the quota market to the extent that this coffee was re-exported to the quota market. No reliable estimates exist on the size of this "tourist coffee" trade, but it was considered to be relatively small—at most 3–4 percent of sales to the quota market.

The new export quota system became effective in 1980 and was successful in stabilizing prices from October 1980 until February 1986, when coffee prices sharply increased, triggering suspension of the quotas. The price increase was caused by a sizable reduction in Brazil's 1986–87 crop as a consequence of a severe drought in 1985. Prices declined steadily after the spring of 1986, leading to prolonged discussions among ICA members and the eventual reinstatement of the quota system in October 1987.

Because the ICA was set to expire in September 1989, intensive negotiations were carried out among the ICA members in 1988–89 concerning the economic clauses of the new agreement. Two key issues went unresolved, resulting in the suspension of the economic (quota) clauses of the ICA in July 1989. The issues were, first, the allocation of quotas, especially among mild arabica-, unwashed arabica-, and robusta-producing countries, in the face of shifting world demand in favor of mild arabicas, and second, the large discount sales made by exporting members to nonmember importing countries. The ICA without economic clauses will continue until September 1991, providing a forum for discussion and negotiation of the economic clauses.

Reintroduction of the quota system hinges on resolution of the quota allocation and discount sales issues. Recent discussions demonstrate the sensitivity of quota allocation as it affects each exporter's financial gain from membership in the ICA. Several exporting members have said that they will withdraw from the ICA if their quotas are reduced. The issue of discounted sales to nonmem-

bers is discussed by Bohman and Jarvis (1989), who claim that it will be difficult to resolve because many exporting countries derive significant benefits from these nonquota exports. Given these obstacles, prospects for the reintroduction of the quota system in the near future are poor.

II. Previous Analyses of the World Coffee Market

Despite the existence of a number of models of the world coffee market, the long-term effects of the quotas on export revenues in individual exporting countries and on coffee prices have not been analyzed. Models of the coffee market either do not include the export quota system or, if they do, focus on the short-term effects of the export quota and/or treat the coffee producers and consumers as broad aggregates. Ford (1978) built a world coffee model to evaluate the effect of different stabilization policies on the world coffee market. These policies included coffee tax variations, changes in the Brazilian diversification program, and buffer stock schemes. The majority of Ford's analysis concentrated on the size, cost, and effects of buffer stocks.

Another set of models of the coffee market concentrates on the political aspects of the ICA. Such models attempt to explain the distribution of quotas within the agreements (Lien and Bates 1987) and the participation of governments in the making and enforcement of international trade agreements (Bates and Contreras 1988). Several attempts have also been made to evaluate the welfare effects of the nonquota market sales of coffee. Bohman and Jarvis (1989) calculate the welfare effects on major exporting countries from participation in the nonquota market, whereas Herrmann (1986) estimates the welfare gains of nonmember importing countries resulting from the quota policy. Both analyses are based on aggregated, short-run models.

Palm and Vogelvang (1988) examine the effects of policies designed to reduce production. Policies are analyzed in a scenario without export quotas and in a scenario in which export quotas are introduced when the spot market price drops below a trigger level. As the authors point out, they use a short-run model in which production is predetermined. Finally, Akiyama and Duncan (1982) and de Vries (1975) do not model the export quota system. Even when other commodities are considered, models of the impact of export quota schemes are available only at theoretical levels (Maizels 1982) or are targeted to individual countries (Dick and others 1982).

III. Description of the Model and Its Validation

The new model used in the study consists of a large number of equations estimated econometrically on annual data. Data were mostly obtained from the International Coffee Organization, the U.S. Department of Agriculture, and the International Monetary Fund (various years). Detailed data for new plantings, age of trees, and yields for a number of producing countries were obtained

from informal unpublished country-specific sources. Export supply is modeled for thirty-one countries or regions, and import demand is modeled for twenty-one ICA member importing countries and two nonquota markets.

Demand, Supply, and Price Determination

Price. The need to explicitly model the effects of the quota system on world prices precludes the use of a price equation linking prices to stocks. This is evident in the case in which world prices are increased through reduction of the global quota. As the quota is reduced, prices rise but stocks held in producing countries (which usually account for the majority of world stocks) also rise. In this case the correlation between prices and world stocks would be positive; this is the opposite of the relationship assumed in price equations with stocks as an explanatory variable.[1]

We concluded that the only satisfactory way to determine the world price when a quota scheme is operating is to equate import demand and export supply in the quota market. When the quota system is not operating, price will be determined by equating world import demand and world export supply.

