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**AN EVALUATION OF ALTERNATIVE DEVELOPMENT
STRATEGIES FOR ROBUSTA COFFEE IN UGANDA**

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Contents

Abstract	2
1. Introduction	3
Coffee in the Ugandan economy	3
Ugandan Coffee in the world market	4
2. Challenges and opportunities for the Ugandan coffee industry	5
Changes in demand and supply of mainstream coffee	5
Growing markets for differentiated coffees	13
Development strategies for Ugandan Robusta	16
3. DREAM model simulations of coffee development strategies	17
The DREAM model	17
Base data for DREAM model simulations	18
4. Results of the DREAM analysis: gross producer benefits of Robusta coffee development scenarios	25
The ‘production increase’ scenarios	25
The ‘quality improvement’ scenarios	27
Sensitivity analysis	30
5. Feasibility of alternative coffee investment options	31
Production increase investment options	31
Quality improvement investment options	33
6. Conclusion	35
References	37

Abstract

Coffee is the most important export crop in Uganda and an important source of income for smallholder farmers in large parts of the country. The paper first investigates the challenges and opportunities faced by the Ugandan coffee industry, especially the decline in the world coffee market, changes in procurement strategies among coffee importers, the rapidly expanding market for high quality and specialty coffees, and the spread of the coffee wilt disease in Uganda. This leads us to examine possible development strategies for Ugandan coffee production within the general types 'production/productivity increase' or 'quality improvement'. Using IFPRI's Dynamic Research Evaluation for Management (DREAM) model, different scenarios for each type of strategy are evaluated to show their potential impacts on Ugandan export prices, export revenues, and producer gross benefits. We then discuss the constraints to and feasibility of development interventions that might achieve the simulated production and quality increases. Notwithstanding the oversupply of coffee in the world market, our analyses suggest that Uganda would benefit from moderately increasing Robusta coffee production as well as from enhancing bean quality and diversifying into sustainable coffees. High and reliable output must be accompanied with, and depend on, reductions in the unit cost of production in order to maintain or raise farm profitability and investment incentives given that prices are likely to remain low. An aggressive production growth strategy, on the other hand, would engage Uganda in a 'race-to-the-bottom' competition with other producer countries if these adopt similar strategies. Quality interventions that focus on increasing bean size for mainstream coffee appear attractive due to the significant and direct effect of prices, the relatively low resource requirements of most technologies, and the added effects of larger beans on yields. Support to the production and marketing of differentiated coffees, particularly productions that combine organic and other sustainability certifications, also appear attractive. Such interventions should be carefully targeted, since relatively few farmers possess the necessary resources to produce for this market, and must be based on thorough market analysis given the high entry barriers to the specialty coffee market. The implementation of both productivity and quality enhancing strategies require a higher level of organization in the industry: horizontally among small farmers, and vertically among producers, traders, and roasters.

I. Introduction

At an annual value of 100 million US dollars, coffee is the most important earner of foreign capital in the developing world, and only second to oil in terms of legal international commodity trade. An estimated 25 million households in 70 developing countries grow coffee (Oxfam 2002). The focus of the paper is on Robusta coffee, which makes up 84% of total production in Uganda. Coffee has been Uganda's most important export and cash crop since the late 1960s, but since 1995 coffee producers, processors and traders have suffered enormous revenue losses as a result of the collapse in world coffee prices and an associated decline in production levels. The impact on poverty has been very negative, since coffee in Uganda is grown by an equal share of poor and less-poor households (DAE-MUK et al 2002). This has coincided with the spread of the coffee wilt disease, which since 1993 has infected 45% of the original coffee trees. New evidence indicates that the persistence of low prices is now slowing down the replacement of infected (and other unproductive) coffee trees with new wilt-resistant and higher yielding varieties, as well as inducing poor management practices (UCDA 2003). This reduces production capacity in the near and medium term and so threatens to undermine Uganda's reputation in the world coffee market as a reliable supplier of high-quality Robusta, which hitherto has earned it a sizeable price premium on the London Exchange¹. Meanwhile, the large coffee roasters are becoming more flexible with respect to the coffees they use in their blends, making it more difficult for suppliers, including Uganda, to maintain an established position in the market (Ponte 2002c, Lewin et al 2003).

