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STRUCTURE AND PROSPECTS OF THE WORLD COFFEE ECONOMY

This paper analyzes the relationships between supply, demand and prices of coffee with the help of an econometric model. The extremely depressed level of coffee prices in 1975 is explained by the lag in their adaptation to general inflation, as well as by the unfavorable income developments in the main consuming areas. This situation reinforces the expectation of firm prices towards the end of the decade, however, since investment in new production is seriously impaired by low prices. Projections of supply, demand and prices are made under different assumptions as to the development of incomes and inflation as well as to the occurrence of frosts in Brazil. Projections assuming the operation of a buffer stock show that its capacity would need to be around 20 million bags, and that the price range of operation would have to be set substantially above the present price levels to ensure its effectiveness.

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I. INTRODUCTION

1.1.1 Due to overproduction following the extremely high prices of the mid-1950's, coffee prices were depressed throughout the 1960's. In the early seventies they started to show very modest gains, but when the commodity boom of 1973/74 started, coffee prices joined the general trend. Average fob prices,[1/] which were around US¢34 per pound in 1967-69, reached a high of US¢60 per pound during the first half of 1974. Although this represented an increase of only 20% in real terms, it nevertheless was of great value to coffee producers, many of whom are amongst the countries most seriously affected by the increase in oil prices.

1.1.2 Since mid-1974 this situation has changed radically. Prices started dropping quickly, and in mid-September 1974 they were in real terms more than 15% below their depressed 1967-69 levels. Actually, in early September real prices for some varieties dropped to their lowest level on record since 1946.

1.1.3 Ad-hoc reasons for this breakdown in coffee prices are not difficult to find. They include:

(a) According to the production forecast for 1974/75, issued by the USDA in July 1974, production would for the first time in seven years exceed estimated consumption.

(b) The winter in Brazil passed without a frost (which would have affected the 1975/76 crop).

(c) The expected dock strike in the USA was averted by a contract negotiated in July.

1/ Throughout this paper the reference will be to the world average unit value of exports, as measured by the US unit value of imports, which is reported on an fob basis.

During the first half of 1974 the uncertainty as to the size of the coming crop, the frost threat in Brazil and the general expectation of a dock strike in the USA had pushed up prices. In addition, the efforts of producers to form a united front to support coffee prices had given an extra impetus to the upward price movement. When then, in July and August 1974, all these factors turned out in a way unfavorable to the producers, prices started to decline sharply and the apparent breakdown of producer unity under the threat of oversupply increased the downward pressure on prices.

1.1.4 The present situation of coffee prices is not very distressing if it can be regarded as only a temporary phenomenon. But many experts today believe that the world coffee economy is on the verge of a new period of oversupply, and that the present difficulties facing the coffee producing countries are only the tip of an iceberg. This, however, would imply that we have to expect a repetition of the coffee depression of the 1960's without ever having seen the coffee boom that preceded (and caused!) the last depression. Therefore, an analysis of supply, demand and prices of coffee has been made with the help of an econometric model, so as to be able to forecast the different aspects of the world coffee market as they influence one another.

1.1.5 The following three chapters deal with the determination of supply, demand and prices respectively. Chapter V contains the forecasts and tries to give some indications of the effects factors like frosts in Brazil or the establishment of a new International Coffee Agreement might have on the coffee economy. The model that has been used in this paper has been estimated for the period 1947/48 through 1972/73,[1/] mainly based on data provided by the USDA. The equations of the model, the data and the precise definition of the symbols used are contained in Annex I.

1/ For lagged variables data for years prior to 1947/48 has been used.

II. THE DETERMINATION OF SUPPLY

Coffee Production

2.1.1 Coffee is a tree crop. The first harvest comes in about 3 to 4 years after planting, and it takes two more years before the tree reaches its normal yield level. Yields generally start to decline around 15 years after planting, but under good management the decline is not very significant, and the tree can have an economic life of up to 50 years. However, in most countries the management of coffee holdings is poor, and after 20-30 years the trees have to be replaced.

2.1.2 There are two types of coffee grown in the world: arabicas and robustas. Robustas can be grown in hot and humid climates. Arabicas require lower temperatures, and are therefore grown at higher altitudes and/or greater distances from the equator than robustas. Coffee is heavily damaged, however, when temperatures fall below the freezing point, and this sets a limit to the area where coffee can be grown. There exist also two other types of coffee, liberica and excelsa, which are both grown in Western Africa, but they constitute less than 0.5% of world production and exports.

2.1.3 Arabica coffees are divided into washed or mild arabicas and unwashed arabicas. Whether a coffee is washed or unwashed is determined by the treatment it receives after the coffee cherry has been picked. If the coffee cherry is dried and then depulped to free the coffee beans the coffee is unwashed. If the cherries are depulped immediately and the beans then placed in water to facilitate the removing of the mucelage afterwards, the coffee is called washed. The washed or mild coffees are further distinguished

into "Colombian Milds" and "Other Milds", but this distinction is of little relevance from a technical point of view. 1/ There are no comparable classifications within the category of the robustas.

1.14 In both South and North America mostly arabicas are grown. Only Trinidad and Tobago produce exclusively robusta coffee. Robusta is further grown in the state of Espirito Santo in Brazil, where it grows in the valleys, with arabicas growing higher up on the hills. Its production is still insignificant, however. Africa produces both robustas and arabicas, but robustas account for by far the largest share (around 70%). Arabicas are grown in Kenya, Ethiopia, Rwanda and Burundi. Further, a number of countries in Africa produces both types of coffee, but of these only Tanzania produces more arabicas than robustas. Also in Asia and Oceania more robustas than arabicas are produced. Indonesia, the area's largest producer, grows almost exclusively robusta coffee. The production of arabicas is concentrated in India and Papua and New Guinea, countries that both also produce robusta coffees.

1.15 Arabica coffees are generally preferred by the consumers. They have a milder flavor, and contain less caffeine than do robustas. However, the tree is more susceptible to diseases and gives lower yields. Also, arabica coffee gives a lower yield of instant coffee per pound of beans. The steady increase in the consumption of instant relative to regular coffee therefore has improved the position of robustas in the world market, and may explain in part the decline of the price premium of arabicas over robustas over the past decade.

1/ Up to 1967 under the International Coffee Agreement only Mild Arabicas, Unwashed Arabicas and Robustas were distinguished. The carving out of "Colombian Milds" out of the Mild Arabicas as a separate category was done at the insistence of Colombia. The Agreement foresaw in the automatic adjustment of the export quota of each group based upon price developments. Since Colombia accounted for 80% of the exports of the new group, it could now, through changing its official quotations, influence its export quota.

2.1.6 A typical characteristic of arabica coffee production is the biennial production cycle. If production is low in any one year due to drought or other climatic conditions, the tree tends to accumulate strength and to produce a bumper crop in the next year. This exhausts the tree, leading to a low production in the following year, during which it can gather strength for a new bumper crop. This process can continue indefinitely, until another climatic adversity changes the phase of the cycle. The cycle can be countered by pruning (e.g. alternate row pruning) which would even out production by having both trees in their "off-year" and trees in their "on-year" on the same plot, but this is not widely practiced. Although every tree crop can be subject to the cyclical effect described here, robusta coffee does not display this cycle to any comparable degree.

2.1.7 The importance of the larger coffee producing countries in total world coffee production is given in Table 1. This table also indicates the type of coffee grown, the growth rate of production in the post-World War II period, and the share of coffee in the total foreign exchange earnings of the countries concerned.

Specification of the Equations

2.2.1 The supply equations derive directly from the technical and economic characteristics of production. It takes about 5-6 years before a coffee tree reaches its normal production level, and another 1-2 years before the decision to plant is reached and the seedlings and the land have been developed. Therefore present production capacity is thought to be determined by past production capacity and past prices with an average lag of seven years. Past production has been taken as a proxy of past production capacity, for lack of better indicators. 1/ How much will be produced with the present

1/ This assumes, of course, that producers in determining the scope of new

Table 1: Coffee Producing Countries: Type of Coffee Grown, Share in World Production, Growth Rate and Share of Coffee in Export Earnings

	Type of Coffee[1]	Production[2] and Shares						Growth Rate[3] 1947/48-1972/73 (% p.a.)	Share of Coffee in Export Receipts[4] 1970-1972 (%)
		1948-1952 ('000 bags)	(%)	1958-1962 ('000 bags)	(%)	1968-1972 ('000 bags)	(%)		
WORLD TOTAL		38,591	100.0	50,370	100.0	65,454	100.0	2.87	[illegible]
Arabicas[5]		33,696	87.3	56,960	80.8	45,801	70.0	1.7	[illegible]
Robustas[5]		4,895	12.7	13,510	19.2	19,653	30.0	7.2	2.1
South America		26,139	67.7	44,237	62.9	28,309	43.3	.8	11.7
Brazil	Unwashed Ar.	19,486	50.5	34,250	48.7	17,275	26.4	-.0	27.7
Colombia	Col. Mild Ar.	5,593	14.5	7,783	11.1	7,904	12.1	.6	58.9
Ecuador	Other Mild Ar.	299	.8	735	1.0	1,048	1.6	6.4	8.6
Peru	Other Mild Ar.	102	.3	568	.8	980	1.5	11.7	4.4
Venezuela	Other Mild Ar.	625	1.6	829	1.2	926	1.4	1.2	.4
North America		6,262	16.2	9,501	13.5	12,101	18.5	3.3	7.2
Costa Rica	Other Mild Ar.	368	1.0	1,062	1.5	1,320	2.0	6.2	28.9
Dominican Rep.	Other Mild Ar.	387	1.0	546	.8	677	1.0	2.7	[illegible]
El Salvador	Other Mild Ar.	1,216	3.2	1,613	2.3	2,332	3.6	3.3	16.8
Guatemala	Other Mild Ar.	1,103	2.9	1,600	2.3	1,978	2.9	3.0	33.7
Haiti	Other Mild Ar.	614	1.6	572	.8	529	.8	-.9	43.2
Honduras	Other Mild Ar.	174	.4	332	.5	505	.9	6.4	14.7
Mexico	Other Mild Ar.	1,158	3.0	2,117	3.0	3,257	4.9	5.4	4.9
Nicaragua	Other Mild Ar.	336	.9	456	.6	625	1.0	3.4	15.5
Latin America		32,401	84.0	53,738	76.4	40,410	61.7	1.4	10.7
Africa		4,732	12.3	13,149	18.7	19,758	30.2	7.2	6.1
Angola	Robusta	749	1.9	2,382	3.4	3,346	5.1	7.8	41.4
Ethiopia	Unwashed Ar.	521	1.3	1,258	1.8	2,100	3.2	6.8	54.3
Kenya	Col. Mild Ar.	175	.5	513	.7	974	1.5	8.5	20.6
Malagasy	Robusta	547	1.4	813	1.2	1,040	1.6	3.1	24.3
Tanzania	Col. Mild Ar.	258	.7	443	.6	855	1.3	6.1	16.1
Uganda	Robusta	609	1.6	1,952	2.8	3,065	4.7	8.2	58.8
Zaire	Robusta	536	1.4	1,089	1.5	1,240	1.9	3.4	5.6
Ivory Coast, Togo and Guinea[6]	Robusta	965	2.5	2,977	4.2	4,676	7.1	6.2	22.5
Asia		1,459	3.8	3,471	5.0	5,285	8.1	7.0	.5
India	Other Mild Ar.	341	.9	908	1.3	1,462	2.2	7.0	1.9
Indonesia	Robusta	822	2.1	1,730	2.5	2,288	3.5	6.5	5.2

1/ Classification as made by ICO.
2/ Weighted average over five years with weights of 1, 3, 4, 3, 1 respectively.
3/ Determined by regressing the logarithm of production on time.
4/ LDC's only
5/ Arabica producers are Latin America plus Kenya, Tanzania, Ethiopia and India. This excludes some minor producers due to the unavailability of data. Robusta producers are taken to be all other countries.
6/ More than 90% of production from Ivory Coast.

Source: Production data: USDA, Shares of Coffee in Export Receipts: IMRD.

capacity depends on the price of one year ago, and, for arabica production, on the phase of the biennial cycle. The general form of the equation used thus becomes

$$Q_t = Q_t(QAV_{t-7}, PAV_{t-7}, P_{t-1}, Q_{t-1}/Q_{t-2})$$

where Q stands for production and P for prices. The addition of the letters "AV" denotes that the single value for the year concerned has been replaced by a moving centered average[1/]. The last term on the right hand side indicates the change in production over the past period, and is used in the equations for the arabica producing regions to capture the effect of the biennial cycle.

2.2.2 Production has been used as a proxy for capacity because data planted and/or area harvested are mostly not available on an annual basis. And even if they are available, they are much more unreliable than production data. In most producing countries the domestic consumption of coffee is insignificant, and stocks are not held. Therefore, exports (plus, where relevant, estimates of domestic consumption and stock changes) give a fairly reliable indication of production. To determine the area under coffee, however, would require extensive field counts, which are at best done every 5 or 10 years under an agricultural census. Therefore, the only real choice is between actual production and time as an indicator of capacity.

2.2.3 The decision against using time as an indicator of past capacity was taken on a priori grounds. The use of time for this purpose invariably leads to an underestimation of both the long term and the short term price elasticity of supply. The reasons are obvious. High prices arise when

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1/ In the case of prices, an unweighted three year moving centered average has been taken. In the case of production, a weighted five year moving centered average with weights 1,3,4,3,1 has been used. Weighing in this case is necessary to eliminate the influence of the biennial cycle on these data.

production capacity falls below its secular trend. A time trend per definition neglects the cyclical movements of capacity. Therefore, introduction of a time trend as a proxy for past production capacity overestimates existing capacity at a time of high prices, and thus underestimates the long term response to high prices. In times of low prices production is underestimated, which leads to an overestimate of the long-term response to low prices, i.e. an underestimate of the negative effects of low price levels. As to the short term price response, if production is regressed on time and one year lagged prices alone, it is clear that a negative short term elasticity of supply with respect to price will result: high prices and low production are concomitant, and time now functions as an estimator of present capacity. When apart from time, both the one year lagged and the seven year lagged price are introduced, the time trend functions as a hybrid indicator of both past and present production capacity, and both elasticities will tend to be underestimated.

2.2.4 A second disadvantage of using time as a regressor in such cases is that it leads to a constant growth trend (either in absolute amounts or as a growth rate) over the projection period, whatever the level of prices. This, of course, makes the projections totally unreliable, since it is clear that there are prices at which coffee production (or the production of any other commodity for that matter) will not grow at all, as well as prices at which production growth would far exceed the historical rates.

2.2.5 The equations have been estimated in a double logarithmic form, yielding direct estimates of the elasticities of supply.

The Long-term and Short-term Elasticities of Supply

2.3.1 Before considering the actual results of the regressions, it should be pointed out that there are two factors that influence both the short and the long term elasticity of coffee supply. These are the degree to which the economy

2.3.2 In a country whose economy is highly dependent on coffee production both the short term and the long term elasticity of supply tend to be low. As to the short term elasticity of supply, since many people depend largely or exclusively on the cultivation of coffee, the chance that coffee will be neglected at times of low prices (and therefore that an increase in prices can have a marked effect on production in the short run) is rather small. Since farmers have no significant other sources of income, they have little other choice than to continue attending to their coffee holding.1/ What they can do is use less fertilizers (if they use any fertilizers at all) and hire less labor during the harvesting season, when, due to the peak in labor requirements during this time, outside labor has to be used. This will lead to less careful picking (e.g. all cherries are stripped off at once, without consideration of the varying stages of ripeness in which they are), and an inferior quality of the product by consequence, but the quantity produced declines only marginally. Roughly the same reasoning that applies to the individual farmer also applies to the country as a whole. Due to its important place in the economy coffee is not likely to be neglected in the case of unfavorable prices. Also, there will be pressure on the government to soften the impact of low prices on its farmers by lowering the taxes on coffee and the government may even be tempted to stimulate coffee production in order to improve its sagging foreign exchange receipts. As to the long run, many farmers have already a major share of their holding under coffee, and can only expand to a limited degree. Also, from a country point of view, the high degree of dependence on coffee will make the government reluctant to stimulate a large expansion of coffee production, since this would only increase its vulnerability to coffee price fluctuations.