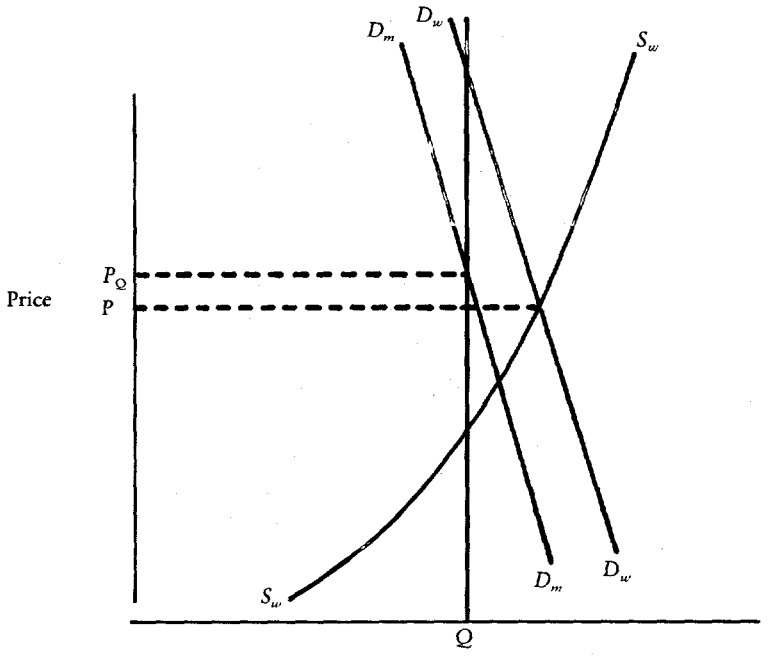
Demand. For each importing country, demand is specified in a conventional manner, that is, on a per capita basis with real income per capita, population, taste, and real retail prices as explanatory variables. Real retail prices, in turn, are a function of exchange rates, inflation, and world prices. A time trend is used as a proxy for changes in tastes. The twenty-one countries modeled as ICA importing countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Federal Republic of Germany, Greece, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States, and Yugoslavia. In addition, two nonmember market regions are modeled: noncoffee producing developing countries and Eastern Europe (including the U.S.S.R.).

Production and exports. Specification of production is based on a version of the vintage capital model (Akiyama and Trivedi 1987) in which supply is determined in two stages—at planting and at harvesting. Planting decisions in the case of a perennial crop like coffee are investment decisions which will affect production capacity in current and future years. Harvesting decisions are short-term and will depend in part on current and past planting decisions and the producer prices prevailing just before and/or during the harvest period. The advantage of this specification is that it allows us to empirically distinguish between short-run and long-run supply responses to the quota system.

New plantings (the long-run supply decision) are determined by recent real farmgate prices, which in turn are a function of exchange rates, inflation, and

1. As discussed by Labys (1973) and Ghosh and others (1987), in many commodity models price equations are inverted stock demand equations, and hence the stock variable should have a negative coefficient.

Figure 1. *Price Determination in the Model*



Export supply and import demand

the world price of coffee. The total number of trees, represented by new and past plantings, together with their yield determines production capacity. Actual production (the short-run supply decision) is then a function of production capacity, real farmgate prices, and other variables such as weather and the biennial production cycle.

The amount of output available for export is defined as the sum of production and carryover stocks net of domestic consumption. This output will be allocated among total exports—the sum of exports to the quota market and exports to the nonquota market—and additions to stocks. When quotas are in force, we assume that demand in the quota market is sufficient to ensure that exporters are able to sell their entire allotment in this market, so that exports to the quota market are exogenous and equal to the quota. Exports to the nonquota market will depend on the world price of coffee. Any residual output which is not exported to either the quota or nonquota markets is allocated to year-end stocks. Price in the quota market, P_Q in figure 1, is determined where the amount of the world quota, Q, equals the import demand of member countries, D_mD_m. Note that we are assuming no interaction (re-exports) between the quota and nonquota markets. This assumption is reasonable if the amount of "tourist coffee" is small, as reported.

When the quota system is not in force, total exports are a function of output available for export, world price, exchange rates, and inflation. Exports to

nonmember countries are modeled as before, and exports to member countries are calculated as the difference between total exports minus exports to nonmembers. In figure 1, export supply, S_wS_w, is an increasing function of price, and world import demand is the sum of quota market and nonquota market demand, D_wD_w. Price is thus determined at P when quotas are not operative. Because export supply is a function of world price here, existing stocks act to stabilize prices to some extent, even when quotas are not in force.

Estimated Elasticities in the Model

A large number of parameters and elasticities was estimated and used in the model. Those for supply and import demand are discussed here.