COFFEE IN THE UGANDAN ECONOMY

Coffee is a central factor for rural poverty in Uganda. The Uganda Coffee Development Authority (UCDA) estimates that 350,000 households distributed over two-thirds of the country depend on coffee production for cash income. Coffee production creates employment for an even larger number of people, as hired farm labor and in businesses such as processing, input supply, trading, and transport. Coffee is mainly grown by smallholders with an estimated average coffee farm size of 0.6 hectares (UCDA 2000). The proportion of coffee cultivating households is fairly equally distributed among different poverty levels (DAE-MUK 2002). Coffee is Uganda's single most important export commodity, with an export value of \$105 million in the 2003 coffee

¹ The London International Futures and Options Exchange (LIFFE) is recognized as the global benchmark for the pricing of Robusta coffee and most mainstream Robusta coffee is traded here.

market year², down from a \$433 million peak in 1995 (UCDA 2003). The share of coffee in Uganda's total exports was at a historical low in 2002, contributing only 20.7% of revenues, against 66.8% in 1991–95. The coffee price slump and the rise of nontraditional exports such as fish products (18.7% of total earnings in 2002), cut flowers, and cattle hides (UBOS 2003) account for most of this change

UGANDAN COFFEE IN THE WORLD MARKET

Uganda produces Robusta and Mild Arabica coffees, and a little Hard Arabica, with Robusta accounting for 84% of export volumes and 78% of export revenues in 2003 (UCDA, 2003). Domestic consumption is estimated at 6000 tons annually, or 3% of production. Uganda contributed only 3.4% of global coffee exports in 2001–03, and 7.5% of Robusta exports. Eighty-six percent of Ugandan Robusta is exported to Europe. Over the last decade, Robusta coffee consumption in the EU has experienced a stronger growth than other coffee types and regions (net imports grew by 3.3% p.a. from 1993 – 2002, against 1.5% for all coffee types globally) (Lewin et al 2003).

Ugandan Robusta is considered one of the best Robusta coffees in the world because of its mild or neutral flavor, which is mainly the result of being grown at higher altitudes than most other Robustas in the world (Ponte 2002c). For this reason, and because it is available in higher volumes than Robusta origins with similar taste attributes, it commands a premium about 15% over LIFFE (Ibid, ITF 2002, CFC 2001b). The coffee is mainly demanded by European roasters (e.g. Sara Lee, Dougwe Egberts) as a component in certain blends, especially espressos and instant coffee.

The remainder of the paper is structured as follows. The next section discusses trends and patterns in the supply and demand for different qualities of Robusta coffee, based on which we identify two possible development or crisis mitigation strategies for the Ugandan coffee industry: production increase and quality improvement. Different scenarios for each strategy are then evaluated to show their potential impacts on Ugandan export prices, export revenues, and gross producer benefits, using the Dynamic Research Evaluation for Management (DREAM) model. This includes a sensitivity analysis using different price elasticities of demand and supply. We then discuss the constraints to and feasibility of interventions that might achieve the simulated

² The coffee market year in Uganda, and in the statistical data published by the International Coffee Organisation (ICO), runs from October to September. For simplicity, in this paper all references to years use this definition, e.g. '2003' or '2002/03' refers to the period October 2002 to September 2003, if not otherwise stated.

production and quality increases.³ Development strategy recommendations for the Ugandan coffee sub-sector conclude the paper.

2. Challenges and opportunities for the Ugandan coffee industry

As outlined in the previous section, events outside and within Uganda during the last decade present some very serious challenges and apparently limited opportunities for the Ugandan coffee industry. Below we go into more detail with these changes, discussing the trends and patterns in the demand and supply of mainstream (industrial blends) and differentiated (specialty) coffees, globally and in Uganda. Both mainstream and differentiated coffees may involve various forms of value addition in the producing country, such as roasting and packaging, and processing into soluble coffee. This aspect is briefly discussed in the section on differentiated coffees.

CHANGES IN DEMAND AND SUPPLY OF MAINSTREAM COFFEE

Collapse of world market prices

The most serious problem facing the Ugandan coffee industry is the dramatic fall in world coffee prices, which reached a 40-year low in 2002 and 2003, and a 100 year low in real prices (ICO 2004, Lewin et al 2003) (Figure 1). This is consistent with the secular decline in relative commodity prices (the annual rate of decline was 1.8% between 1960 and 2002) and a worsening of this trend since the collapse of the commodity agreements in the 1980s (ITC 2002). The price collapse followed a peak in 1986, caused by a ruined Brazilian harvest due to a seven-month drought in 1985, and accelerated after 1998.⁴ It was temporarily offset by a combined frost and drought starting in July 1994 that destroyed nearly half of Brazil's 1995-96 coffee crop, and a speculative Arabica price hike in 1997. These price fluctuations form part of a repeated cycle in world coffee prices (Lewin et al 2003:3, Mehta and Chavas 2004). A substantial increase in prices caused by frost or drought in Brazil (the most notable in 1975, 1985 and 1994) is followed by new price lows 5–7 years later, caused by increased production induced by the price spike.

³ An ex ante estimation of the costs of such interventions is beyond the scope of the paper.