1/ Of course there is the alternative to move out of coffee altogether, but this is a very drastic decision, especially for small coffee growers without alternative sources of income.

2.3.3 Exactly the opposite of the above can be said for countries where coffee is an agricultural product of only minor importance. In a time of low prices the government will tend to neglect the coffee sector, and the farmer will turn his attention to the other products he cultivates. When prices subsequently increase, farmers will start to devote considerably more time to their coffee holding, and at the same time they may start substituting coffee for other crops. And the government will not feel inhibited in stimulating the expansion of production by the disadvantages of a growing monoculture.

2.3.4 The second factor in determining the price elasticities of supply is the type of holding. The estate sector generally shows a higher short term elasticity of supply than the small-holder sector. In a time of low prices, the small-holder certainly can neglect his coffee holding, but he will nearly always pick at least a part of the coffee. An estate holder, however, can very well decide to stop attending to his estate altogether. He has alternative uses for his funds, whereas the small-holder may not have any alternative uses for his labor.

2.3.5 There is no reason to assume any significant differences in the long-term elasticity of supply on the basis of the type of holding alone. Only when a country has ample virgin lands available will an estate economy be able to expand at a higher rate since large investments are needed to develop new lands for agricultural production. This explains why Brazil, a country which was until a short time ago highly dependent on coffee, could nevertheless show such an enormous expansion in production after the price boom of the mid-fifties.

2.3.6 The elasticities that result from the supply equations (the equations will be dealt with in the next section) are given in Table 2.

Table 2: Elasticities of Production with Respect to Prices, by Region

Region	Short Term Price Elasticity (lag 1 year)	Long Term Price* Elasticity (lag 7 years)
Brazil	.20 (fixed)	.444 (.103)
Colombia	.03 (fixed)	.176 (.042)
Other South America	.062 (.081)	.460 (.051)
North America	.030 (.034)	.137 (.024)
Africa	.123 (.059)	.436 (.042)
Asia and Oceania	.10 (fixed)	.433 (.180)
World (excluding Brazil)	.056 (.031)	.291 (.021)

* Strictly speaking this is a kind of "medium term" price elasticity of supply, since it measures changes over a seven year period only.

2.3.7 Looking at Table 2, the long-term price elasticities of supply conform fairly well to what was said earlier. Colombia as well as the main North American coffee producing countries are highly dependent on coffee, and production comes mostly from smallholders. Brazil also depended heavily on coffee in the past, but nearly all of its production is done on huge estates and it had extremely large resources in virgin land that was suitable for coffee cultivation. Other countries in South America, Africa and Asia and Oceania do not depend on coffee to the degree of the first three regions mentioned, although the rate of dependence in Africa has been growing rapidly over the period.[1/]

1/ It should be noted here that a country can be highly dependent on coffee for its export earnings whereas at the same time coffee is only of minor importance in the agricultural economy, like was true for many African countries in the initial stages of their economic development.

2.3.8 The pattern of short term elasticities is less satisfactory. This is not astonishing since for tree crops the effects of exogenous factors like wars, government policies and climatic circumstances are generally larger than the production changes that can be brought about by the short term price response. Therefore, it is not unexpected that the greatest difficulties arise in the "regions" that are dominated by one country, i.e. in Brazil, Colombia and Asia and Oceania (where up to 1960 Indonesia accounted for over 50% of total production). Actually, the values of the short term elasticities of supply for these regions had to be fixed in advance, since the values that resulted from the regressions were unacceptable.

2.3.9 Of course, statistically the most elegant solution would have been to omit the one year lagged price as an independent variable. But the existence of a positive short term price response is undeniable from a theoretical point of view, and since we want to use the model for forecasting purposes, we have preferred to retain this variable as a regressor and to adjust its coefficient where necessary. The reasons behind the adjustments are given in the next section.

Regression Results

2.4.1 Supply equations have been estimated for six regions: Brazil, Colombia, Other South America, North America, Africa and Asia and Oceania. Brazil and Colombia have been singled out because of the large share of the market they command (at present around 30% and 10% respectively). The other regions have been selected on a geographical basis. The period covered is 1947/48 through 1972/73. Production figures from 1945/46 onwards are those given by the USDA. For the years prior to 1945/46, FAO data was taken. The price used is the United States unit value of coffee imports (reported on an f.o.b. basis), deflated by the United States wholesale price index (1967 = 100).

1. Brazil

2.4.2 The supply equation for Brazil is the most complicated of the six supply equations. The equation in its estimated form is

$$\log Q_t^{br} = \underset{}{0.69} + \underset{(1.4)}{0.33} \log QAV_{t-7}^{br} + \underset{(4.3)}{0.44} \log PAV_{t-7}$$

$$+ \underset{(\text{fixed})}{0.20} \log P_{t-1} - \underset{(2.0)}{0.15} \log (Q_{t-1}^{br}/Q_{t-2}^{br})$$

$$- \underset{(2.0)}{0.47} (S_{t-7}^{prod} - S_{t-12}^{prod})/QAV_{t-7}^{br}$$

$$- \underset{(3.1)}{0.36} D1_t^{br} - \underset{(6.6)}{0.83} D2_t^{br}$$

$R^2 = .84$ DWS = 1.89

The first four variables on the right hand side conform to the general pattern of the supply equations discussed above. The last three variables are specific for Brazil and require some explanation.

2.4.3 Brazil is exceptional in the coffee world due to its large share of the market. For a long time it supplied over half of the world's coffee, and even today it still accounts for 30% of world coffee exports. Since the price elasticity of world demand for coffee is only around -0.25, Brazil thus is the sole country that can increase its export receipts by restricting its exports. This explains why 80% of world stocks in the years of oversupply in the early sixties were accumulated by Brazil. Therefore, it is only logical that, apart from prices, stock developments also play a role in determining the changes in Brazilian coffee production capacity.

2.4.4 The variable that accounts for the influence of stock developments on Brazilian production policy is $(S_t^{prod} - S_{t-5}^{prod})/QAV_t^{br}$, where S^{prod} stands for stocks in the producing countries. This variable measures the change in

stocks[1] over the last five years in relation to the present level of production, or, in other words, it measures the extent to which production over this period has fallen short of or exceeded the requirements of domestic consumption and exports. Since this will mainly affect long term production targets, the above variable has been used as a regressor with a lag of seven years.

2.4.5 Coffee trees are heavily damaged by the occurrence of frosts. Although Brazilian production has always been affected by frosts from time to time, frosts only became a major determinant of Brazilian production after coffee production moved massively southward into the frost-prone state of Parana in the middle and late fifties. Over the past 25 years five major frosts have been reported: in 1953, 1955, 1963, 1969 and 1972. Since frosts affect only next year's production, the effects of the frosts of 1972 fall outside the estimation period. For the other frosts dummy variables have been introduced: one ($D1^{br}$) for the frosts of 1953 and 1955 and one ($D2^{br}$) for the frosts of 1963 and 1969. The use of two separate dummy variables is necessary, since the importance of Parana in total production has changed drastically over this period: the share of Parana in the total area under coffee in Brazil increased from 15% in the mid-1950's to 35% in the early 1960's.

2.4.6 If no restrictions are applied, the supply equation for Brazil yields a negative short term elasticity of supply of -0.1 (t-value 0.7). One of the reasons for this may be that for Brazil, exceptionally, shipments are not a good indicator of production,[2] since many estates store their coffee for years according to their price expectations. Nevertheless, a relatively strong short term price elasticity of supply has to be expected in a country where virtually

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1/ Ideally, data on Brazilian stocks instead of data on total producer stocks should have been used. Such data is not available, however. For the estimation period this does not cause problems since Brazil was holding nearly all of the producer stocks.

2/ Data before 1960 are mainly based on shipments from the interior.

all production comes from huge commercial estates. Therefore, we have fixed the elasticity at 0.2, a value that seems reasonable in relation to the values obtained for the other regions.

2. Colombia

2.4.7 Colombia is the only Arabica producing region that does not show a significant biennial cycle if $\log(Q_{t-1}/Q_{t-2})$ is used as a regressor. Actually in conjunction with the other variables this variable even gets the wrong sign. Therefore, we have replaced this variable with a dummy variable, $D1^{col}$, equal to 1 on "on-years", -1 in "off-years" and zero in years in which the phase of the cycle cannot be unequivocally determined. In addition, the short-term elasticity of supply turns out negative (-0.05, t-value 0.8). This can be regarded as a statistical caprice, although the civil war that ravaged Colombia in the early 'fifties, exactly the time of the highest coffee prices, could be at least partly responsible for this phenomenon. We have fixed the short-term elasticity for Colombia at 0.03, the same value as found for North America, where coffee is produced under very similar conditions. The final result is the following supply equation:

$$\log Q_t^{col} = \underset{}{1.46} + \underset{(5.7)}{0.56} \log QAV_{t-7}^{col} + \underset{(4.2)}{0.18} \log PAV_{t-7}$$

$$+ \underset{(\text{fixed})}{0.03} \log P_{t-1} + \underset{(1.6)}{0.03} D2_t^{col}$$

$$R^2 = .80 \qquad DWS = 1.58$$

2.4.8 In Colombia the recent planting of the high yielding caturra varieties has given a boost to production that is not captured by the equation. Present information leads us to believe that an addition of 15% to the forecast values can account for this factor. This correction, which does not affect the estimation period, leaves the price response

3. Other South America

2.4.9 The main coffee producers in this region are Ecuador, Venezuela and Peru. Production in Venezuela has been fairly stagnant, and the long term price response has been weak. Peru, on the other hand, has been growing very rapidly, displaying a very high long term price elasticity of supply. Ecuador is the "average" producer in the area, both where the rate of growth and the pattern of price responses is concerned. The equation for the region is "standard" and requires no specific explanation:

$$\log Q_t^{sam} = \underset{}{-5.26} + \underset{(16.0)}{0.96} \log QAV_{t-7}^{sam} + \underset{(9.0)}{0.46} \log PAV_{t-7}$$

$$+ \underset{(0.8)}{0.06} \log P_{t-1} - \underset{(2.2)}{0.25} \log (Q_{t-1}^{sam}/Q_{t-2}^{sam})$$

$R^2 = .96$ DWS = 2.06

4. North America

2.4.10 The largest producer in the area is Mexico. Since domestic consumption in Mexico is fairly high, it ranks only third as an exporter, after El Salvador and Guatemala. Further important producers are Costa Rica, Dominican Republic, Honduras, Haiti and Nicaragua, which all produce more than half a million bags per year at present. All the countries in the area show rates of growth and long term price elasticities which are close to the average for the region. The only exceptions are Costa Rica, which shows a very high long term price elasticity of supply, and Haiti, where production has been marginally declining over the post-war period. As for Other South America, the equation for North America does not cause any special problems:

$$\log Q_t^{nam} = \underset{}{-0.63} + \underset{(23.6)}{0.82} \log QAV_{t-7}^{nam} + \underset{(5.8)}{0.14} \log PAV_{t-7}$$

$$+ \underset{(0.9)}{0.03} \log P_{t-1} - \underset{(3.4)}{0.34} \log (Q_{t-1}^{nam}/Q_{t-2}^{nam})$$

5. Africa

2.4.11 The importance of Africa in world coffee production has grown steadily after the Second World War. By now, Angola and the Ivory Coast immediately follow Brazil and Colombia on the list of the largest coffee producers in the world. Further large producers are Uganda, Kenya, Tanzania, Ethiopia, Malagasy Republic and Zaire. Nearly all of these countries show fairly high long term price elasticities of supply. The supply equation for Africa in the model is of the standard type:

$$\log Q_t^{afr} = \underset{}{-3.41} + \underset{(28.5)}{0.77} \log QAV_{t-7}^{afr} + \underset{(10.5)}{0.44} \log PAV_{t-7}$$

$$+ \underset{(2.1)}{0.12} \log P_{t-1}$$

$$R^2 = .99 \qquad DWS = 2.27$$

2.4.12 If Africa is split up into an arabica producing region (Kenya, Tanzania and Ethiopia) and a robusta producing region (all other countries)[1/] the arabica producing region shows a lower long term and a higher short term elasticity of supply than the robusta producing region. The higher short term elasticity of supply is caused by the estate structure of production under British rule in Eastern Africa: when prices increased after the war, it was easy to bring the derelict estates into production again, especially since the coffee was grown under shade trees, a situation that makes it possible to neglect the coffee for years without any harmful effects to the plantation. The lower long term elasticity of supply reflects the fact that

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1/ This division is not totally correct, since arabica producing countries like Rwanda and Burundi are included in this group, but the data does not contain separate figures for these countries.

coffee production in Eastern Africa was much more firmly established before the price boom of the mid-fifties than it was in Western Africa, or, in other words, that Eastern Africa was more dependent on coffee production. On this basis, it might be expected that the long term price elasticity of supply for Africa as a whole will be somewhat lower now than it was in the past, since the dependence on coffee production in many African countries has grown rapidly over the past 20 years.

6. Asia and Oceania

2.4.13 If the standard supply equation is used for Asia and Oceania, a short term price elasticity of supply of 0.4 results. This is difficult to believe, but fortunately easy to explain. From 1940 to 1949 Indonesia, which produced 80% of the region's total output in the preceding decade, was involved in war. First it was occupied by the Japanese during World War II, an afterwards it waged a struggle for independence from the Dutch. Production, which was at a level of 2 million bags up to 1939/40, dropped abruptly to almost nil afterwards. This leads to a serious underestimation of production capacity, and the rapid recovery of production in the early 1950's is therefore attributed to the then prevailing high prices by the regression. Also, the low production up to 1949 is being attributed to the low prices in the early post-war period, instead of to the effects of the war for independence.

2.4.14 To account for the effects of the wars in Indonesia, two dummy variables have been used. One, $D1^{as}$, is needed to capture the direct effect of the war on production in 1947/48 through 1949/50.[1/] A second variable,

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1/ This variable equals unity in 1947/48, 1948/49 and 1949/50, and zero in all other years.

$D2^{as}$, is needed to correct for the underestimation of lagged production capacity, which affects the first ten observations.[1] The short term elasticity of supply has been fixed in advance at 0.1, roughly the same value as was found for Africa. The resulting equation is

$$\log Q_t^{as} = \underset{}{-4.34} + \underset{(6.5)}{0.86} \log QAV_{t-7}^{as} + \underset{(2.4)}{0.42} \log PAV_{t-7} + \underset{(fixed)}{0.1} P_{t-1}$$

$$- \underset{(5.0)}{0.60} D1_t^{as} + \underset{(1.7)}{0.40} D2_t^{as}$$

$$R^2 = .94 \qquad DWS = 1.42$$

2.4.15 In the Asia and Oceania region, Indonesia and India are the largest producers. Indonesia depended much more haavily on coffee than India, and therefore shows a lower than average long term price elasticity of demand. India, on the other hand, has shown a long term price response that was far more marked. The area's third largest producer are the Philippines, a country t consumes domestically all the coffee it produces (around 0.8 million bags at pro

Production Growth Rates and Equilibrium Levels at Constant Prices

2.5.1 As stated earlier, the structure of the supply equations used allows us to calculate the rates of growth of coffee production in the various regions at different price levels. Omitting the variable for the biennial cycle[2], the general equation reads

$$\log Q_t = a + b_1 \log QAV_{t-7} + b_2 \log PAV_{t-7} + b_3 \log P_{t-1}$$

At a constant price PC the growth rate over a seven year period will be

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1/ This variable equals 0.5 in the first and the tenth year of observation, unity in the intervening years, and zero in all other years. The lower values at the tail ends of the series are required because lagged production is measured as a five year moving average.

2/ In actual calculations, a correction factor has been applied based on the average rate of growth of production over the estimation period.

equal to the exponential of

$$\log Q_t - \log Q_{t-7} = a + (b_1 - 1) \log Q_{t-7} + (b_2 + b_3) \log PC$$

If $b_1 = 1$, the growth rate is dependent on prices alone. Otherwise, it also depends on the starting level of production. Since actually b_1 is smaller than unity in all cases, the growth rate at constant prices declines with increasing production.