Supply is modeled for thirty-one countries or regions, but the degree of detail in the supply specification for different countries varies according to the availability and reliability of data. We distinguish four categories of supply specification in the model: (a) For Colombia, equations describing new plantings, stumping, production capacity of old trees, and production were estimated. More detailed analysis was possible for Colombia because of the availability of reliable data from the National Coffee Federation on new plantings, stumping, and stock of old trees. (b) For sixteen countries (Brazil, Costa Rica, Côte d'Ivoire, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, India, Indonesia, Kenya, Madagascar, Mexico, Papua New Guinea, Philippines, and Rwanda), equations describing net new plantings and production were estimated. (c) For nine countries and regions (rest of Asia, Burundi, Cameroon, Ethiopia, Nicaragua, Peru, rest of South America, Tanzania, and Zaire) simple supply equations were specified because of lack of success in the estimation of new planting equations or the unavailability of tree stock data. (d) For five countries and regions (rest of Africa, Angola, rest of Central America, Uganda, and Venezuela) production was taken to be exogenous because of the unsatisfactory results obtained from attempts to estimate supply equations. Because these countries play a small role in the world market, however, we do not believe that this reduces the effectiveness of the model.

The countries for which the vintage capital approach was used (countries which fall into categories a and b above) account for about 70 percent of world production. Table 1 presents the elasticities of new plantings with respect to output price for the countries in categories a and b.

For countries in category c, new plantings were not estimated. For these countries, it was assumed that tree stocks or production capacity change with time, and prices affect production only in the short term.

Short-, medium- and long-term supply elasticities are given in table 2 for most of the countries in categories a, b, and c.[2] These elasticities were derived from model simulations. As discussed by Akiyama and Trivedi (1987), the price elasticity of supply is not time-invariant but instead increases over time as

2. Prices were not significant in the new plantings and supply equations for Honduras and Mexico.

Table 1. *Price Elasticities of New Plantings*

Country	*t−1*	*t−2*	*t−3*	*t−4*
Brazil	1.02			2.34
	(2.06)			(7.72)
Colombia	1.68			
	(3.37)			
Costa Rica				2.03
				(1.93)
Côte d'Ivoire	4.19			
	(2.52)			
Dominican Republic			1.49	0.73
			(2.47)	(2.18)
Ecuador	1.63			
	(3.22)			
El Salvador		2.29		
		(3.47)		
Guatemala		2.88		
		(3.18)		
Honduras				0.49
				(3.17)
India			2.59	
			(2.95)	
Indonesia				0.56
				(2.67)
Kenya			1.72	1.56
			(4.1)	(3.82)
Madagascar				4.48
				(2.93)
Mexico			1.23	
			(3.78)	
Papua New Guinea	1.20	0.43		
	(2.36)	(1.84)		
Philippines	2.19	1.30	0.45	
	(5.50)	(4.05)	(3.08)	
Rwanda	2.67	0.98		
	(3.27)	(1.99)		

Note: *t*-statistics are in parentheses; only significant coefficients are reported. Column heads $t - i$, $i=1, \ldots, 4$ refer to the elasticity of new plantings with respect to P_{t-i}, that is, price at time $t - i$.

Source: Authors' calculations, based on World Bank data available from the authors on written request.

producers adjust their planted acreage with farmgate prices. Estimated elasticities tend to be high in countries where general economic and coffee policies have been stable and where data are reliable.

The short-term (within the first year) price elasticity of supply for countries in categories a–c taken together is found to be 0.04, and the short-term price elasticity of export supply is found to be equal to 0.06. Behrman (1978) assumed the short-term price elasticity of supply to be zero. Herrmann (1986) found it to be slightly less than the short-term export supply elasticity, which he calculated to be 0.04, whereas Akiyama and Duncan (1982) estimated a

Table 2. *Elasticities of Supply in Selected Countries*

Country	Years after price change		
	Two years	*Five years*	*Ten years*
Brazil	0.03	0.10	0.36
Burundi	0.03	0.47	0.95
Cameroon	0.04	0.14	0.16
Colombia	0.16	0.44	0.74
Costa Rica	0.11	0.15	0.41
Côte d'Ivoire	0.55	0.68	0.84
Dominican Republic	0.19	0.34	0.78
Ecuador	0.11	0.13	0.14
El Salvador	0.13	0.15	0.16
Ethiopia	0.06	0.15	0.19
Guatemala	0.13	0.13	0.20
Honduras	0.13	0.15	0.20
India	0.19	0.10	0.15
Indonesia	0.14	0.17	0.25
Kenya	0.04	0.14	0.45
Mexico	0.02	0.06	0.13
Papua New Guinea	0.07	0.18	0.18
Philippines	0.06	0.18	0.20
Zaire	0.02	0.15	0.17

Source: Authors' calculations, based on World Bank data available from the authors on written request.

short-term supply elasticity of 0.12, somewhat higher than in other studies. The results from all of these studies confirm Ford's (1978) perception that coffee supply is very price inelastic in the short run.