⁴ Brazilian exports made up 30% of global exports in 2003, a dominance that has been increasing over the last 20 years. Production in Brazil therefore greatly affects international prices.

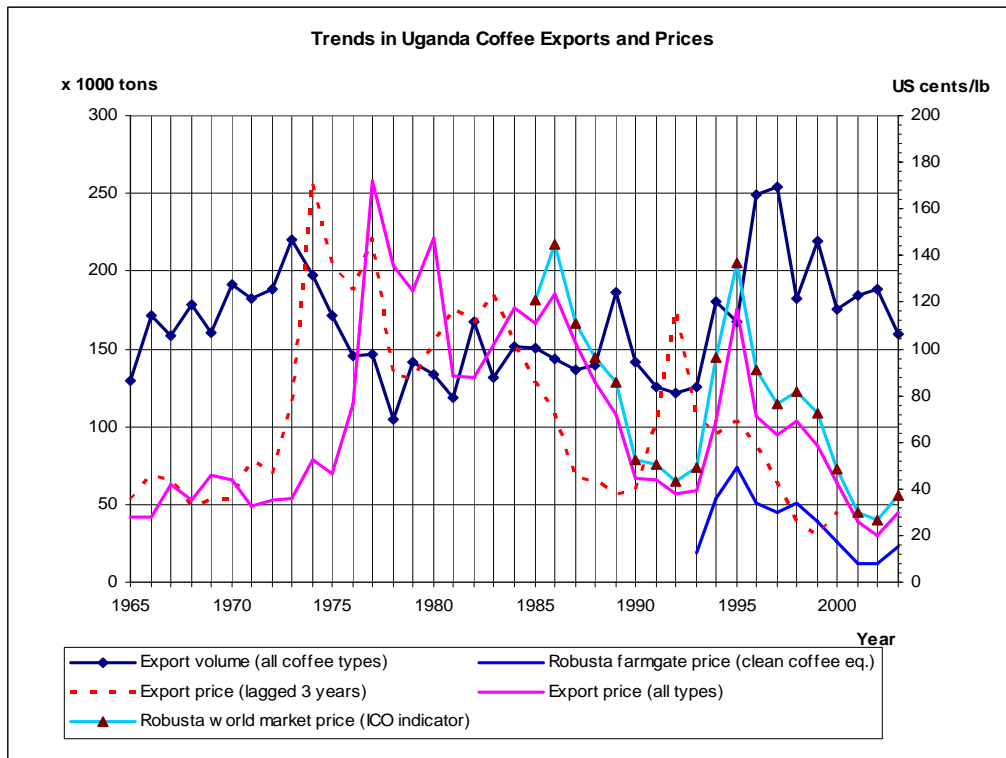
The cause of the current price slump is a chronic oversupply due to a higher growth in world coffee production (1.3% p.a. or 549,700 tons in 1989 – 2003) than in consumption (less than 1.0% p.a.) (Lewin et al 2003, ICO 2004).⁵ This caused stocks of green coffee in importing countries to reach 1.26 million tons in August 2001, about 19% of estimated consumption that year, compared to a ‘normal’ level of 0.4–0.6 million tons in the 1970s and 1980s. The expansion occurred mainly in Vietnam, where Robusta exports increased from 56,900 to 697,900 tons per year between 1989 and 2003 (22.7% p.a.), and in Brazil with an increase in annual exports by 587,000 tons (2.4% p.a.) during that period. A key factor was the ending in 1989 of the International Coffee Agreements that had regulated coffee export volumes since 1962 (Ponte 2002a). There is also evidence that the price stabilization effect of the ICA improved farmer incentives to plant new trees and so contributed to the increase in global production capacity (Mehta and Chavas 2004).

World Arabica prices have improved in 2003/04 compared to 2002/03, from 57 to 65 US cents/lb on NYBoT⁶, due mainly to an estimated 42% reduction in the production of Brazilian Naturals (ICO 2004). Robusta price trends were less positive and less stable (from 26 to 34 US cents/lb on LIFFE between 2003 and 2004, and declining in early 2004) due to continued high production levels in the major origins, Brazil and Vietnam. Despite the recent fall in global coffee exports (from 5.1 – 5.4 million tons between 2001 and 2003), most analysts forecast that in the medium term the world coffee price will continue to be low, driven largely by low-cost Robusta production in Brazil and Vietnam, which shows no signs of abating (CARANA 2003, ICO 2004, Stein 2002, Oxfam 2002, Lewin et al 2003). This trend may well be accompanied by a higher price differentiation between low and high quality coffees, as the demand for specialty coffees (most of which are high quality) is increasing rapidly while the consumption of industrial blends is stagnating (Lewin et al 2003, Giovannucci 2001).