2.5.2 The growth rates of production by region, starting from the 1972 production level, are given in Table 4 under different price assumptions. Although it is dangerous to attach too much value to the exact magnitudes of the growth rates in the Table, it is tempting to derive some tentative conclusions from the patterns shown by these growth rates. First, in order for world production to grow by about 2% p.a. (corresponding to the generally expected rate of consumption growth) an average price of around US¢40 per pound in 1967 constant terms, f.o.b. producing countries, would be required. This equals roughly US¢ 62 in 1974 prices. Second, production expansion will then mainly come from Other South America, Africa and Asia and Oceania. The growth potential of the traditional coffee producing regions is very limited and their relative importance in total production will continue to decline in such a case.

Table 4: ANNUAL COMPOUND GROWTH RATES OF PRODUCTION AT VARIOUS CONSTANT PRICE LEVELS, STARTING FROM 1972 PRODUCTION LEVELS, BY REGION

Region	Price level (US¢ per lb) in 1967 constant terms					
	20	30	40	50	60	70
	----------percent per annum----------					
Brazil	-5.1	-1.5	1.1	3.2	5.0	6.5
Colombia	-2.4	-1.2	-0.4	0.3	0.8	1.3
Other South America	-1.3	1.7	3.9	5.7	7.1	8.3
North America	0.2	1.1	1.8	2.4	2.8	3.2
Africa	-2.3	0.9	3.3	5.1	6.7	8.0
Asia and Oceania	-1.8	1.3	3.5	5.3	6.8	8.0
World (ex Brazil)						

2.5.3 The rate of growth to be expected in a certain region at a given price declines with increasing production, or, saying the same thing in other words, the price needed to cause production to increase at a constant rate increases over time. At a given price production will thus always approach a certain long term equilibrium level. These levels, together with the production level reached in the year 2000 if prices would be at the level indicated from 1975/76 onwards, are given in Table 5.

2.5.4 The purpose of Table 5 is to bring out clearly the implications of the supply equations used. In all equations, the rate of growth of production at a given constant price level declines with increasing production. This decline has to be explained as a reflection of the increasing costs of additional production.[1/] In the case of Brazil and Colombia, the rate of growth declines very rapidly, and production already very closely approaches its equilibrium level in the year 2000. In the other regions growth rates decline more slowly, and it takes production much longer to attain its equilibrium level under any given price.

2.5.5 The levels of production in the year 2000 under different constant price assumptions have, of course, more meaning in terms of the model than the long term "equilibrium levels". The latter are mainly important in as far as they give an indication of the speed with which growth rates are projected to decline with increasing production. Also they are more sensitive to changes in the equations than either the growth rates of Table 4 or the

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1/ Although the structure of the equation is similar to that of the partial adjustment model, the time lag involved is much too long to warrant an explanation in these terms.

Table 5: LONG TERM EQUILIBRIUM LEVELS OF PRODUCTION AT DIFFERENT CONSTANT PRICE LEVELS

Region	Price Level (US¢ per lb) in 1967 Constant Terms						1972 Production level
	20	30	40	50	60	70	
	in millions of bags						
Brazil	14	21	27	33	40	46	24
(year 2000)	(14)	(21)	(27)	(33)	(39)	(45)	
Colombia	7	8	10	10	11	12	9
(year 2000)	(7)	(8)	(10)	(11)	(11)	(12)	
Other South America/1	1	55	..	..	..	..	3
(year 2000)	(3)	(6)	(9)	(13)	(17)	(22)	
North America	14	20	26	33	39	45	13
(year 2000)	(14)	(17)	(19)	(21)	(23)	(24)	
Africa	11	28	56	96	148	214	22
(year 2000)	(15)	(27)	(40)	(54)	(70)	(87)	
Asia and Oceania	2	11	32	74	144	256	6
(year 2000)	(5)	(8)	(12)	(17)	(23)	(29)	
World excl. Brazil/2	35	77	136	210	301	407	52
(year 2000)	(45)	(66)	(86)	(105)	(125)	(144)	
WORLD TOTAL /3	49	98	163	243	341	453	76
(year 2000)	(58)	(87)	(117)	(149)	(183)	(219)	

/1 Values for Other South America become unrealistically large at higher prices. These values are only reached in the extremely far future, however, and have no implications for the forecasting properties of the equation, as can be seen from the reasonable values for the year 2000.

/2 From separate equation.

production levels in the year 2000 in Table 5.[1/]

2.5.6 Although the data in Table 5 (and, for that matter, in Table 4) follows from purely mechanical operations, the results seem to us to be fairly realistic, and we therefore have no reservations in using the underlying supply equations in a forecasting model.

1/ This can easily be seen by comparing the regional figures with the figures for "World excl. Brazil". Although the latter figures derive from a separate equation, the results are very close to the totals arrived at by adding the regional figures (excluding Brazil) as far as the hypothetical levels for the year 2000 are concerned. Differences are much larger for the "equilibrium levels", however.

III. THE DETERMINATION OF DEMAND

Coffee Consumption

3.1.1 The technical aspects of the conversion of coffee beans into coffee as a beverage are fairly simple: the green beans are roasted, ground, and the soluble parts are then extracted with hot water. The result can either be consumed directly, or it can be "re-solidified" by evaporating (or freezing) the water, yielding soluble coffee.

3.1.2 Soluble coffee was first sold in the USA in 1951, and has rapidly gained ground afterwards. Its share in the market depends to a large extent on local tastes and habits. It is around 17% in the USA, around 80% in the UK, and less than 10% in the Scandinavian countries. The share of soluble coffee in the retail market generally is largest in countries where the popularity of coffee as a beverage is only a very recent phenomenon.

3.1.3 The existence of soluble coffee causes statistical problems both on the consumption and on the production side. As a general rule one pound of soluble coffee is taken to be equivalent to three pounds of green coffee beans. From the point of view of consumption this ratio is too low: one pound of soluble coffee yields up to 50% more cups of coffee than can be extracted by the consumer from the equivalent amount of roasted coffee beans.[1/] This means that, although the rise of soluble coffee may have benefitted coffee consumption in terms of the number of cups consumed, it not necessarily has benefitted consumption in terms of the use of coffee in green bean form. From the point of

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1/ One pound of roasted coffee is equivalent ot 1.19 pounds of green coffee. Therefore, one pound of soluble is equivalent to 2.52 pounds of roasted coffee.

view of production the ratio of 3 to 1 is too high: many manufacturers of soluble coffee manage to use only 2.5 pounds of green beans in making one pound of soluble coffee[1/].

3.1.4 Coffee is traded and sold to consumers in all stages of processing: as green beans, roasted coffee, ground coffee and soluble coffee. In trade and consumption statistics everything is converted into "green bean equivalents" according to ratios established by the International Coffee Organization. One pound of roasted or ground coffee is equivalent to 1.19 pounds of green beans, one pound of soluble coffee is equivalent to 3 pounds of green beans. Only for US consumption statistics slightly different conversion ratios are used.

3.1.5 The shares of the major importing countries in total world imports over the period 1970-1973, with comparable figures for the period 1950-1953, are given in Table 6. The Table also gives the average per capita imports over these periods.

Specification of the equations and regression results

3.2.1 In studying the demand[2/] for coffee three regions can be distinguished that require attention. These regions are formed respectively by the producing countries (i.e., the net exporting countries), the United States and the other importing countries.

3.2.2 Data on demand in producing countries are taken from the USDA. For demand in the USA the data on the "Net Civilian Visible Disappearance" has

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1/ The amount of coffee used can be estimated by dividing the amount of caffeine found in the soluble coffee by the amount of caffeine per pound of green beans, since all caffeine contained is extracted.

2/ Except for the US the available data does not allow for a clear distinction between "consumption" and "demand", and we will therefore use the two expressions interchangeably. Since the symbol D has been reserved for dummy variables, the symbol C will be used for demand (consumption) throughout this chapter.

Table 6 : AVERAGE WORLD IMPORTS OF COFFEE, TOTAL AND PER CAPITA, 1950-53 and 1970-73

	Average Annual Imports 1950-1953		Average Annual Imports 1970-1973		Per Capita Imports[1/] 1950-1953	Per Capita Imports[1/] 1970-1973
	'000 bags	% of total	'000 bags	% of total	- - in pounds per capita - -	
U.S.A.	20,034	62.8	20,986	37.6	16.8	13.3
Canada	712	2.2	1,320	2.4	10.3	8.0
Latin America	686	2.2	814	1.5	n.a.	n.a.
W-Germany	843	2.6	5,478	9.8	2.2	11.7
France	2,657	8.3	4,251	7.6	8.3	10.9
Italy	976	3.1	3,006	5.4	2.7	7.3
Benelux	1,276	4.0	3,201	5.7	8.7	18.1
Scandinavia	1,667	5.2	4,253	7.6	11.7	25.9
U.K.	656	2.1	1,770	3.2	1.7	4.2
Other W-Europe	996	3.1	3,962	7.1	1.7	5.7
Total W-Europe	9,071	28.4	25,921	46.4	3.9	8.6
Eastern Europe	107	.3	2,709	4.9	.1	1.0
Africa	854	2.7	1,196	2.2	n.a.	n.a.
Japan	30	.1	1,583	2.8	.0	2.0
Other Asia & Oceania	442	1.4	2,920	5.3	n.a.	n.a.
WORLD TOTAL	31,906	100.0	55,866	100.0	n.a.	n.a.

1/ Average annual imports divided by 1952 and 1972 population data, respectively. Not calculated for regions that include producing countries.

Sources: Data on coffee imports: PACB, various issues.
Data on population: UN data.

been used[1/]. For the other importing regions demand has been derived by subtracting US demand and changes in US inventories from world exports as reported by the USDA[2/]. Therefore, in contradistinction to the US data, the data for this last region includes the effects of changes in inventories.

3.2.3 The specifications of the demand equations have been determined on the basis of a priori assumptions about the behavior of the price and income elasticities of demand in the respective regions.

1. Producing Countries

3.2.4 Consumption of coffee in the producing regions is to a very large extent a policy variable. In times of overproduction, accompanied by low prices and burdening stocks, producing countries tend to stimulate domestic consumption by all possible means. During virtually the whole of the 1960's, for example, domestic roasters in Brazil received coffee from the government stocks at a purely nominal charge. If the market turns around, international prices increase and stocks are drawn down, the subsidies on internal coffee consumption tend to be abolished. Thus, the internal price increases more than proportionately to the international price, and therefore the elasticity of demand with respect to the international price should increase when this price rises, and vice versa. The relevant price in this case is the price of one year ago, due to the inevitable lag in policy formation.

3.2.5 The income elasticity of demand in the producing countries has been assumed to be constant. On the one hand there are many producing countries

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1/ The Net Civilian Visible Disappearance equals imports minus reexports, changes in inventories and demand by the armed forces.

2/ Series for net imports are not available for a sufficient length of time. Due to the way of calculation, the demand of the U.S. armed forces is included in the demand of "other importers", but this has only negligible effects.

where coffee consumption has hardly come off the ground (notably in Asia). In such countries the income elasticity can quite well increase with increasing incomes for some time to come. On the other hand coffee is already firmly established in Brazil, by far the largest consumer of coffee among the producing countries, and here the income elasticity of demand will definitely decrease with rising incomes. Therefore we have chosen for a constant income elasticity of demand. Income in OECD countries has been taken as a proxy for income in producing countries, not only because other data are hard to come by, but also because long term forecasts for income in other than OECD countries do not exist.

3.2.6 The equation that satisfies the above conditions is

$$\log C_t^{prod} = a_{11} + b_{11} \log Y_t^{oecd} + b_{12} (P_{t-1})^2$$

where C^{prod} stands for coffee consumption in the producing countries, Y^{oecd} for real OECD income, and P for prices. In this equation the income elasticity of demand equals b_{11}, whereas the price elasticity of demand is equal to $2\, b_{12} (P_{t-1})^2$. Estimation gives (t - values in parentheses):

$$\log C_t^{prod} = 2.414 + \underset{(19.2)}{0.777} \log Y_t^{oecd} - \underset{(7.9)}{0.906}\ 10^{-8} (P_{t-1})^2$$

$$R^2 = .964 \quad DWS = 2.684$$

2. U.S.A.

3.2.7 Consumption in the USA shows a remarkable pattern. It recovered quickly after the second World War. The peaking of coffee prices in 1953-1954 led to a sudden and fairly marked decline, but consumption picked up again afterwards. The rate of growth over the whole of this period was diminishing rapidly, however, and since 1962 consumption has actually been declining.

3.2.8 The US consumers seem to accept moderate price fluctuations fairly easily. However, when prices of coffee rise markedly, an increasing consumer

resistance starts to develop and this can lead to significant cutbacks in consumption at higher price levels. Therefore, we have assumed that the price elasticity of demand will increase with increasing prices, although at a lower rate than is the case for consumption in the producing countries. Since the series for US consumption was derived by averaging figures based on calendar years, the one year lagged price has been added as an independent variable.

3.2.9 Coffee consumption in the US has obviously been rapidly approaching its saturation level, and therefore the income elasticity of demand has to decline sharply with increasing income. Unless one is prepared to accept a negative income elasticity of demand from a certain income level onwards, however, no explanation of the decline in consumption over the past decade can be found.[1/] Therefore we have simply added a time trend to the equation in the form of a normal distribution curve. This variable captures both the short pre-1962 rally in consumption as well as the post-1962 decline, under the assumption that the decline will taper off in future.

3.2.10 The desired behavior of elasticities has been obtained by fitting the following equation

$$C_t^{usa} = a_{21} + b_{21} \ (Y_t^{usa})^{-4} + b_{22}P_t + b_{23}P_t/P_{t-1} + b_{24}\exp\ (\ 0.1(t-16)^2)$$

Here C^{usa} refers to US consumption and Y^{usa} to US real income. The income elasticity of consumption is equal to $-4.\ b_{21}\ (Y_t^{usa})^{-4}/C_t^{usa}$ and thus declines extremely rapidly with increasing income, whereas the price elasticity of consumption, equal to $b_{22}\ P_t/C_t^{usa}$ if one abstracts from the third term on the

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1/ Actually, since we regress consumption on total, and not on per capita consumption it can be argued that a negative income elasticity of per capita coffee consumption from a certain level of income upwards is already implied in our reasoning.

right hand side 1/, increases with price. Estimation of the equation yields (t - values in parentheses):

$$C_t^{usa} = 22{,}909 - \underset{(10.1)}{0.253\ 10^{18}\ (y_t^{usa})^{-4}} - \underset{(14.1)}{0.646\ P_t}$$

$$+ \underset{(2.6)}{912\ P_t/P_{t-1}} + \underset{(3.5)}{584} \exp\ (-0.1(t-16)^2)$$

$$\bar{R}^2 = .955 \quad DWS = 1.77$$

3. Other Importing Countries

3.2.11 As to the price elasticity of the demand for coffee in the other importing regions, we see no specific reasons for assuming this elasticity to be other than constant. The income elasticity of demand will slowly decline with rising incomes, however. The bulk of consumption in this region occurs in Western Europe, where coffee consumption is already firmly established, and a number of countries, especially in North-Western Europe, are approaching saturation levels in per capita consumption. On the other hand, the "region" also includes countries like Japan, where coffee consumption has only recently started to grow, and countries like those of Eastern Europe, where coffee consumption is kept at very low levels due to extremely high taxes. Therefore, the rate at which the income elasticity of demand decreases with increasing income should be very moderate. The inclusion of changes in US inventories as an independent variable in the equation has no explanatory meaning. It is only a device to correct the "consumption" series for inventory changes. 2/

1/ This term has the effect of lowering the short-run price elasticity in the estimated equation by about one third at price levels of around US¢40 per pound.

2/ Inventory changes in Europe, for which only short series are available, run roughly parallel with those in the US. The average level of US inventories hardly changed over the estimation period, and therefore no major problems [illegible] For the forecast period no changes in US inventories are assumed.

3.2.12 The demand equation for the "other importing countries" is

$$\log C_t^{other} = a_{31} + b_{31} (Y_t^{other})^{-3/8} + b_{32} \log P_t + b_{33} S_{t+1}^{usa}/S_t^{usa}$$

In this equation C^{other} stands for demand in the "other importing countries", Y^{other} for real income of the OECD countries excluding the USA and S^{usa} for the opening inventories in the US. The price elasticity of consumption is constant at b_{32}, whereas the income elasticity of consumption, $-0.375\ b_{31}(Y_t^{other})^{-3/8}$, declines slowly with increasing income. The estimated form of the equation is

$$\log C^{other} = 14.31 - \underset{(51.8)}{54.70}\ (Y_t^{other})^{-3/8} - \underset{(9.5)}{0.262} \log P_t + \underset{(5.7)}{0.146}\ S_{t+1}/S_t^{usa}$$

$R^2 = .995$ DWS = 2.52

Values of the Elasticities

3.3.1 Since most elasticities in the demand equations depend on the levels of prices and/or income, it is not possible to give single numerical values. Therefore, in Table 7 the values of the price and income elasticities of demand in the three regions are given at different combinations of price and income levels.