Average estimated income and price elasticities of demand in importing countries and selected producing countries for 1968–86[3] are given in table 3.[4] The price and income elasticities of world coffee demand for that period are estimated to be equal to −0.33 and 0.6 respectively. Behrman (1978) found a price elasticity of demand of −0.2; Herrmann (1986) estimated a value of −0.27; and Akiyama and Duncan (1982) obtained a value of −0.186. The somewhat higher price elasticity here might be the result of the fact that we used deflated retail prices of each individual consuming country while other studies used world prices. The income elasticity of demand is similar to that obtained by de Vries (1975), Akiyama and Duncan (1982), and Herrmann (1986).

3. The "crop year" used in producing countries varies from one country to another in terms of starting date. For example, Colombia's crop year is the same as the international year, which starts October 1, but Brazil's crop year starts July 1. In this paper the production year refers to the ending year unless otherwise specified; for example, Brazil's production for the 1987–88 crop year is referred to as Brazil's 1988 crop. All exports are on the international coffee year basis, thus exports for the period October 1987–September 1988 are referred to here as exports of 1988.

4. Income elasticities for some countries, such as Ireland and Japan, were found to be very high because of the low levels of per capita consumption in these countries in the 1960s and early 1970s.

Table 3. *Demand Elasticities*

Country	*Income*	*Price*
Importing		
Austria	1.30	−0.54
Australia	1.72	−0.37
Belgium	0.36	−0.28
Canada	0.28	−0.13
Denmark	0.58*	−0.43
Finland	0.34	−0.08*
France	0.68	−0.13
Germany, Fed. Rep.	0.98	−0.17
Greece	0.52	−0.49
Ireland	2.89	−0.34
Italy	0.92	−0.18
Japan	2.03	−0.31
Netherlands	0.89	−0.34
New Zealand	1.28	−0.13
Norway	0.26	−0.14
Portugal	0.62	−0.28
Spain	1.07	−0.07*
Switzerland	0.56*	−0.24
Sweden	0.70**	−0.29
United Kingdom	1.26	−0.51
United States	0.50**	−0.46
Yugoslavia	0.12**	−0.15**
Nonmember importing		
Noncoffee-producing developing	0.68	−0.13
Eastern Europe (including U.S.S.R.)	—	−0.22
Selected producing[a]		
Brazil	0.50**	−0.09
Colombia	0.41	−0.14
Dominican Republic	0.20**	−0.08
Ecuador	0.40	−0.08
India	0.24	0.08**
Indonesia	0.18**	−0.07
Mexico	0.35**	−0.14

—Not available.

Note: *Significant at 10 percent level of significance. **Significant at 25 percent level of significance or below. All others without asterisks significant at 5 percent level of significance.

a. Because of the unavailability of retail price data for these countries, the international coffee price in terms of local currencies and deflated by the local consumer price index was used. Therefore, the price elasticities presented here should generally underestimate the demand response to changes in retail prices.

Source: Authors' calculations, based on World Bank data available from the authors on written request.

Table 4. *Descriptive Statistics for the Ex-post Simulation Run*

Statistic	ICA *other milds indicator price*	*World production*	*Total exports to the quota market*
Mean percent absolute error	5.4	1.1	0.9
Root mean squared percentage error	4.3	1.4	1.4

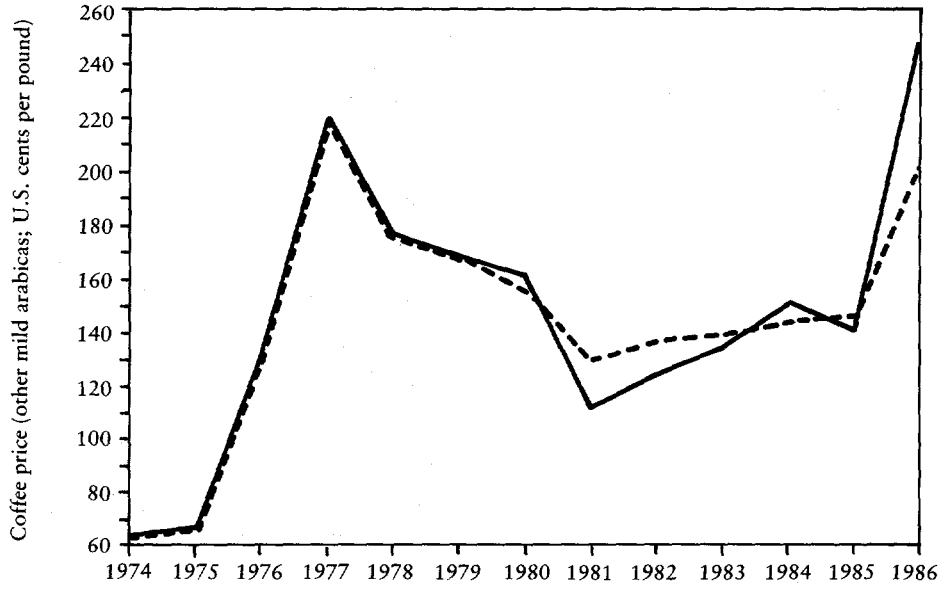
IV. Ex-Post Simulation Results with and without the ICA

The model was run for the period 1974–86 and the results compared with the actual values for prices, output, and exports. Some statistics from this comparison are given in table 4, and indicate that the simulation is fairly accurate in predicting price and especially production and quota market exports.