TABLE 7: PRICE AND INCOME ELASTICITIES OF DEMAND

INCOME	PRICE	PROD. COUNTRIES EL. WITH PRICE	PROD. COUNTRIES RESP. TO INCOME	USA EL. WITH PRICE	USA RESP. TO INCOME	OTHER IMPORTERS EL. WITH PRICE	OTHER IMPORTERS RESP. TO INCOME
1950	3500.	-0.222	0.777	-0.120	0.243	-0.262	1.046
1950	7000.	-0.888	0.777	-0.241	0.243	-0.262	1.046
1955	3500.	-0.222	0.777	-0.117	0.101	-0.262	0.946
1955	7000.	-0.888	0.777	-0.233	0.101	-0.262	0.946
1960	3500.	-0.222	0.777	-0.105	0.059	-0.262	0.866
1960	7000.	-0.888	0.777	-0.211	0.059	-0.262	0.866
1965	3500.	-0.222	0.777	-0.105	0.023	-0.262	0.781
1965	7000.	-0.888	0.777	-0.210	0.023	-0.262	0.781
1970	3500.	-0.222	0.777	-0.108	0.012	-0.262	0.705
1970	7000.	-0.888	0.777	-0.215	0.012	-0.262	0.705
1975	3500.	-0.222	0.777	-0.108	0.006	-0.262	0.643
1975	7000.	-0.888	0.777	-0.216	0.006	-0.262	0.643
1980	3500.	-0.222	0.777	-0.107	0.003	-0.262	0.587
1980	7000.	-0.883	0.777	-0.214	0.003	-0.262	0.587
1985	3500.	-0.222	0.777	-0.106	0.001	-0.262	0.536
1985	7000.	-0.888	0.777	-0.212	0.001	-0.262	0.536

IV. THE DETERMINATION OF PRICE

4.1.1 In the traditional model demand and supply depend on current prices, and the market-clearance price is determined by setting demand equal to supply. Unfortunately such a model is not relevant in the case of coffee. Coffee can be easily stored, and production, which is mainly determined by the prices of more than half a decade ago, production can outstrip consumption for several years in a row: total exportable supply, i.e. beginning stocks plus exportable production (production minus domestic consumption) has at times exceeded import requirements by as much as 200%.

4.1.2 A solution to the problem would be to introduce the concept of a "demand for stocks" on the part of the producing countries, but such a concept defies reality if one thinks of the fact that Brazil alone has held stocks equal to nearly one and a half year of world import requirements. Producer stocks are a residual quantity, neither planned nor wished by the producing countries, but simply forced upon them through the course of events. Since there is therefore no theoretical model that presents itself clearly as the correct and sole solution, we have estimated a single price equation, with the following result

$$P_t = \underset{(9.5)}{0.513}\, P_{t-1} + \underset{(10.6)}{2162}\, \frac{C_{t-1} + C_{t-2}}{S_t^{prod} + Q_t} + \underset{(6.3)}{-1.01}\, \left(\frac{I_t - I_{t-2}}{I_{t-2}}\right) P_{t-1} + \underset{(2.3)}{450}\, DIC_t$$

$R^2 = .960$ DWS = 2.60

Here S^{prod} are the opening stocks in the producing countries, Q is world production, C is world demand, I is the inflation index, here the U.S. wholesale price index, and DIC is a dummy variable to account for the establishment of the ICO[1/].

4.1.3 The most important explanatory variable in the equation of paragraph 72 is the second variable on the right hand side, which represents the supply-demand balance. The average demand of the last two years has been taken as a proxy for expected demand. Total supply is made up of opening stocks and total production. Since stocks have varied from almost nothing to the equivalent of more than one year of total world demand whereas the fluctuations in production have been much smaller in comparison, the stock variable is basic in determining the level of prices. The introduction of the price of last year accounts for a certain rigidity of coffee prices in the short run. The third term represents the change in real price that is solely due to the inflation over the past two years. Since it has a coefficient of -1, the equation suggests that real coffee prices lag behind inflation by about two years. The last term is a dummy variable to capture the temporary effect on prices due to the establishment of the ICO[1/].

4.1.4 The price equation suggests that, in a situation without inflation, the equilibrium value of the real price is about US¢80 when supply (production plus carry-over stocks) equals demand, as happened around 1954, US¢40 when supply is twice as large as demand, and US¢30 when supply equals between 2.5 and 3 times demand. The prices of US¢80 and US¢30 (in 1967 real terms) can be safely regarded as the upper and lower limits of price respectively. If total supplies exceed 2.5 to 3 times demand, excess stocks

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1/ The establishment of the ICO implied the regulation of the market by means of export quota, and initially importers feared that this would lead to a tighter supply situation. Over the years it became clear that this fear was totally without foundation, and prices dropped to their old levels again.

will almost certainly be destroyed, since it makes no economic sense to pay the storage costs for coffee that has no prospects of being sold anywhere in the foreseeable future. On the other hand, already long before demand can actually overtake supply, prices will start to move upwards, stimulating production. As to inflation, since it takes price about 2 years to adjust to it, real prices tend to suffer the full impact of inflation over this length of time.

4.1.5 Of course there are many factors influencing prices other than those incorporated in the equation of paragraph 4.1.2. The most conspicuous of these factors is formed by the Brazilian frosts. A frost occurring in, say, mid-1969, does generally not affect the 1969/70 production, but can decimate the harvest in 1970/71. Thus, despite a good harvest in 1969/70, prices can increase very considerably in this year in anticipation of the low outturn of the next crop year. And once 1970/71 arrives, prices can drop despite the reduced harvest when, as often happens, the frost scare had driven prices beyond what was reasonable in view of the actual size of the frost-damaged crop.

4.1.6 Additional difficulties in the determination of prices are introduced by the artificial prices quoted for Brazilian and Colombian coffees. The majority of Brazilian coffee, and a large share of Colombian coffee is sold on the basis of special contracts. Under these contracts the roaster imports coffee against the official price, and later receives a restitution on the basis of the difference between the official price and the price of a predetermined other variety[1/]. The impact of these special

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1/ At present the refund in the case of Brazilian coffee is equal to the difference between the ICO indicator for Unwashed Arabicas and a weighted average of the ICO indicators for Other Milds and Robustas (weights 60% and 40% respectively). For Colombian coffee the refund is said to bring the price actually paid down to between US¢1.5 and US¢2.0 above the price of "Other Milds". The practice of

deals could be very clearly seen in the beginning of 1971, when, due to the temporary abolishment of the special deals by Brazil, the unit value of US imports from Brazil suddenly dropped by over 20% whereas coffee prices in general moved slightly upwards. Unfortunately, however, not enough data are presently at our disposal to correct for these effects.

4.1.7 Despite the inevitable shortcomings noted above, the price equation fits the data remarkably well, and incorporates the factors we think are most important in explaining the behavior of real prices.

V. COFFEE MODEL: SIMULATION AND FORECASTS

The Model

5.1.1 Given the supply and demand equations and the price equation discussed above, only three definitional equations are needed to close the system. The first equation specifies world production (Q_t) as the sum total of production in the six regions, i.e.:

$$Q_t = Q_t^{br} + Q_t^{col} + Q_t^{sam} + Q_t^{nam} + Q_t^{afr} + Q_t^{as}$$

The second equation is

$$C_t = C_t^{prod} + C_t^{usa} + C_t^{other} + (S_{t+1}^{usa} - S_t^{usa})$$

where C_t stands for world demand. The change in US inventories has to be added because it has been excluded from the US demand equation.

5.1.2 The third equation needed is the stock equation

$$S_t^{prod} = S_{t-1}^{prod} + Q_{t-1} - C_{t-1} + SRV_{t-1}$$

The last term equals the difference between actual and theoretical or calculated beginning stocks for the year t. Such differences arise because of inconsistencies in the basic data, and because of stock destructions and official stock revisions.[1] An additional cause of differences is that from 1964/65 onwards ICO data instead of USDA data on producer stocks was used. The USDA stopped its regular reporting on producer stocks when the ICO started carrying out annual stock verifications. Therefore, since this time USDA data on stocks could no longer influence market behavior.

5.1.3 The resulting model covers the main aspects of the world coffee economy. Simulation results are given in the next sections. Later sections use the model for making projections under different sets of assumptions.

1/ Also, since only official stocks are included, the transfer of coffee stored by private coffee growers to the government stocks adds to the figure for world producer stocks without changing either demand or supply. This phenomenon is especially important in Brazil where coffee estates store huge amounts of coffee, depending on their price expectations and on the level of the government's minimum guarantee price.

Simulation of the Model

5.2.1 The model has been simulated from 1949/50 through 1985/86. A comparison between the actual and the simulated average world price (in 1967 constant US¢ per pound, f.o.b. origin) can be found in Chart I. Complete results are given in Annex II, Tables 1a-1e.

5.2.2 In the simulation the most crucial variable is the price, since it is directly influenced by all other endogenuous variables in the model. The results, as far as the price is concerned, are shown in Chart I. The small systematic deviation is caused mainly by a slight overestimation of Brazilian production in the immediate pre-1954 period. This makes for higher stocks and lower prices in the 'fifties and, by consequence, for lower production and higher prices in the sixties, than occurred in actual fact.[1/] However, due to the balancing properties of the model, this error redresses itself towards the end of the period.

5.2.3 Judging a model by the closeness of fit over the simulation period is not the only possibility. Since coffee is a tree crop, future changes in production are "foreshadowed" by earlier plantings, and the production levels forecast for the second half of the 'seventies can already partially be judged in the light of present knowledge about planting programs. A case in point is Brazil. Here the "forecast", resulting from extending the simulation from 1949/50 onwards beyond the estimation period, shows a significant increase in production for the second half of this decade. This is in line

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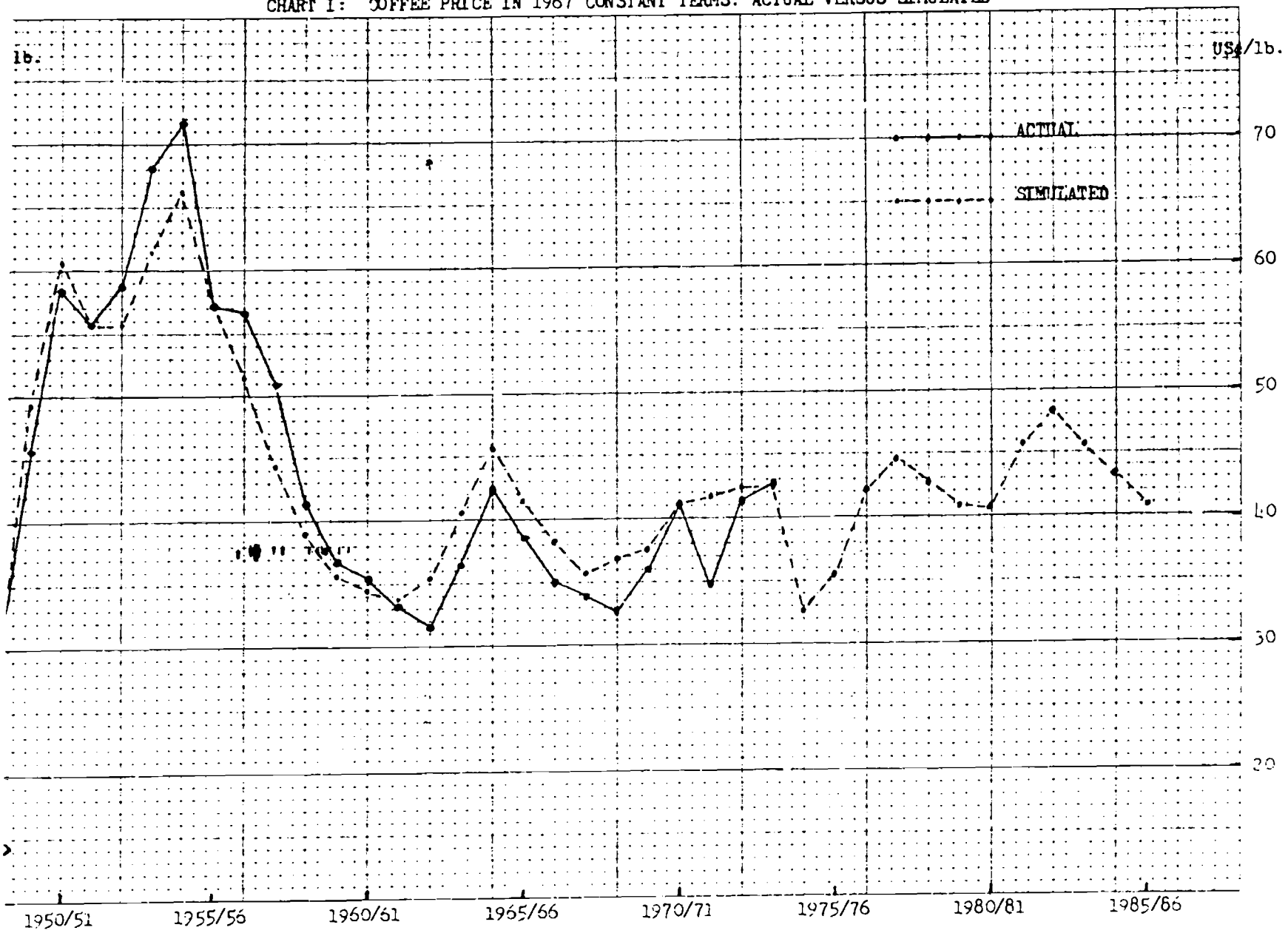
1/ These deviations do not show when Brazilian production is specified as an exogenous variable in which case there is no distinguishable difference between the "simulated" and the "estimated" price.

CHART I: COFFEE PRICE IN 1967 CONSTANT TERMS: ACTUAL VERSUS SIMULATED



with what can be expected on the basis of the large planting programs executed by Brazil in the first half of this decade. For the other producing regions, the increases in production are too "regular" to enable us to judge the soundness of the projections in advance on the basis of available data on plantings.

Projections

5.3.1 The model has been used for making projections under various assumptions about the future. Projections have been made with different assumptions about the occurrence of frosts in Brazil's coffee-producing areas, and with different assumptions as to income growth. Also, projections have been made assuming the re-establishment of the International Coffee Organization. In this case, we have tried to assess the effects of different possible ICO policies (price-indexing and buffer stocks).

5.3.2 Some projections have been made through the year 2000. This, of course, in no way means that we would attach any forecasting value to these figures. But such a procedure is very useful in bringing out trends that are implied in the model but that do not show up in short projection series.

5.3.3 The forecasts of real incomes and inflation are those of the Bank. These projections run up to 1985. After 1985, inflation is projected to continue at the same rate as for 1980-1985, i.e. 7% per annum. Real income growth, in the Bank projections 5.2% per annum over the period 1980-1985, is assumed to drop to 4.5% per annum for 1985-1990, and 4% per annum afterwards. This assumption is a reflection of our conviction that real income growth will have to decline in future, both because real resources are not unlimited and because population growth cannot go on forever at its present rates.

Projections under varying assumptions about frosts

5.4.1 Since the occurrence of heavy frosts in Brazil has been accounted for by dummy variables in explaining Brazilian production, it is necessary to make assumptions about the future occurrence of frosts. First, we can assume that no heavy frosts will occur. Second, we can assume that frosts in future will occur with the same frequency as in the past and calculate its "average effect". Since heavy frosts occurred about once in five years and have cut production by 55%, this would mean subtracting 11% from the projected levels from 1976/77 onwards (since no frost occurred in 1974, we know already that production in 1975/76 cannot be reduced by frost). Third, we can assume arbitrarily heavy frosts in specific years. We have done this for the years 1975, 1977 and 1979.