In order to evaluate the effects of the ICA, the model was run with the quotas (factual) and without the quotas (counterfactual) for the period 1981–86. (Projections for the 1987–2000 period based on this model are presented in Akiyama and Varangis 1989.) The simulation results for the world price and exports are given in figures 2 and 3. To allow examination of the market stabilizing effects of the ICA, coefficients of variation around the mean for prices, exports, and export revenues are given in table 5. The results show significant price-stabilizing effects of the ICA during the period 1981–85. An interesting result is the ICA's price stabilizing impact in 1986 when the quota system was not in place. If there had been no quota scheme during the period 1981–85, world coffee prices would have been 24 percent higher in 1986. The explanation for this is that when the quota system was in operation during the period 1981–85, many producing countries were forced to accumulate stocks. When the quotas were lifted in 1986, these stocks were released, dampening the rise in price caused by the drought in Brazil. The simulation results show that had the quotas not been in force for the period 1981–85, total stocks held in producing countries at the end of 1985 would have been 22 million bags instead of the actual 33 million bags, and exports to the quota market would have been 55 million bags in 1986 instead of the actual 62.5 million bags. Table 5 also shows that the quota system led to significant reduction in variation of export revenues but increased the variation of export quantities. This implies that under the quota system total exports adjusted to stabilize prices resulting in stabilization of export revenues.

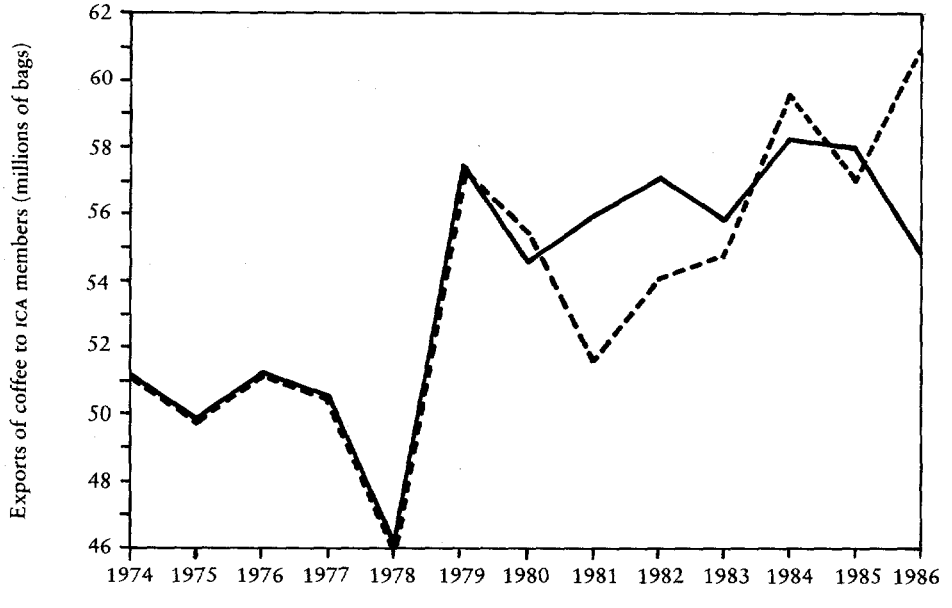
The benefits of the quota system for each producing country were also estimated. Transfer and risk benefits were calculated in terms of real export revenues (nominal U.S. dollar exports deflated by the World Bank's export unit value of manufactures). Export revenues are sums of export revenues derived from exporting to the quota and nonquota markets. It is assumed here that coffee prices in the nonquota market were 30 percent lower than in the quota market when the quota system was in operation, while the two prices are

Figure 2. *Factual versus Counterfactual Simulations*



Key: ——— counterfactual; - - - - factual.

Figure 3. *Factual versus Counterfactual Simulations*



Key: ——— counterfactual; - - - - factual.

Table 5. *Coefficient of Variation of Key Variables, with and without the Export*

	Real world prices		*Total export quantity to the quota market*		*Total real export revenue*[a]	
Period	*With quota*	*Without quota*	*With quota*	*Without quota*	*With quota*	*Without quota*
1981–85	3.89	10.29	4.86	1.73	9.18	12.67
1981–86	13.79	30.42	9.57	2.82	24.23	30.29

a. Deflated by World Bank's export unit value of manufactures (MUV).

assumed to be the same when there were no quotas. Following Newbery and Stiglitz (1981, p. 93), the benefits can be calculated as:

$$\frac{B}{\overline{Y}} = \frac{\Delta\overline{Y}}{\overline{Y}} - \frac{R\Delta\sigma_y^2}{2} \tag{1}$$

where B = total benefits of the quota system, Y = average real export revenue under the without-quota scenario, ΔY = the difference in real export revenues with and without quotas, R = coefficient of relative risk aversion, and σ_y = coefficient of variation of real export revenue.

The first and second terms of the right-hand side of equation 1 are transfer and risk benefits, respectively. We assumed $R = 1$, that is, the producers are only somewhat risk averse (see Newbery and Stiglitz 1981 for development of the theory with empirical application based on Binswanger 1980; see also Kanbur 1984 for an empirical review). Before one can calculate risk benefits, instability must be defined. After examining several possibilities we concluded that deviation of export revenues from their three-year moving average would be appropriate, since policymakers in many coffee-exporting countries often use average export revenues of the preceding two to three years as expected export revenue for the current year.

Export revenues for 1981–85 and 1981–86 (in 1985 constant dollars), and transfer and risk benefits of the quota system for all ICA exporters and for individual countries with and without quotas are given in table 6. Total transfer benefits from the quota system for the period 1981–85 are negligible. This is partly because of the fact that when the quota was operating, prices received from sales to the nonquota markets were considerably lower than when there was no quota. If 1986 is included, however, the total transfer benefits would have been 4.7 percent higher if there had been no quota system during the period 1981–85. This is because world prices would have been much higher in 1986 had there been no quotas in the period 1981–85.[5]

5. Another interpretation is that the quota system played the role of a buffer stock in 1986. In this case, as suggested by Newbery and Stiglitz, the transfer benefit from the producers' point of view is negative as long as the absolute value of the price elasticity of demand is constant (as assumed here) and less than unity. See equation 6-61 in Newbery and Stiglitz (1981, p. 95).

Table 6. *Total Real Export Revenues and Benefits of the Quota System, 1981–85 and 1981–86*

Country	Date	Revenues (millions of constant 1985 U.S. dollars)		Benefits (percentage of real export revenue)		
		With quota	Without quota	Transfer[a]	Risk	Total
World total	1981–85	54,869	55,115	−0.5	0.4	−0.1
	1981–86	69,828	73,087	−4.7	1.6	−3.1
Brazil	1981–85	15,568	15,191	2.4	1.7	4.1
	1981–86	17,979	18,327	−1.9	1.8	−0.1
Burundi	1981–85	427	459	−7.3	0.3	−7.0
	1981–86	604	599	0.7	0.2	0.9
Cameroon	1981–85	1,397	1,353	3.1	1.9	5.0
	1981–86	1,809	1,867	−3.2	5.6	2.4
Colombia	1981–85	8,271	8,114	1.9	0.2	2.1
	1981–86	10,876	11,358	−4.4	−1.6	−6.0
Costa Rica	1981–85	1,445	1,524	−5.5	1.4	−4.1
	1981–86	1,781	1,942	−9.1	4.4	−4.7
Côte d'Ivoire	1981–85	3,726	3,659	1.8	−0.1	1.7
	1981–86	4,712	4,887	−3.7	4.5	0.8
Dominican Republic	1981–85	485	581	−5.0	−0.2	−5.2
	1981–86	773	772	0.2	−0.6	−0.4
Ecuador	1981–85	1,198	1,316	−9.8	1.4	−1.9
	1981–86	1,661	1,757	−5.8	3.9	−1.9
El Salvador	1981–85	2,230	2,184	2.1	−0.4	1.7
	1981–86	2,831	2,932	−3.6	5.7	2.1
Ethiopia	1981–85	1,232	1,223	0.7	0.4	1.1
	1981–86	1,508	1,567	−3.9	−1.0	−4.9
Guatemala	1981–85	1,947	1,978	−1.6	−1.4	−3.0
	1981–86	2,468	2,627	−6.4	5.4	−1.0
Honduras	1981–85	942	969	−2.9	0.7	−2.2
	1981–86	1,278	1,387	−8.5	3.9	−4.6
India	1981–85	1,050	1,135	−8.1	0.5	−7.6
	1981–86	1,433	1,613	−12.6	4.5	−8.1
Indonesia	1981–85	3,327	3,588	−7.8	−0.5	−8.3
	1981–86	4,550	5,035	−10.7	11.5	0.8
Kenya	1981–85	1,305	1,300	0.4	0.5	0.9
	1981–86	1,769	1,878	−6.2	2.7	−3.5
Madagascar	1981–85	776	783	−0.9	1.2	0.3
	1981–86	991	1,041	−5.1	2.0	−3.1
Mexico	1981–85	2,166	2,261	−4.4	−0.1	−4.5
	1981–86	3,001	3,302	−10.0	−6.3	−3.7
Nicaragua	1981–85	721	737	−2.3	1.2	−1.1
	1981–86	859	909	−5.9	−1.5	−4.4
Papua New Guinea	1981–85	660	662	−0.2	2.1	−1.6
	1981–86	854	914	−7.0	5.4	−1.6
Peru	1981–85	748	859	−4.8	4.1	−0.7
	1981–86	1,091	1,118	−2.5	1.5	−1.0
Philippines	1981–85	394	457	−6.2	−1.1	−7.3
	1981–86	595	586	1.6	−2.4	1.9
Rwanda	1981–85	446	452	−1.4	0.6	−0.8
	1981–86	638	663	−4.0	3.5	−0.5
Tanzania	1981–85	776	809	−4.2	−0.4	−4.6
	1981–86	973	1,029	−5.8	2.5	−3.3
Uganda	1981–85	2,172	2,081	4.2	1.0	4.3
	1981–86	2,712	2,755	−1.6	1.8	0.2
Zaire	1981–85	1,018	976	4.1	0.5	4.5
	1981–86	1,514	1,593	−5.3	7.9	2.6