5.4.2 The price projections under the three different assumptions mentioned above are given in Chart II. The projections show that, not unexpectedly, an occurrence like three heavy frosts in one five-year period would lead to a repetition of the familiar boom-bust cycle in coffee. The two other assumptions do not lead to very different results. In both cases stocks reach a low of 15-20 million bags around 1977/78 and start to increase afterwards. Prices under "average" frost conditions are understandably higher than under conditions of no frost, but the difference gradually starts to diminish because of the reaction of the production capacity to the higher price levels.

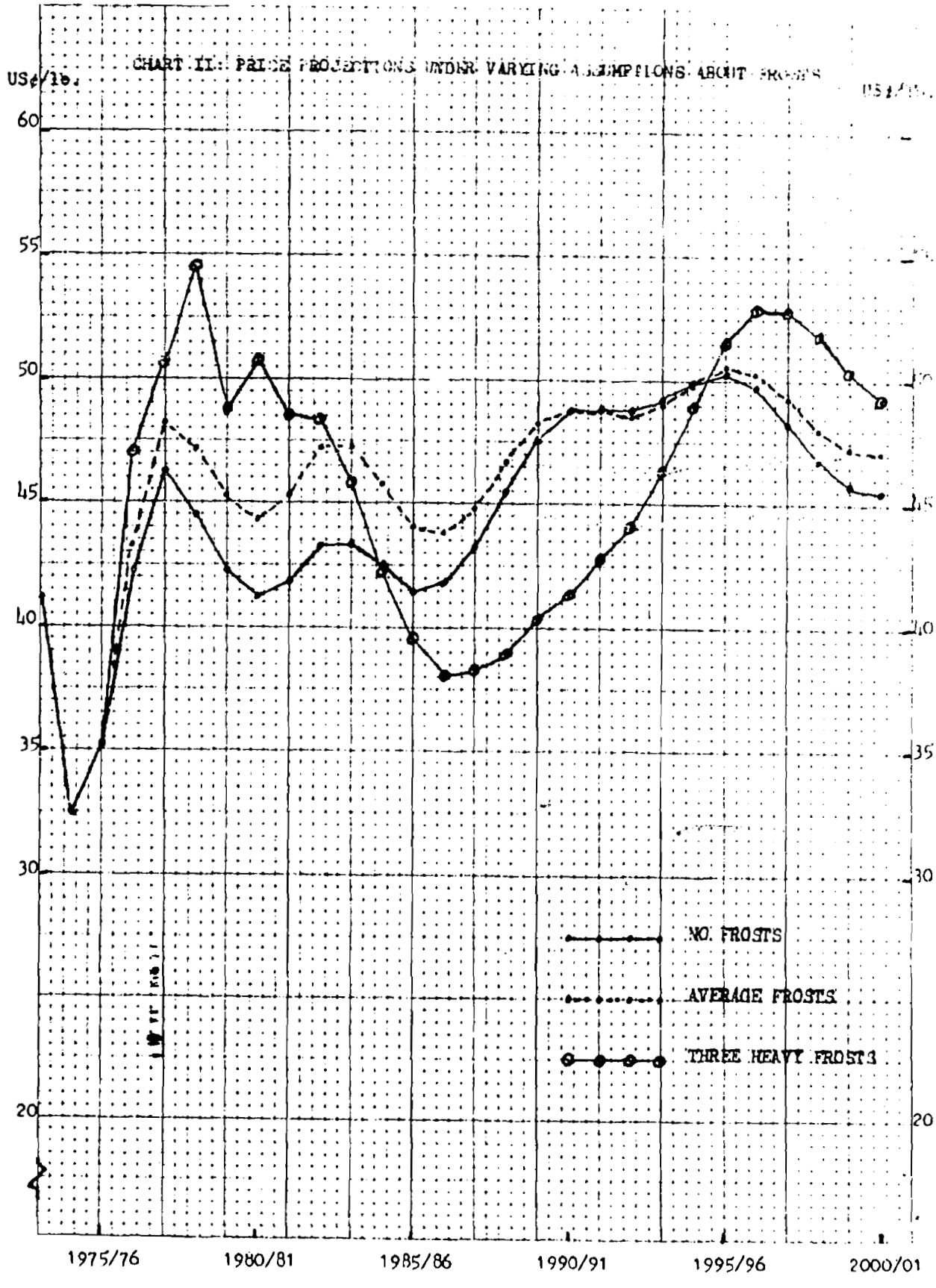
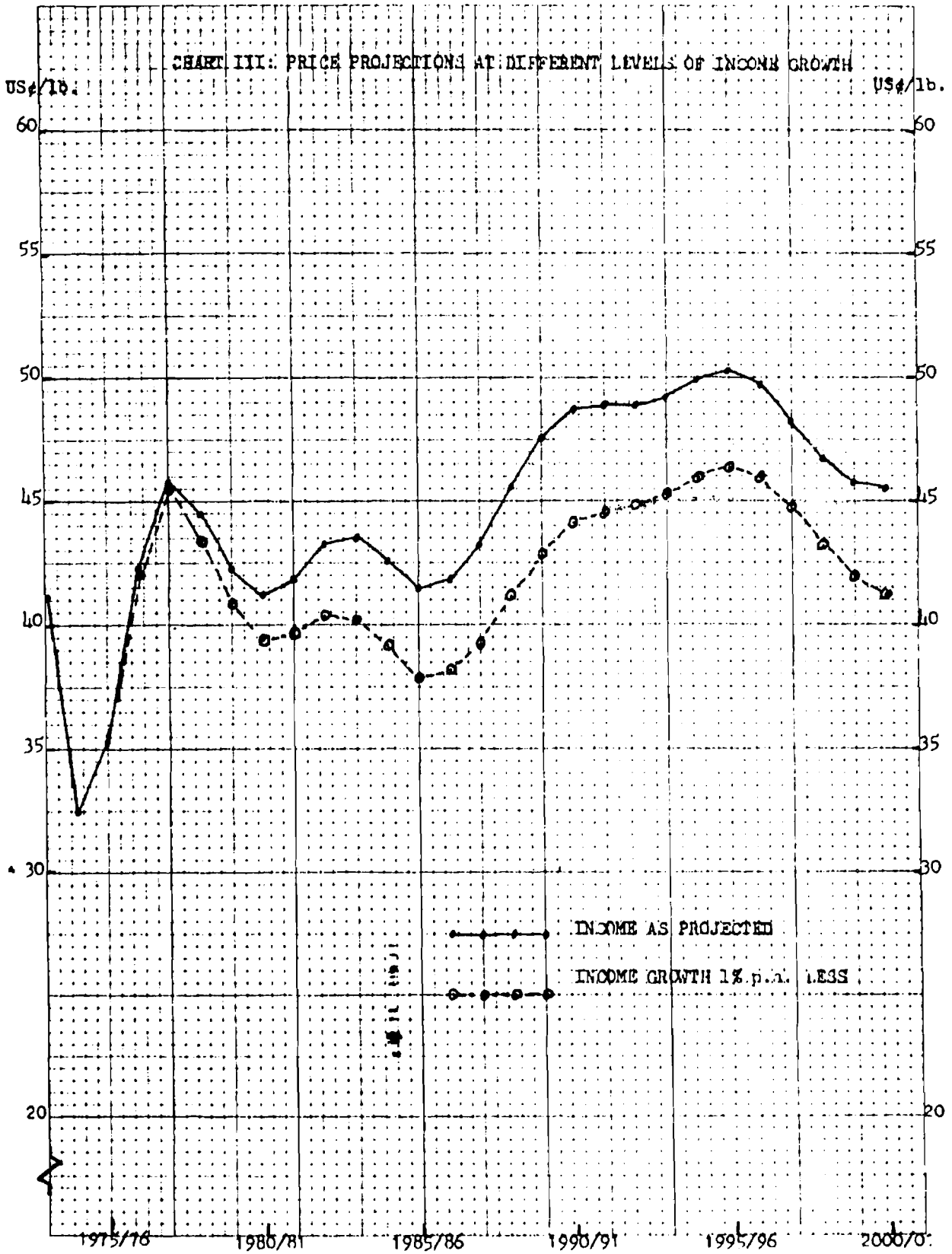


CHART II: PRICE PROJECTIONS UNDER VARYING ASSUMPTIONS ABOUT FROSTS

Projections under varying assumptions about income growth

5.5.1 Chart III gives the price projection with income growth as projected above, compared with the price projection for a situation in which income would grow 1% p.a. less than projected, starting in 1975. As can be seen, the long term price development is rather sensitive to the assumptions about income growth. Unlike the case of frosts or inflation, to be discussed in the next section, there is here no balancing mechanism which makes the long term price level relatively independent of the income growth assumption. The reason is simple: although lower prices lead to lower output levels, these lower output levels do not lead to a revival of prices since consumption requirements are also lower.

5.5.2 A change in the income growth assumption does not lead to a change in the pattern of the price development (as opposed to its level).



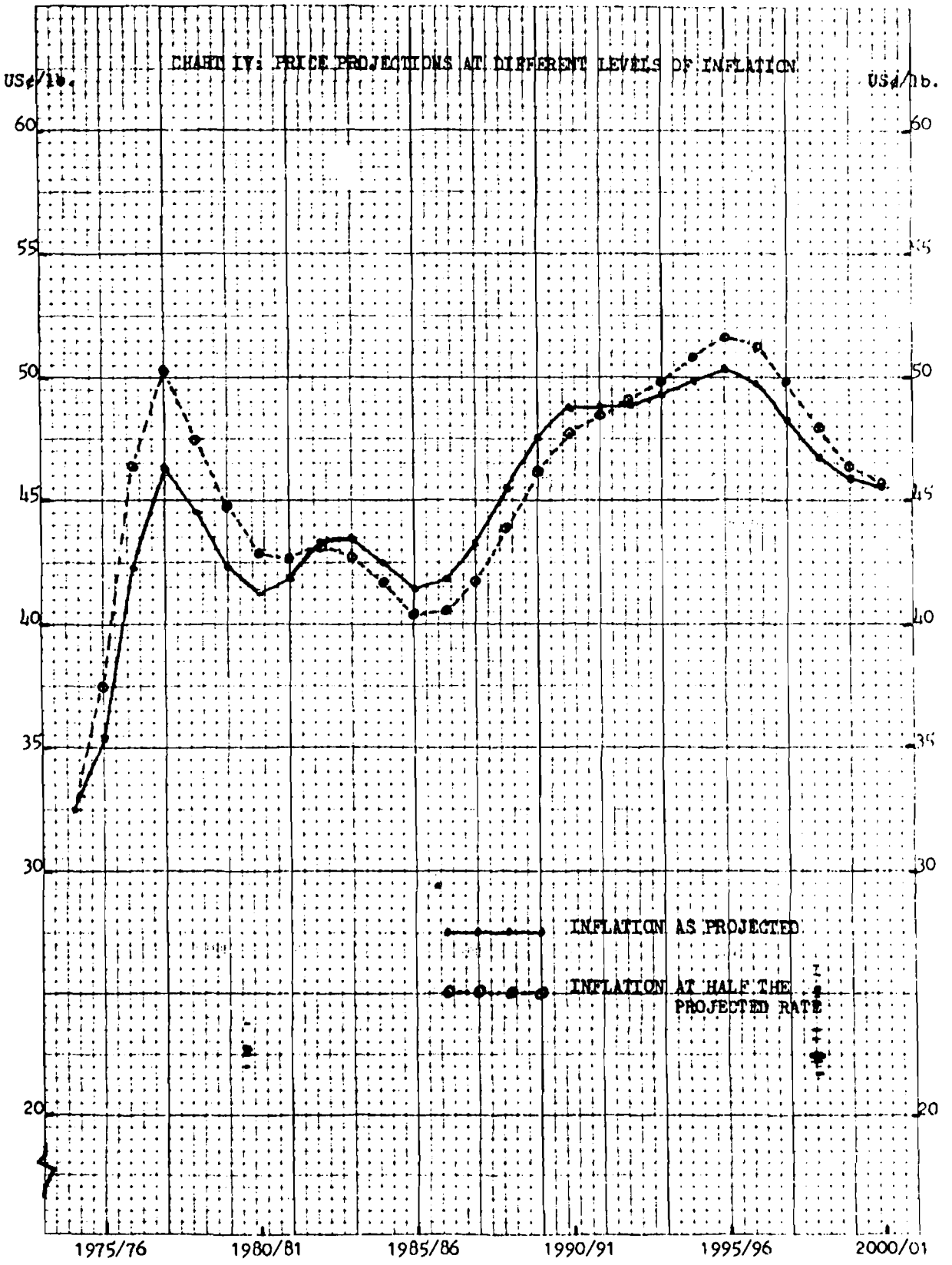
Projections under varying assumptions about inflation

5.6.1 The immediate effect of inflation on prices can be derived directly from the price equation. The price equation comes close to assuming that real prices adapt to inflation with a lag of two years. This means that, if the inflation assumption is increased by, say, 2% p.a., the real price will be lower by 2% in the first year, and by 4% in the following year(s). There will be a balancing effect caused by the short term responses of production and consumption, but this effect is relatively small.

5.6.2 The effect of a change in the inflation assumption on prices in the long run is quite different, however. This can be seen from Chart IV, where the price projection under the inflation assumption used in this paper is compared with the price projection that would result if the inflation would be only half of what it is projected to be, starting in 1975. In the short run the real price improves considerably. But in the long run the increased supply that follows these improved prices counteracts the beneficial effects of lower inflation on real prices, and the net result is close to zero.

5.6.3 The difference of this case with the case of a change in income growth is that here the changed supply is confronted with an unchanged strength in demand, which causes the long run "adaptation" of prices to the changed circumstances. In the case of changing income, a changed supply is confronted with a demand that has changed in the same direction, thus preventing such an adaptation.

5.6.4 The soaring inflation in recent years caused a very sharp drop in real coffee prices, and created severe balance of payments problems for several coffee exporting countries. Nevertheless, this fact should not be judged on the basis of its immediate effects alone, since it will lead to a reduced production expansion and therefore to better coffee prices in the early 1980's.



The possibilities of price-indexing

5.7.1 At present producing and consuming countries are trying to negotiate a new International Coffee Agreement. One of the main issues in the discussions is the wish of the producing countries to come to a system by which coffee prices will be periodically adjusted according to the development of an inflation index, in order to maintain the real value of coffee earnings.

5.7.2 A long term balance between demand and supply is ensured by the price mechanism. If one wants to impose a fixed price upon the coffee market, one of the first problems to be solved is then how to ensure a balanced development of demand and supply. This, of course, has to be done by means which fall outside the scope of the "market mechanism". But the task can be made easier by choosing a price at which demand and supply will automatically balance more or less, so as not to have to resort too much to the difficult process of artificial production limitation or stimulation.

5.7.3 What will happen if prices are fixed at different constant levels from 1975/76 onwards can be seen in Table 8. At levels below US¢40 in 1967 constant terms (around US¢60 in 1974/75 constant terms), stocks are very quickly drawn down to dangerously low levels. At prices above US$44, stocks start to pile up to much higher levels than required to guarantee against normal production and trade fluctuations.

5.7.4 The developments towards the end of the period show that the rate of increase in consumption slowly declines with increasing incomes. However, the slowdown in the rate of growth of production at constant prices is somewhat more pronounced, and therefore the price that will maintain a balance between supply and demand rises slowly over the period concerned.

Table 8: DEVELOPMENT OF PRODUCTION, CONSUMPTION AND STOCKS UNDER INDEXED PRICES
-in millions of bags-

	Price Level in 1967 Constart Terms (US¢/lb)								
	38			40			42		
	World Prod.	World Cons.	Producer Stocks	World Prod.	World Cons.	Producer Stocks	World Prod.	World Cons.	Producer Stocks
1980/81	92	92	21	93	91	28	93	90	34
1985/86	99	105	- 2	101	103	19	103	102	39
1990/91	101	117	- 56	103	115	- 18	106	114	20
1995/96	111	128	-134	113	127	- 77	115	125	-21
2000/01	124	141	-218	127[/1]	139	-143	129	138	-68

	Price Level in 1967 Constant Terms (US¢/lb)					
	44			46		
	World Prod.	World Cons.	Producer Stocks	World Prod.	World Cons.	Producer Stocks
1980/81	94	89	41	94	88	47
1985/86	106	101	59	108	100	78
1990/91	108	112	57	111	111	93
1995/96	117	124	34	119	122	89
2000/01	132	136	7	134	134	83

/1 The difference between Table 8 and Table 5 is due to the fact that the reaction of Brazilian production to stock changes has not been incorporated in the latter table. Its incorporation in the present table has a balancing effect, which is only noticeable towards the end of the period, however.