a. A negative number indicates lower total export revenues in the with-quota case.

Source: Authors' calculations, based on World Bank data available from the authors on written request.

The total risk benefit is small (0.4 percent) for the period 1981–85 but increases to 1.6 percent of total revenue when 1986 is included. This again reflects the significant stabilizing effect that the 1981–85 quotas had on export revenues and on prices in 1986.

For individual countries it is interesting to note that transfer benefits are negative for most of the small exporters for the period 1981–86, so that these exporters would have been better off if there had been no quota system for that period. But large exporters such as Brazil, Colombia, and Côte d'Ivoire are among the few countries that gained in terms of transfer benefits from the quota system for 1981–85. This is because when large countries increase their exports, world prices decline—often to the extent that marginal export revenues are small or even zero. This result is also verified by the fact that the risk benefits are significant for many small exporting countries but are small for Brazil and Colombia because their export quantity is negatively correlated with world prices. The effect of price stabilization on income stability is greater for countries whose export quantities are positively correlated with prices than those for which the correlation is negative. In fact, price stabilization could reduce income stability for the latter countries. Hence, in general, the quota system benefited large countries in terms of transfer benefits and small countries in terms of risk benefits.

A qualification should be made about the interpretation of these results. When the counterfactual runs (that is, without-quota runs) were made, possible effects of changes in risk on supply were not taken into account, and it was assumed that there would be no changes in government policies affecting production. In many producing countries, high export taxes on coffee are reportedly used to suppress production so that large stocks will not accumulate under the quota system. If this is the case, then in the counterfactual scenario some of these countries could have had lower export taxes and consequently larger production and exports than what the simulation results indicate—and therefore world prices could have been lower.

V. Conclusions

The results in this paper reveal several interesting findings which models focused on short-run effects would not. The ex-post simulation results show that the export quota system had an important stabilizing impact on world coffee prices over the period 1981–85. They also show that coffee prices in 1986, the year prices increased sharply because of the drought in Brazil in 1985, would have been much higher had the quota system not operated during the period 1981–85. This is because producing countries accumulated stocks during the period 1981–85, which were released into the market when quotas were lifted in 1986. In this case, the quota system worked like a buffer stock scheme, that is, it prevented a large increase in coffee prices, which otherwise would have resulted from a significant production shortfall. Symmetrically, the

quotas could have prevented a large drop in prices had a large Brazilian crop been realized.

The impact of the quota system in terms of gains in real export revenues was estimated to be rather small. For the period 1981–85, both transfer and risk benefits were calculated to be quite small overall but increased when 1986 was included. The increase in risk benefits when including 1986 shows the significant stabilizing effect quotas had on prices, although this was at the expense of revenues. The quotas led to decreased real export revenues for most countries, except for the large exporters such as Brazil and Colombia. These countries gained because they face very small or even zero marginal export revenues from increased exports because of their large market shares and the price inelasticity of demand for coffee. However, the risk benefits of the quota system to large exporters are small while they were found to be large for most of the small exporters.

To evaluate the total benefits of the quota system, exporting countries should weigh the transfer and risk benefits against the cost of holding additional stocks, for example, interest and warehouse costs. Judging from the fact that exporting countries show great interest in the quota system, risk benefits might be considerably higher than calculated here, especially to the policymakers in these countries. In other words, they might be more risk averse than is assumed here, which implies that the coefficient of relative risk aversion (R) exceeds unity.