5.7.5 From the above it can be derived that, if a single constant price would have to be chosen, it would have to be in the range of US¢40-44 (US¢ 60-70 in 1974/75 terms). Of course in practice the setting of a single price would not be manageable, and a price range would be more realistic. This allows a limited degree of adjustments and thus eases the operation of any system aiming at establishing stable prices. Table 9 gives the development of prices, production, consumption and stocks under the assumption that price fluctuations are limited to certain ranges. As expected, the table suggests that the establishment of a price range of US¢40-44 per pound would not require too much interference to be maintained. Higher or lower price ranges would be faced with a continuous pressure of prices against the lower or higher limit of the range respectively.

5.7.6 A question that still has to be dealt with is how the price can be kept within a certain range. Under the second International Coffee Agreement (ICA), a system of flexible export quota was used. The export quota that were fixed at the beginning of each coffee year were adjusted upward (downward) whenever the price fell outside the pre-established range.

5.7.7 The effectiveness of such a system depends totally on the willingness of the participants to abide by its rules. Since the burden of the stocks resulting from a limitation of exports is borne by the individual producing countries, who often need badly each dollar of foreign exchange they can possibly earn, such a system has invariably broken down when it was backed by producers alone. A moderate amount of success could only be achieved when consumers joined the producers to "police" the system under the aegis of the International Coffee Organization. However, consumers did not allow for

Table 9: DEVELOPMENT OF PRICES AND STOCKS UNDER DIFFERENT INDEXED PRICE RANGES

	Price Range in 1967 Constant Terms (US¢/lb)					
	40-42		42-44		40-44	
	Price US¢	Stocks (mill.bags)	Price US¢	Stocks (mill.bags)	Price US¢	Stocks (mill.bags)
1975/76	40.00	36	42.00	36	40.00	36
1976/77	42.00	24	42.67	25	42.50	24
1977/78	42.00	23	44.00	25	44.00	23
1978/79	42.00	21	42.48	24	42.96	22
1979/80	42.00	29	42.00	33	41.72	31
1980/81	41.92	33	42.00	37	41.13	35
1981/82	42.00	36	44.00	40	44.00	38
1982/83	42.00	36	44.00	41	44.00	39
1983/84	42.00	34	42.81	42	43.65	38
1984/85	42.00	35	42.45	45	43.36	42
1985/86	42.00	36	42.00	48	41.94	45
1986/87	42.00	38	42.00	50	42.16	48
1987/88	42.00	36	42.80	48	43.27	46
1988/89	42.00	32	44.00	45	44.00	43
1989/90	42.00	25	44.00	40	44.00	38
1990/91	42.00	17	44.00	36	44.00	33

an adequate revision of price ranges in the light of world inflation, and this caused the breakdown of the second ICA. At present producers and consumers are trying to negotiate a new International Coffee Agreement. In this process, a buffer stock is frequently mentioned as an alternative to a system of export quotas. We will therefore turn to the operation of a buffer stock in the next section.

The possibilities of a buffer stock

5.8.1 The simplest form of a buffer stock is a stock that buys (sells) whenever the price drops below (rises above) a predetermined range. In contradistinction to export quota, a buffer stock tries to contain prices in complete conformity with the market mechanism. Also, it centralizes the stock burden, and therefore the mechanism does not run the danger of being "violated" by individual countries.

5.8.2 Table 10 shows the simulated developments in case a buffer stock would be approved.[1/] The price range required for the smooth operation of a buffer stock is somewhat higher than the range required for a quota system. A buffer stock first has to accumulate some coffee before it can prevent a rise of prices above the established range. A quota system, however, can keep prices from rising simply by inspiring confidence with buyers that all available coffee will be sold at the upper price limit when required, and that therefore no hedging against future price increases is necessary. In the case a price range of US¢42-46 is chosen, the capacity of the buffer stock can probably be limited to around 20 million bags.

1/ The buffer stock has been assumed to be "outside the market". Therefore, total supply in the price equation has been defined as $S_t^{prod} + Q_t - BS_t$, where BS_t is the size of the buffer stock.

Table 10: DEVELOPMENT OF PRICES AND STOCKS UNDER THE OPERATION OF A BUFFER STOCK

	Price Range in 1967 Constant Terms (US¢/lb)								
	38-42			40-44			42-46		
	Price (US¢/lb)	Buffer Stock[1]	Total Stocks[2]	Price (US¢/lb)	Buffer Stock[1]	Total Stocks[2]	Price (US¢/lb)	Buffer Stock[1]	Total Stocks[2]
		-----mill.bags-----			-----mill.bags-----			-----mill.bags-----	
1975/76	38.00	8.0	36	40.00	13.2	36	42.00	17.8	36
1976/77	42.00	-1.1	24	44.00	4.5	24	46.00	9.7	25
1977/78	42.00	-11.0	22	44.00	- 3.0	24	46.00	4.6	26
1978/79	40.46	-11.0	20	41.83	- 3.0	23	43.14	4.6	26
1979/80	39.69	-11.0	27	40.56	- 3.0	32	42.00	7.4	36
1980/81	39.76	-11.0	30	40.33	- 3.0	35	42.00	9.2	41
1981/82	40.76	-11.0	31	41.05	- 3.0	37	42.38	9.2	44
1982/83	42.00	-11.9	29	42.10	- 3.0	36	42.75	9.2	45
1983/84	42.00	-14.0	26	42.12	- 3.0	34	42.05	9.2	45
1984/85	41.96	-14.0	26	41.79	- 3.0	37	42.00	12.8	50
1985/86	42.00	-14.5	27	41.65	- 3.0	39	42.00	14.0	53
1986/87	42.00	-19.9	27	42.70	- 3.0	40	42.85	14.0	55
1987/88	42.00	-26.5	23	44.00	- 4.6	36	44.16	14.0	53
1988/89	42.00	-36.0	18	44.00	-13.8	32	45.99	14.0	50
1989/90	42.00	-45.3	9	44.00	-20.0	25	46.00	7.5	45
1990/91	42.00	-54.4	1	44.00	-26.3	19	46.00	4.3	42

/1 Cumulative total. Negative totals imply a breakdown of the buffer stock.

/2 Stocks in producing countries plus buffer stock.

5.8.3 In ... projections, there is not much difference between a system of export quota and a buffer stock. This is because the price projected for the near future does not deviate too much from the price needed to ensure a balanced development of supply and demand. The market mechanism itself can therefore perform the lion's share of the required adjustments if the price range is chosen properly. In reality, the buffer stock will do more "business" or the quotas will have to be adapted more frequently than suggested by the projections. The projected prices, being averages, abstract from the month to month fluctuations, and the difference between the highest and the lowest monthly average price in any one year can be as high as 30%. Therefore, in paractice somewhat wider price ranges and/or a somewhat larger size of the buffer stock might be required.

5.8.4 As suggested before, we think price stabilization through a buffer stock operation may offer a better chance of success than price stabilization by means of a system of export quotas because the buffer stock operation is not open to violations in the same way as an export quota system. A main objection is often the costs involved, but here it has to be kept in mind that the total costs of stock-keeping from the point of view of the world economy do not change: it is only a question of distribution of costs. As to the frequently cited danger that the creation of a buffer stock might provoke an unlimited expansion of production: the model implies that the suggested prices simply are not high enough to provoke such a reaction.

Forecasts

5.9.1 In forecasting, as opposed to projecting, one has to commit oneself to a judgment about the most likely development of the exogenous variables. Also, one has to incorporate any knowledge that is available about the endogenous variables and that is not already incorporated in the model.

5.9.2 The most probable development of incomes and of inflation has been taken to be the development as projected by the Bank. The other exogenous variable, the frost variable, has been set equal to zero, since the effects of frosts have been accounted for in our exogenous forecast of Brazilian production given below.

5.9.3 Knowledge about the endogenous variables which is not incorporated in the model exists in two ways. First there is the most recent knowledge about their actual behavior. In the forecast we have set the 1974/75 production equal to the latest USDA estimates for this crop year.[1/] For all other endogenous variables the latest exogenous information incorporated is the information for 1973/74.

5.9.4 A second source of information which is not contained in the model is the available information about recent planting programs. About most of the regions we do not have sufficiently detailed information to enable us to make exogenous forecasts,[2/] but Brazil is an exception.

5.9.5 The available information about Brazil's recent planting programs, as well as about other factors influencing production, enable us to make an

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1/ In the projections in the previous sections we only incorporated exogenous information up to 1973/74.

2/ An exogenous correction has been made in the case of Colombia, as explained in paragraph 2.4.8.

exogenous forecast for Brazilian production through 1980/81. The forecast, on a state-by-state basis, is given in Table 11. 1/

Table 11: BRAZIL: PRODUCTION OF COFFEE BY STATE, 1974/75 THROUGH 1980/81

Year	State: Parana	Sao Paulo	Minas Gerais	Espirito Santo	Others	Total
	in millions of 60 kg. bags					
1975/76	8.5	7.5	4.5	0.9	0.5	21.9
1976/77	11.0	10.5	6.0	1.4	0.9	29.8
1977/78	9.0	8.0	5.0	1.2	1.2	24.4
1978/79	11.0	9.5	6.8	1.6	1.4	30.3
1979/80	10.0	8.5	5.5	1.5	1.5	27.0
1980/81	10.5	9.0	6.5	1.6	1.5	28.9

After 1980/81, the model equation has been used.

Price Forecast

5.10.1 Prices are forecasted to develop as indicated in Table 12. For 1974/75 a drop in real prices of 25% is projected. This drop is caused both by the soaring rate of inflation and by the relatively large 1974/75 crop. The recovery of prices is slowed down by the unfavorable income developments depressing demand. Only in 1977/78 are real prices expected to reach their 1973/74 levels again. After that they will remain firm under the inflation and income developments as projected by the Bank.

1/ The forecast is based on the following average yield assumptions (in bags per 1,000 trees): old trees: Parana 11.0, Sao Paulo 9.7, Minas Gerais 5.2, Espirito Santo 3.3, and other states 3.1; new trees: Parana and Sao Paulo 14, Minas Gerais 12, Espirito Santo 9 and other states 8. The biennial cycle has been phased out towards the end of the forecast period, not because it would become less important in the future, but because it becomes increasingly difficult to forecast its phase.

Table 12: PROJECTED UNIT VALUE OF WORLD COFFEE EXPORTS, F.O.B. ORIGIN, IN US¢ PER POUND

Year	Unit Value of Exports		Index of Inflation 1/
	Current	1967 Constant	
	-------US¢ per pound--------		(1967=100)
Actual:			
1970/71	45	41	110.4
1971/72	40	35	113.9
1972/73	49	41	119.1
1973/74	58	43	135.5
Projected:			
1974/75	54	33	164.9
1975/76	62	34	182.7
1976/77	77	39	198.8
1977/78	92	43	214.7
1978/79	99	43	230.6
1979/80	107	43	247.9
1980/81	115	44	265.2
1985/86	165	44	372.0

1/ Index pertaining to calendar years. Historical data: US wholesale price index. Projections: Index of International Prices as projected by IBRD.

Supply Forecast

5.11.1 The forecast of supply by region is contained in Table 2a of Annex II. The forecast has been summarized in Table 13 below. The high rate of growth of world coffee production does not lead to a decline in prices because the average production level in 1972 was far below world coffee consumption, which averaged close to 80 million bags.

Table 13: PROJECTED PRODUCTION AND PRODUCTION GROWTH RATES, BY REGION

Region	Average Production 1/			Rate of Growth	
	1972	1980	1985	1972-1980	1980-1985
	- - millions of bags -			- - -% per annum - - -	
Brazil	20.7	29.0	30.9	4.3	1.3
Colombia	7.9	8.9	9.4	1.5	1.1
Other South America	3.2	4.3	5.5	3.8	5.0
North America	12.8	14.6	16.0	1.7	1.8
Africa	19.8	25.6	31.4	3.3	4.2
Asia and Oceania	5.7	7.3	9.0	3.2	4.3
World Total	70.2	89.7	102.1	3.1	2.6

1/ Three year centered average.

5.11.2 World producer stocks are forecasted to reach a low of 25-30 million bags around 1977/78 and to stabilize at around 30 million bags afterwards. Such stock levels are sufficient to overcome one year of adverse weather (assuming pipeline requirements to be around 15 million bags) but they cannot prevent a physical scarcity of coffee in case of more adverse circumstances. This explains the firmness of the expected price levels in comparison with the prices ruling in the 'sixties when stocks of between 60 and 80 million bags were hanging over the market.

5.11.3 The supply forecasts imply a continued decline in the share of the traditional coffee producing regions in total world production. Only Brazil manages to increase its share towards 1980, but this does not change the underlying long term trend which is definitely downward. This development at the same time means that the share of Robusta coffees in world coffee production will continue to increase.

Demand Forecast

5.12.1 The outlook for demand has been summarized in Table 14. The projections by year can be found in Table 2b in Annex II.

Table 14: PROJECTED DEMAND AND DEMAND GROWTH RATES BY REGION

Region	Average Demand[1/]			Rate of Growth	
	1972	1980	1985	1972-1980	1980-1985
	- - millions of bags - -			- - -% per annum - - - -	
Producing Countries	19.2	24.2	29.0	2.9	3.7
U.S.A.	21.4	21.0	20.9	-0.2	-0.1
Other Importers	38.6	44.4	50.6	1.8	2.6
World Total	79.6	89.5	100.6	1.5	2.4

1/ Three year centered average.

In the short run, the outlook is fairly pessimistic, the reason for this being the very unfavorable developments of income in the OECD countries. In 1974/75 total demand will actually drop, both on account of the decline in OECD incomes in 1974 and on account of the draw-down of the large consumer stocks built up during 1973/74. From 1975/76 through 1977/78 the growth of demand to be expected on account of the recovery of OECD incomes does not show up since it is curbed by the simultaneous recovery of real prices. After this last year, however, the growth in demand resumes its momentum. Only in the U.S. demand is expected to continue to decline, although only at a nominal rate.

Conclusion

5.13.1 The best way to conclude this chapter seems to be by adding a few words of caution to the results described in it. Both projections and forecasts assume that the relationships implied in the model have been correctly specified, that the estimators coincide with the true values of the coefficients, and that the structure of the coffee economy will not abruptly change in future. In addition, the forecasts imply specific assumptions about the future development of the exogenous variables and therefore can be invalidated by any development in these variables which is different from the one assumed.

5.13.2 Since the above caveats are common to all models, whether econometric or conceptual, we will not dwell very long upon them. A few examples, however, can serve to illustrate the forecast errors that are possible. If we had made a forecast at the beginning of 1972, we would not have known that a heavy frost was going to decimate the 1973/74 harvest, and our 1973/74 price forecast would have been much too low. Again, if we had made our forecast at the beginning of 1973, we would not have known that inflation was going to reach such dramatic proportions and our 1974/75 price forecast would have been much too high.

5.13.3 Already from these few examples given above it will be clear that the projections, and especially the forecasts given in this section, have to be surrounded with many "ifs" and "buts". Nevertheless, we are left with the hope that such projections and forecasts will perform better than projections and forecasts that do not take their point of departure in an analysis of the structure and past behavior of the world coffee economy.

POSTSCRIPT

The present paper was presented as a Bank Staff Working Paper in June 1975. At the time of printing, in July 1975, a heavy frost hit Brazil's coffee producing areas. No official information is available as of yet, but if the frost were to be of the same proportions as those of 1963, 1969 and 1972 it could reduce Brazil's 1976/77 crop to between 12 and 16 million bags.

The model has now been used to make forecasts incorporating this additional information.[1/] Real prices in this case increase to a high of US¢49 in 1977/78 (compared to US¢43 in Table 12). The consequence is a stronger expansion of production in the first half of the 1980's (3.6% p.a. as compared to 2.6% p.a. in Table 13), and a decline in real prices to US¢41 in 1985/86 (US¢44 in Table 12). The demand forecasts change only by 1-2% in an opposite direction to the forecast changes in real prices. World producer stocks are now forecast to reach a low of around 15 million bags in 1977/78. This implies a narrowing of the margin between total supply and demand, and therefore the volatility of coffee prices may be expected to increase considerably.

1/ The information has been incorporated by setting the exogenous forecast for Brazilian production in 1976/77 equal to 13.8 million bags (assuming production in Parana, Sao Paulo and Minas Gerais to decline to 2.0, 4.5 and 5.0 million bags respectively). In view of the present lack of information these figures should be regarded as illustrative only. Another way of incorporating the information is by setting the grost-dummy, $D2^{br}$, equal to unity in 1976/77 and using the model equation for Brazilian production. In this case the real price reaches a high of US¢51 in 1977/78 and declines to US¢39 in 1985/86.

Coffee Model: Equations 1947/48-1972/73

1. $$\log Q_t^{br} = 0.69262 + \underset{(1.36)}{0.32609} \log QAV_{t-7}^{br} + \underset{(4.32)}{0.44386} \log PAV_{t-7} + \underset{(fixed)}{0.2} \log P_{t-1}$$
$$- \underset{(2.02)}{0.14601} \log (Q_{t-1}^{br}/Q_{t-2}^{br}) - \underset{(1.96)}{0.46559} \left(\frac{S_{t-7}^{prod} - S_{t-12}^{prod}}{QAV_{t-7}^{br}}\right)$$
$$- \underset{(3,05)}{0.36152} D1_t^{br} - \underset{(6.60)}{0.83875} D2_t^{br}$$

$R^2 = .840$ DWS = 1.888

2. $$\log Q_t^{col} = 1.45585 + \underset{(5.73)}{0.55961} \log QAV_{t-7}^{col} + \underset{(4.21)}{0.17612} \log PAV_{t-7} + \underset{(fixed)}{0.03} \log P_{t-1}$$
$$+ \underset{(1.58)}{0.02527} D1_t^{col}$$

$R^2 = 0.800$ DWS = 1.578

3. $$\log Q_t^{sam} = -5.2557 + \underset{(16.07)}{0.95693} \log QAV_{t-7}^{sam} + \underset{(9.02)}{0.45997} \log PAV_{t-7} + \underset{(0.77)}{0.06199} \log P_{t-1}$$
$$- \underset{(2.24)}{0.24549} (Q_{t-1}^{sam}/Q_{t-2}^{sam})$$

$R^2 = 0.962$ DWS = 2.065

4. $$\log Q_t^{nam} = - 0.63024 + \underset{(23.44)}{0.82343} \log QAV_{t-7}^{nam} + \underset{(5.74)}{0.13676} \log PAV_{t-7} + \underset{(0.90)}{0.03019} \log P_{t-1}$$
$$- \underset{(3.36)}{0.34088} (Q_{t-1}^{nam}/Q_{t-2}^{nam})$$

$R^2 = .982$ DWS = 1.725

5. $$\log Q_t^{afr} = - 3.40738 + \underset{(28.57)}{0.76647} \log QAV_{t-7}^{afr} + \underset{(10.48)}{0.43605} \log PAV_{t-7} + \underset{(2.08)}{0.12335} \log P_{t-1}$$

$R^2 = .988$ DWS = 2.275

6. $$\log Q_t^{as} = \underset{(6.49)}{0.85623} \log QAV_{t-7}^{as} + \underset{(2.40)}{0.43288} \log PAV_{t-7} + \underset{(fixed)}{0.1} \log P_{t-1} - \underset{(4.95)}{0.59811} D1_t^{as} + \underset{(1.74)}{0.40167} D2_t^{as}$$

$R^2 = .942$ DWS = 1.422

7. $$Q_t = Q_t^{br} + Q_t^{col} + Q_t^{sam} + Q_t^{nam} + Q_t^{afr} + Q_t^{as}$$

8. $$S_t^{prod} = S_{t-1}^{prod} + Q_{t-1} - C_{t-1} + SRV_{t-1}$$

9. $$P_t = \underset{(9.47)}{0.51296} P_{t-1} + \underset{(10.59)}{2162.3} \frac{C_{t-1} + C_{t-2}}{S_t^{prod} + Q_t} - \underset{(6.28)}{1.01405} \left(\frac{I_t - I_{t-2}}{I_{t-2}}\right) P_{t-1} + \underset{(2.32)}{449.7} DIC_t$$

$R^2 = .960$ DWS = 2.599

10. $$\log C_t^{prod} = 2.41447 - \underset{(7.88)}{906\ 10^{-11}} (P_{t-1})^2 + \underset{(19.42)}{0.77738} \log Y_t^{oecd}$$

$R^2 = .965$ DWS = 2.685

11. $$C_t^{usa} = 22909 - \underset{(10.09)}{0.25274\ 10^{18}} (Y_t^{usa})^{-4} - \underset{(14.10)}{0.646} P_t + \underset{(2.65)}{912.44} (P_t/P_{t-1}) + \underset{(3.46)}{583.66} \exp(-0.1(t-16)^2)$$

$R^2 = .960$ DWS = 1.767

12. $$\log C_t^{other} = 14.3071 - \underset{(51.78)}{54.7014} (Y_t^{other})^{-3/8} - \underset{(9.54)}{0.26165} \log P_{t-1} + \underset{(5.69)}{0.14552} (S_{t-1}^{usa}/S_t^{usa})$$

$R^2 = .995$ DWS 2.519

13. $$C_t = C^{prod} + C^{usa} + C^{other} + (S_{t-1}^{usa} - S_t^{usa})$$

Coffee Model: Symbols Used

Q_t : Total harvested production of coffee in thousands of 60 kg bags. 1947/48: t=1

Regions : br = Brazil
col = Colombia
sam = South America excluding Brazil and Colombia
nam = North America
afr = Africa
as = Asia and Oceania

QAV_t : The three year moving centered average of Q_t:

$$QAV_t = 0.25\ Q_{t-2} + 0.75\ Q_{t-1} + Q_t + 0.75\ Q_{t-1} + 0.25\ Q_{t+2}$$ 1/

P_t : Real price of coffee, in US¢ per 100 pounds. 1947/48: t=1. This price is measured by the unit value of US imports (f.o.b.). The deflator is USW_t.

PAV_t : The three year moving centered average of PR_t:

$$PRAV_t = PR_{t-1} + PR_t + PR_{t-1}$$ 1/

I_t : Index of US wholesale prices, 1967=100. 1947: t=1.

Y_t^{oecd} : GNP of OECD countries at market prices in hundreds of millions of 1963 constant US$. 1947: t=1.

Y_t^{usa} : GNP of USA at market prices in hundreds of millions of 1963 constant US$. 1947: t=1

Y_t^{other} : GNP at market prices of OECD countries other than the USA, in hundreds of millions of 1963 constant US$. 1947: t=1

C_t^{prod} : Domestic consumption of coffee in producing countries, in thousands of 60 kg. bags. 1947/48: t=1

C_t^{usa} : Net Civilian Visible Disappearance of coffee in the USA, in thousands of 60 kg. bags. 1947/48: t=1

C_t^{other} : Consumption in importing countries other than the USA, as measured by total exports from producing countries minus US Net Civilian Visible Disappearance and minus the increase in US inventories. In thousands of 60 kg. bags. 1947/48: t=1

1/ To simplify calculations division by 3 has been omitted.

C_t : World disappearance of coffee, as measured by total exports from producing countries plus domestic consumption in those countries. In thousands of 60 kg. bags. 1947/48: t=1

S_t^{prod} : Begin of period stocks in producing countries, in thousands of 60 kg. bags. 1947/48 t=1

S_t^{usa} : Begin of period inventories of green coffee in the USA, in thousands of 60 kg. bags. 1947/48: t=1

$D1_t^{br}$: Dummy variable to capture the effects of Brazilian frosts in 1953 and 1955. It is unity in 1954/55 and 1956/57, and zero in all other years

$D2_t^{br}$: Dummy variable to capture the effects of Brazilian frosts in 1963 and 1969. It is unity in 1964/65 and 1970/71, and zero in all other years

$D1_t^{col}$: Dummy variable to capture the effect of the biennial cycle in Colombia. It is nil in non-cyclical years (t=4-8, 25 and 26), -1 in "off years" (t=1,3,10,12,14,16,18,20,22,24) and 1 in "on years" (all other years).

$D1_t^{as}$: Dummy variable to capture the direct effects of the war in Indonesia on production in Asia and Oceania. It is unity from 1947/48 through 1949/50, and zero in all other years

$D2_t^{as}$: Dummy variable to correct for the underestimation of past production capacity by lagged production for the Asia and Oceania region due to the war in Indonesia. It is 0.5 in 1947/48 and 1956/57, unity in the intervening years, and zero in all other years.

DIC_t : Dummy variable to capture the effect of the establishment of ICO on prices. It is unity in 1963/64 and 1964/65, 0.5 in 1966/67 and 1967/68, and zero in all other years.

Table [1] : WORLD PRODUCTION OF COFFEE 1934/35 to 1973/74
(in thousands of 60kg. bags)

Year	World Total	Brazil	Colombia	Other South America	North America	Africa	Asia and Oceania
1934/35	31,373	18,157	3,502	1,397	4,305	1,625	2,388
1935/36	36,085	20,927	4,197	1,447	5,087	1,972	2,457
1936/37	42,692	26,358	4,360	1,600	5,437	2,323	2,613
1937/38	39,783	23,578	4,460	1,410	5,287	2,332	2,717
1938/39	39,065	23,300	4,417	1,018	5,380	2,468	2,482
1939/40	35,447	19,283	4,450	1,492	4,873	2,787	2,563
1940/41	31,358	16,702	4,760	1,152	4,765	2,793	1,187
1941/42	30,947	16,027	5,488	985	4,713	2,842	893
1942/43	28,607	13,832	5,283	817	4,945	2,977	753
1943/44	30,598	15,365	5,533	902	5,057	2,935	807
1944/45	26,925	11,445	5,478	1,150	5,180	2,985	687
1945/46	31,075	16,100	5,478	1,080	4,876	3,077	468
1946/47	35,568	17,300	6,500	1,054	5,632	4,230	852
1947/48	34,618	16,920	5,780	1,100	5,646	4,299	873
1948/49	40,492	22,348	6,140	1,230	5,870	3,834	1,070
1949/50	37,615	19,250	5,740	853	6,244	4,395	1,133
1950/51	38,164	19,750	5,042	1,065	6,030	4,708	1,569
1951/52	38,530	18,520	5,726	1,036	6,466	5,107	1,675
1952/53	41,513	19,170	6,405	1,565	7,024	5,607	1,742
1953/54	43,996	19,700	7,088	1,229	7,073	6,790	2,116
1954/55	42,357	18,100	6,405	1,517	7,487	7,281	1,567
1955/56	50,348	23,500	6,800	1,275	7,823	8,749	2,201
1956/57	45,532	18,000	6,500	1,715	7,750	8,942	2,625
1957/58	55,196	25,000	7,800	1,750	8,780	9,437	2,429
1958/59	61,818	31,000	7,700	1,905	7,923	10,911	2,379
1959/60	78,754	44,000	8,000	2,070	9,427	12,236	2,971
1960/61	65,694	29,000	7,700	2,140	9,050	13,994	3,810
1961/62	72,058	35,000	7,800	2,411	10,511	12,646	3,690
1962/63	67,404	27,000	7,500	2,544	10,079	15,994	4,287
1963/64	70,998	28,000	8,200	2,533	10,762	17,109	4,194
1964/65	50,613	10,000	7,600	2,393	10,546	16,002	4,072
1965/66	81,604	37,700	8,200	2,901	10,883	17,423	4,497
1966/67	60,577	20,000	7,600	2,696	10,168	15,569	4,544
1967/68	68,612	23,000	8,000	3,021	11,667	18,444	4,480
1968/69	61,068	16,500	7,900	2,972	10,742	18,215	4,739
1969/70	66,362	19,000	8,450	2,739	11,791	19,549	4,833
1970/71	58,321	9,750	7,800	3,322	11,842	19,817	5,790
1971/72	71,854	23,600	7,200	3,236	12,949	19,839	5,030
1972/73	76,444	24,000	8,800	3,380	12,883	21,454	5,927
1973/74	64,283	14,500	9,500	3,488	12,401	18,388	6,006

Source: 1934/35 to 1944/45: The World Coffee Economy, FAO Rome, 1961. Figures may not add up due to conversion into bags from rounded data in metric tons.

1945/46 to 1973/74: Foreign Agricultural Circular, USDA, various issues.

TABLE 2 : CONSUMPTION, EXPORTS AND STOCKS
in thousands of bags

YEAR[1]	CONSUMPTION			EXPORTS	PRODUCER[2] STOCKS	US[3] INVENTORIES
	PRODUCERS	USA	OTHER IMPORTERS			
1947	8352.	19516.	11404.	30848.	17050.	3243.
1948	9128.	20552.	11612.	32266.	12528.	3345.
1949	8304.	19637.	12138.	31205.	10027.	2775.
1950	8114.	18781.	12476.	31592.	8133.	3111.
1951	8350.	19329.	12940.	32152.	6541.	2994.
1952	8236.	19839.	13057.	32939.	5273.	3037.
1953	9756.	18974.	13800.	33458.	5411.	3721.
1954	8488.	18321.	13032.	29219.	6493.	1587.
1955	8957.	19408.	17842.	38295.	11196.	2632.
1956	10976.	19032.	16022.	36203.	16517.	2881.
1957	8881.	20097.	17775.	37340.	14956.	2349.
1958	9867.	20514.	18534.	38977.	23846.	2278.
1959	12652.	20972.	20726.	42351.	36870.	2931.
1960	12869.	21482.	22524.	44220.	60940.	3145.
1961	13754.	21928.	23528.	45361.	66536.	3050.
1962	14001.	21996.	25480.	47861.	61146.	3435.
1963	14097.	21890.	26698.	49369.	64681.	4216.
1964	14735.	21762.	23288.	43446.	71340.	2612.
1965	15360.	21501.	24601.	50958.	69678.	3468.
1966	16134.	21536.	29493.	50018.	88796.	2457.
1967	16886.	21651.	32135.	54615.	82804.	3286.
1968	17658.	21530.	31890.	53523.	78826.	3389.
1969	18284.	21229.	33366.	54646.	69182.	3440.
1970	18211.	21025.	30356.	50968.	59156.	3027.
1971	18804.	21346.	36635.	58460.	48360.	3506.
1972	19251.	21579.	38274.	60672.	45243.	4325.
1973	19553.	21537.	39483.	61803.	44693.	5108.