The distribution of benefits of the quota system for the period 1981–85 favored exporters that were large and/or were traditionally assigned high quotas. In such a system, countries with potential for expansion were penalized. Negotiations for a new quota system in the 1990s are likely to include, among other issues, proposals for a redistribution of quotas in favor of these countries.

References

Akiyama, Takamasa, and R. C. Duncan. 1982. *Analysis of the World Coffee Market.* World Bank Staff Commodity Working Paper 7. Washington, D.C.

Akiyama, Takamasa, and P. K. Trivedi. 1987. "Vintage Production Approach to Perennial Crop Supply." *Journal of Econometrics* 36: 133–61.

Akiyama, Takamasa, and Panayotis N. Varangis. 1989. "Impact of the International Coffee Agreement's Export Quota System on the World's Coffee Market." World Bank PPR Working Paper 148. Washington, D.C.: Processed.

Bates, R. H., and C. Contreras. 1988. "The Economics of Politics in International Trade Policy: Lessons from the International Coffee Agreement." Duke University Program in International Political Economy, Working Paper Number 38, March.

Behrman, J. R. 1978. *Development, the International Economics Order, and Commodity Agreements.* Reading, Mass.: Addison-Wesley.

Binswanger, Hans P. 1980. "Attitudes Towards Risk: Experimental Measurement Evidence in Rural India." *American Journal of Agricultural Economics* 62 (August): 395–407.

Bohman, M., and L. Jarvis. 1989. "The International Coffee Agreement: Economics of the Nonmember Market." Paper presented at the Canadian Agricultural Economics and Farm Management Society Meeting, Montreal, July 1989.

Dick, H., S. Gupta, T. Mayer, and D. Vincent. 1982. "Indexation of UNCTAD Core Commodities Prices by Buffer Stocks or Export Quotas? A Comparison of the Benefits for Two Developing Economies." *Journal of Development Economics* 11: 379–401.

Fisher, B. S. 1972. *The International Coffee Agreement: A Study in Coffee Diplomacy.* New York: Praeger.

Ford, D. J. 1978. "Simulation Analysis of Stabilization Policies in the International Coffee Market." In F. G. Adams and J. R. Behrmann, eds., *Econometric Modeling of World Commodity Policy.* Lexington, Mass.: Heath.

Ghosh, S., C. L. Gilbert, and A. J. Hughes-Hallett. 1987. *Stabilizing Speculative Commodity Markets.* Oxford: Clarendon Press.

Gilbert, C. L. 1987. "International Commodity Agreements: Design and Performance." *World Development* 15: 591–616.

Gordon-Ashworth, F. 1984. *International Commodity Control: A Contemporary History and Appraisal.* London: Groom Helm.

Herrmann, R. 1986. "Free Riders and the Redistributive Effects of International Commodity Agreements: The Case of Coffee." *Journal of Policy Modeling* 8, no. 2: 1–25.

International Monetary Fund. Various years. *International Financial Statistics.* Washington, D.C.

International Coffee Organization. Various years. *Quarterly Statistical Bulletin.* London.

Kanbur, S. M. R. 1984. "How to Analyze Commodity Price Stabilization? A Review Article." *Oxford Economic Papers* 36, no. 3: 336–58.

Krasner, S. D. 1973. "Manipulating International Coffee Markets: Brazilian Coffee Policy 1906 to 1962." *Public Policy* 21, no. 4: 493–523.

Labys, W. C. 1973. *Dynamic Commodity Models: Specification, Estimation, and Simulation.* Lexington, Mass.: Heath.

Lien, D-H. D., and R. H. Bates. 1987. "Political Behavior in the Coffee Agreement." *Economic Development and Cultural Change* 35 (April): 629–36.

Maizels, A. 1982. *Selected Issues in the Negotiation of International Commodity Agreements: An Economic Analysis.* Geneva: U.N. Conference on Trade and Development.

Newbery, D. M. G., and J. E. Stiglitz. 1981. *The Theory of Commodity Price Stabilization.* Oxford: Clarendon Press.

Palm, F. C., and E. Vogelvang. 1988. "Policy Simulations Using a Quarterly Rational Expectations Model for the International Coffee Market." Paper presented at the Twenty-Fifth International Conference of the Applied Econometric Association, International Commodity Market Modeling, World Bank, Washington, D.C., October 24–26.

U.S. Department of Agriculture. Various years. *Foreign Agricultural Service: Coffee.* Washington, D.C.

Vries, J. de. 1975. *Structure and Prospects of the World Coffee Economy.* World Bank Staff Working Paper 208. Washington, D.C.