1) Year refers to crop year, starting in year shown
2) Beginning stocks
3) End of period (June 30) inventories

TABLE 3: INCOMES AND INFLATION: ANNUAL RATES OF CHANGE

	REAL INCOME			US Wholesale Price Index
	OECD	USA	OECD excl. USA	
1948	5.5	4.5	7.0	8.2
1949	3.1	0.1	7.5	-5.0
1950	8.6	9.6	7.2	3.9
1951	7.5	8.1	6.7	11.4
1952	3.6	3.1	4.4	-2.7
1953	4.7	4.4	5.1	-1.4
1954	1.1	-1.3	4.5	0.2
1955	7.2	7.6	6.7	0.2
1956	3.3	1.8	5.2	3.3
1957	2.8	1.5	4.4	2.9
1958	0.7	-0.8	2.5	1.4
1959	5.6	6.1	5.0	0.2
1960	4.6	2.4	7.3	0.1
1961	4.1	2.1	6.4	-0.4
1962	5.7	6.4	4.9	0.3
1963	4.6	4.0	5.4	-0.3
1964	6.2	5.4	7.0	0.2
1965	5.5	6.3	4.7	2.0
1966	5.8	6.6	5.0	3.3
1967	3.7	2.7	4.7	0.2
1968	5.7	4.8	6.7	2.5
1969	4.7	2.4	7.2	3.9
1970	2.5	0.5	4.6	3.7
1971	6.1	3.0	9.2	3.2
1972	5.4	5.9	5.0	4.6
1973	6.3	5.9	6.7	13.8
1974	-0.4	-2.2	1.3	21.7
1975	-1.1	-4.5	2.0	10.8
1976	5.0	4.9	5.1	8.8
1977	5.6	5.2	5.9	8.0
1978	5.5	5.4	5.6	7.4
1979	5.3	5.2	5.4	7.5
1980	5.2	5.3	5.1	7.0
1981	5.2	5.3	5.1	7.0
1982	5.2	5.3	5.1	7.0
1983	5.2	5.3	5.1	7.0
1984	5.2	5.3	5.1	7.0
1985	5.2	5.3	5.1	7.0
1986	4.5	4.5	4.5	7.0
1987	4.5	4.5	4.5	7.0
1988	4.5	4.5	4.5	7.0
1989	4.5	4.5	4.5	7.0
1990	4.5	4.5	4.5	7.0
1991	4.0	4.0	4.0	7.0
1992	4.0	4.0	4.0	7.0
1993	4.0	4.0	4.0	7.0
1994	4.0	4.0	4.0	7.0
1995	4.0	4.0	4.0	7.0
1996	4.0	4.0	4.0	7.0

TABLE 1a: PRODUCTION BY REGION, ACTUAL VS SIMULATED
(in thousands of bags)

	BRAZIL		COLOMBIA		OTHER SOUTH AM	
YEAR	ACTUAL	SIMUL	ACTUAL	SIMUL	ACTUAL	SIMUL
1949	19250.	18844.	5740.	5770.	853.	975.
1950	19750.	19512.	5042.	6013.	1065.	1134.
1951	18520.	20322.	5726.	6178.	1036.	1143.
1952	19170.	21629.	6405.	6417.	1565.	1296.
1953	19700.	22100.	7088.	6645.	1809.	1336.
1954	18100.	18127.	6405.	6764.	1517.	1422.
1955	23500.	23800.	6800.	7047.	1275.	1525.
1956	18000.	19278.	6500.	7060.	1715.	1662.
1957	25000.	34226.	7800.	7528.	1750.	1790.
1958	31000.	29434.	7700.	7410.	1905.	1906.
1959	44000.	32058.	8000.	7769.	2070.	2029.
1960	29000.	30018.	7700.	7720.	2140.	2203.
1961	35000.	29917.	7800.	8099.	2411.	2334.
1962	27000.	28568.	7500.	7883.	2544.	2446.
1963	26000.	26811.	8200.	8080.	2533.	2485.
1964	10000.	11912.	7600.	7795.	2393.	2553.
1965	37700.	28066.	8200.	8000.	2901.	2588.
1966	20000.	20085.	7600.	7697.	2736.	2649.
1967	23000.	21891.	8000.	7937.	3021.	2739.
1968	16500.	20364.	7900.	7726.	2972.	2868.
1969	19000.	21691.	8450.	8089.	2739.	3062.
1970	9750.	9811.	7800.	7979.	3322.	3292.
1971	23100.	26439.	7200.	8179.	3236.	3455.
1972	24000.	21507.	8100.	8132.	3380.	3520.
1973	14500.	10597.	7800.	8660.	3378.	3500.
1974	27300.	24149.	0.	8599.	0.	3577.
1975	21900.	19288.	0.	8551.	0.	3653.
1976	29800.	24424.	0.	8690.	0.	3968.
1977	24400.	25573.	0.	8847.	0.	4251.
1978	30300.	32254.	0.	8985.	0.	4539.
1979	27000.	29716.	0.	9080.	0.	4653.
1980	28900.	28664.	0.	9048.	0.	4592.
1981	0.	28270.	0.	9017.	0.	4596.
1982	0.	28528.	0.	9079.	0.	4786.
1983	0.	30419.	0.	9310.	0.	5275.
1984	0.	32463.	0.	9466.	0.	5660.
1985	0.	31744.	0.	9508.	0.	5953.

TABLE 1b: PRODUCTION BY REGION, ACTUAL VS SIMULATED
(in thousands of bags)

YEAR	NORTH AM		AFRICA		ASIA AND OCEANIA	
	ACTUAL	SIMUL	ACTUAL	SIMUL	ACTUAL	SIMUL
1949	6244.	6087.	4395.	4450.	1133.	891.
1950	6030.	6293.	4708.	4801.	1569.	1551.
1951	6466.	6460.	5107.	5207.	1675.	1502.
1952	7024.	6704.	5607.	5876.	1742.	1569.
1953	7073.	6939.	6790.	6659.	2116.	1810.
1954	7487.	7301.	7281.	7217.	1567.	2108.
1955	7823.	7699.	8749.	8000.	2201.	2517.
1956	7750.	8095.	8942.	9011.	2625.	2527.
1957	8780.	8478.	9437.	10157.	2429.	2487.
1958	7923.	8726.	10911.	10933.	2379.	2759.
1959	9427.	9013.	12286.	11699.	2971.	2961.
1960	9050.	9362.	13994.	12892.	3810.	3323.
1961	10511.	9703.	12646.	13940.	3690.	3730.
1962	10079.	10026.	15994.	14725.	4287.	3971.
1963	10768.	10259.	17109.	15175.	4194.	3959.
1964	10546.	10515.	16002.	15774.	4072.	3939.
1965	10883.	10686.	17423.	16228.	4497.	3979.
1966	10168.	10865.	15569.	16444.	4544.	4096.
1967	11167.	11077.	18444.	16934.	4480.	4330.
1968	10742.	11352.	18215.	17700.	4739.	4623.
1969	11791.	11725.	19549.	19009.	4833.	4986.
1970	11842.	12126.	19817.	20579.	5790.	5326.
1971	12949.	12462.	19839.	21820.	5030.	5530.
1972	12883.	12660.	21454.	22137.	5927.	5560.
1973	12690.	12764.	18185.	21805.	6008.	5518.
1974	0.	12948.	0.	21981.	0.	5662.
1975	0.	13081.	0.	22048.	0.	5810.
1976	0.	13538.	0.	23841.	0.	6321.
1977	0.	13903.	0.	26008.	0.	6858.
1978	0.	14326.	0.	27607.	0.	7228.
1979	0.	14520.	0.	28030.	0.	7325.
1980	0.	14595.	0.	27105.	0.	7127.
1981	0.	14679.	0.	26549.	0.	7069.
1982	0.	14950.	0.	27521.	0.	7416.
1983	0.	15433.	0.	30261.	0.	8229.
1984	0.	15805.	0.	32395.	0.	8866.
1985	0.	16108.	0.	33260.	0.	9129.

TABLE 1c: CONSUMPTION BY REGION, ACTUAL VS SIMULATED
(in thousands of bags)

	PRODUCERS		USA		OTHER IMPORTERS	
YEAR	ACTUAL	SIMUL	ACTUAL	SIMUL	ACTUAL	SIMUL
1949	8304.	8987.	19637.	20083.	12138.	11386.
1950	8114.	8412.	18781.	19550.	12476.	12109.
1951	8350.	7942.	19329.	19901.	12940.	12954.
1952	8236.	8625.	19839.	20070.	13057.	13021.
1953	9656.	8928.	18974.	19908.	13800.	14384.
1954	8486.	8472.	18321.	19544.	13032.	13107.
1955	8957.	8468.	19408.	20090.	17842.	17380.
1956	10976.	9585.	19932.	20523.	16022.	17196.
1957	8881.	10355.	20097.	20991.	17775.	17838.
1958	9867.	11107.	20514.	21334.	18534.	19327.
1959	12652.	12038.	20972.	21664.	20726.	21616.
1960	12869.	12741.	21482.	21824.	22524.	22516.
1961	13754.	13264.	21928.	21904.	23528.	23505.
1962	14001.	13904.	21996.	21936.	25480.	24741.
1963	14097.	14266.	21890.	21668.	26698.	25287.
1964	14735.	14417.	21762.	21208.	23288.	23666.
1965	15360.	14419.	21501.	21163.	28601.	27914.
1966	16134.	15596.	21536.	21298.	29493.	27068.
1967	16886.	16421.	21651.	21407.	32135.	31245.
1968	17658.	17424.	21530.	21403.	31890.	31113.
1969	18284.	17923.	21229.	21349.	33366.	32520.
1970	19211.	18207.	21025.	21186.	30356.	32116.
1971	18804.	18571.	21346.	21082.	36035.	35445.
1972	19251.	19281.	21579.	21064.	38274.	36925.
1973	19553.	20148.	21537.	21059.	39483.	38226.
1974	0.	20073.	0.	21461.	0.	39230.
1975	0.	21221.	0.	21560.	0.	39809.
1976	0.	21685.	0.	21237.	0.	39290.
1977	0.	21590.	0.	20956.	0.	40071.
1978	0.	22036.	0.	20987.	0.	41903.
1979	0.	23286.	0.	21116.	0.	43781.
1980	0.	24587.	0.	21173.	0.	45163.
1981	0.	26026.	0.	20979.	0.	44814.
1982	0.	26027.	0.	20751.	0.	45386.
1983	0.	26415.	0.	20825.	0.	47374.
1984	0.	28092.	0.	20979.	0.	49315.
1985	0.	29709.	0.	21123.	0.	51343.

TABLE 1d: WORLD PRODUCTION, CONSUMPTION AND STOCKS,
ACTUAL VS SIMULATED
(in thousands of bags)

YEAR	TOTAL PRODUCTION ACTUAL	TOTAL PRODUCTION SIMUL	TOTAL CONSUMPTION ACTUAL	TOTAL CONSUMPTION SIMUL	PRODUCER STOCKS ACTUAL	PRODUCER STOCKS SIMUL
19[illegible]	37615.	37018.	39509.	39889.	10027.	10027.
1950	38164.	39305.	39707.	40407.	8133.	7156.
1951	38530.	40805.	40502.	40680.	6541.	6005.
1952	41513.	43490.	41175.	42360.	5273.	6834.
1953	43996.	45539.	43114.	43904.	5611.	7964.
1954	42357.	40938.	37707.	38990.	6493.	9599.
1955	50348.	55588.	45253.	46924.	11196.	11600.
1956	45532.	47632.	47179.	47553.	10517.	20490.
1957	55196.	64661.	46221.	48702.	14956.	20655.
1958	61818.	61169.	48844.	51697.	23846.	36529.
1959	78754.	65529.	55003.	55970.	36870.	46050.
1960	65694.	65520.	57089.	57295.	60940.	55928.
1961	72058.	67723.	59115.	58578.	66534.	61141.
1962	67404.	67619.	61861.	60966.	61148.	51957.
1963	70998.	66768.	63467.	62002.	64681.	56600.
1964	50613.	52486.	58181.	57688.	71340.	60494.
1965	61604.	69547.	66318.	64352.	69678.	61201.
1966	60577.	61836.	66152.	62950.	88796.	70228.
1967	66612.	64909.	71501.	69902.	82804.	68697.
1968	61068.	64633.	71181.	70044.	78826.	62615.
1969	66362.	66561.	72930.	71843.	69182.	57678.
1970	58321.	59113.	69179.	71096.	59156.	50933.
1971	71854.	77884.	77264.	75577.	48360.	39011.
1972	76444.	73515.	79923.	78089.	45243.	43611.
1973	62161.	62843.	81356.	80216.	44693.	41966.
1974	0.	76917.	0.	79981.	0.	35095.
1975	0.	72431.	0.	82591.	0.	32031.
1976	0.	80782.	0.	82212.	0.	21871.
1977	0.	85439.	0.	82624.	0.	20440.
1978	0.	94938.	0.	84926.	0.	23256.
1979	0.	93324.	0.	88184.	0.	33268.
1980	0.	91130.	0.	90923.	0.	38408.
1981	0.	90180.	0.	91819.	0.	38616.
1982	0.	92281.	0.	92164.	0.	36976.
1983	0.	98927.	0.	94614.	0.	37093.
1984	0.	104656.	0.	98386.	0.	41406.
1985	0.	105682.	0.	102175.	0.	47676.

TABLE 1e: UNIT VALUE OF EXPORTS, ALL ORIGINS, ACTUAL VS SIMULATED
(in 1967 constant US$ per pound)

	PRICE	
YEAR	ACTUAL	SIMUL
1949	4567.	4933.
1950	5818.	6074.
1951	5585.	5554.
1952	5867.	5565.
1953	6809.	6139.
1954	7182.	6610.
1955	5702.	5728.
1956	5674.	5159.
1957	5100.	4413.
1958	4145.	3901.
1959	3681.	3583.
1960	3532.	3443.
1961	3508.	3378.
1962	3152.	3531.
1963	3653.	4056.
1964	4228.	4588.
1965	3855.	4154.
1966	3501.	3827.
1967	3392.	3586.
1968	3267.	3699.
1969	3602.	3750.
1970	4120.	4118.
1971	3483.	4166.
1972	4128.	4212.
1973	4282.	4221.
1974	0.	3275.
1975	0.	3539.
1976	0.	4202.
1977	0.	4474.
1978	0.	4285.
1979	0.	4088.
1980	0.	4062.
1981	0.	4548.
1982	0.	4820.
1983	0.	4542.
1984	0.	4318.
1985	0.	4094.

Table 2a: PROJECTIONS (1)

PRODUCTION BY REGION
(IN MILLIONS OF BAGS)

YEAR	BRAZIL	COL.	STH.AM.	N.AM.	AFRICA	AS.& OC.
1974	27.0	9.5	3.1	13.2	19.9	6.3
1975	21.9	8.5	3.6	12.7	21.8	5.7
1976	29.8	8.6	3.7	13.5	23.3	6.2
1977	24.4	8.6	4.0	13.6	24.4	6.6
1978	30.3	8.7	4.2	14.4	25.5	7.1
1979	27.0	8.9	4.2	14.4	25.5	7.4
1980	28.9	9.1	4.2	14.8	25.3	7.6
1981	31.0	9.1	4.2	14.6	25.1	7.4
1982	29.2	9.1	4.3	14.9	25.9	7.4
1983	31.1	9.2	4.8	15.2	28.4	7.9
1984	31.0	9.3	5.2	15.7	30.5	8.6
1985	32.1	9.4	5.5	16.0	31.6	9.1
1986	29.7	9.5	5.6	16.4	31.9	9.4
1987	30.4	9.6	5.7	16.6	32.1	9.6
1988	29.0	9.6	5.9	16.8	32.6	9.8
1989	30.2	9.7	6.2	17.0	34.0	10.0
1990	30.3	9.8	6.6	17.3	35.8	10.5

Table 2b: PROJECTIONS (2)

CONSUMPTION BY REGION
(IN MILLIONS OF BAGS)

YEAR	PRODUCING COUNTRIES	USA	OTHER IMPORTERS
1974	20.0	21.5	39.3
1975	21.2	21.6	40.2
1976	21.9	21.4	40.1
1977	22.1	21.1	40.5
1978	22.4	21.0	41.8
1979	23.2	21.0	43.2
1980	24.2	21.0	44.4
1981	25.1	21.0	45.5
1982	26.0	20.9	46.5
1983	26.7	20.9	47.7
1984	27.8	20.9	49.2
1985	29.0	20.9	50.8
1986	30.2	21.0	51.9
1987	31.2	20.9	52.9
1988	32.1	20.9	53.7
1989	32.9	20.8	54.7
1990	33.8	20.7	55.7

Table 2c: PROJECTIONS (3)

AGGREGATE PRODUCTION, CONSUMPTION AND STOCKS
(IN MILLIONS OF BAGS)

YEAR	PRODUCTION	CONSUMPTION	STOCKS
1974	79.0	79.9	36.0
1975	74.3	83.1	35.1
1976	85.1	83.3	26.3
1977	81.7	83.7	28.1
1978	90.2	85.2	26.1
1979	87.5	87.4	31.0
1980	89.7	89.5	31.1
1981	91.4	91.5	31.3
1982	90.7	93.3	31.1
1983	96.7	95.3	28.5
1984	100.2	97.8	29.8
1985	103.8	100.7	32.2
1986	102.5	103.1	35.3
1987	103.9	105.1	34.7
1988	103.7	106.7	33.6
1989	107.1	108.1	30.6
1990	110.2	110.3	29.3

Table 2d: PROJECTIONS (4)

UNIT VALUE OF COFFEE EXPORTS
(IN US-CENT PER POUND)

YEAR	UNIT VALUE OF EXPORTS	
	CURRENT	1967 CONST.
1974	53.75	32.59
1975	62.30	34.10
1976	77.54	39.00
1977	91.99	42.85
1978	99.38	43.10
1979	107.04	43.18
1980	115.31	43.46
1981	125.19	44.10
1982	137.55	45.29
1983	147.97	45.53
1984	156.64	45.04
1985	164.46	44.20
1986	176.47	44.32
1987	191.71	45.00
1988	210.80	46.25
1989	230.18	47.19
1990	248.46	47.61