⁵ The average annual growth rates in net imports between 1993 and 2002 in the major consuming regions were: USA/Canada 0.5%, Western Europe 1.2%, Eastern Europe 4.3%, Japan 2.3%, other Asian countries 1.6% (based on data in Lewin et al 2003). US growth occurs mainly in specialty coffees, while consumption of industrial blends is stagnating. A similar pattern is observed in Western Europe. Asia and Eastern Europe experiences the greatest increase in the demand for traditional industrial blends (and so Ugandan Robusta). This is because mainstream coffee consumption increases with rising incomes but levels off at the highest income levels.

⁶ New York Board of Trade, the major commodity exchange for Arabica coffees.

Figure 1. Trends in coffee prices and in Uganda coffee export volume



Data source: ICO (2004) and UCDA (various years).

Trends in Ugandan coffee production, prices and incomes

Ugandan coffee export prices follow the same pattern as world market prices (Figure 1).⁷ There was a downward cycle between 1986 and 1992, when the Uganda price dropped from 123 to 38 US cents/lb. In 1995 it had climbed back to 117 cents, but fell to 70 cents already the year after, where it stayed until 1998, before plunging to an all time low of 20 cents in 2002. The Robusta price recovered to around 30 cents/lb in early 2003, which was also the level in March 2004. Ugandan farm gate prices are closely related to export prices (Figure 1).⁸ The price of Robusta *kiboko* fell from UGX 715 to 245 in 1998 – 2002, and recovered to UGX 530 in 2003. Producer prices are also influenced by domestic marketing and processing costs. As Table 1 shows, the farmers' share of the Robusta export price was squeezed appreciably during the period of

⁷ Uganda export prices are Free on Truck (FOT) or Free on Rail (FOR).

⁸ Farm gate prices are "green coffee equivalent" in US cents per pound. They were calculated based on: monthly Arabica 'parchment' and Robusta kiboko farm gate prices (simple averages of price data collected monthly by UCDA field agents); an estimated out-turn after processing of 54% for Robusta kiboko and 80% for Arabica 'parchment'; and monthly exchange rates (Bureau Middle Rates) reported by Bank of Uganda. Farm gate price data are only available from 1993 onwards.

plummeting world market prices, from 79% in 1998 to 53% in 2001, but it recovered in 2002 and reached 82% in 2003, possibly as a result of rising export prices.

Table 1. Ugandan farmers' share of the export price

Coffee year ending in ^c	Arabica			Robusta		
	Farm gate price ^a	Export price	Farm gate / Export price	Farm gate price ^b	Export price	Farm gate / Export price
	<i>US cents/lb</i>	<i>US cents/lb</i>	%	<i>US cents/lb</i>	<i>US cents/lb</i>	%
1993	27.6	45.18	61.2	19.4	27.04	71.8
1994	72.2	90.34	79.9	53.6	68.40	78.4
1995	96.8	156.33	61.9	74.0	125.13	59.1
1996	68.8	86.14	79.9	50.5	70.87	71.3
1997	89.7	117.37	76.4	45.1	59.42	76.0
1998	101.1	105.87	95.5	50.6	63.90	79.2
1999	74.0	72.26	102.4	38.4	56.29	68.3
2000	53.4	56.54	94.5	25.5	37.58	67.9
2001	38.2	40.39	94.6	12.4	23.43	53.0
2002	31.4	33.13	94.7	11.6	17.61	65.8
2003	35.3	38.88	90.9	23.1	27.88	82.7

Notes: Prices are averages of monthly prices. ^a Parchment clean coffee equivalent. ^b Kiboko clean coffee equivalent. According to UCDA (2003), which uses a slightly different calculation method, farmers' share of the export price increased from 45% in 1992 to 77% in 1994 (after liberalization), fell to 67% in 2002, and remounted to 78% in 2003. ^c October – September. Source: Authors. Data source: UCDA (various years).

Uganda exported (produced) on average 164,600 tons of coffee per year between 1965 and 2003.⁹ Production rose briefly above 200,000 tons in the mid 1970s and mid 1990s, and fell below 120,000 tons in the late 1970s and early 1990s (Figure 2). The spectacular production growth experienced from 1993 – 1997 (from 125,300 to 254,200 tons, or 19% p.a.) may be attributed to a combination of very favorable world market prices and an initial low production level in the early 1990s.¹⁰ Production had dropped to 159,600 tons already by 2003, however, or – 5.2% p.a. This reflects the response to plummeting producer prices as well as the negative effects of the coffee wilt disease on production capacity. The high price volatility, reinforced by the negative effects of prices on production levels, has caused large variations in Ugandan coffee revenues during the last 15 years (Figure 2). The value of exports plummeted from \$390 million in 1986 to US\$101 million in 1992, reached a \$433 million peak in 1995, and then dropped to 84

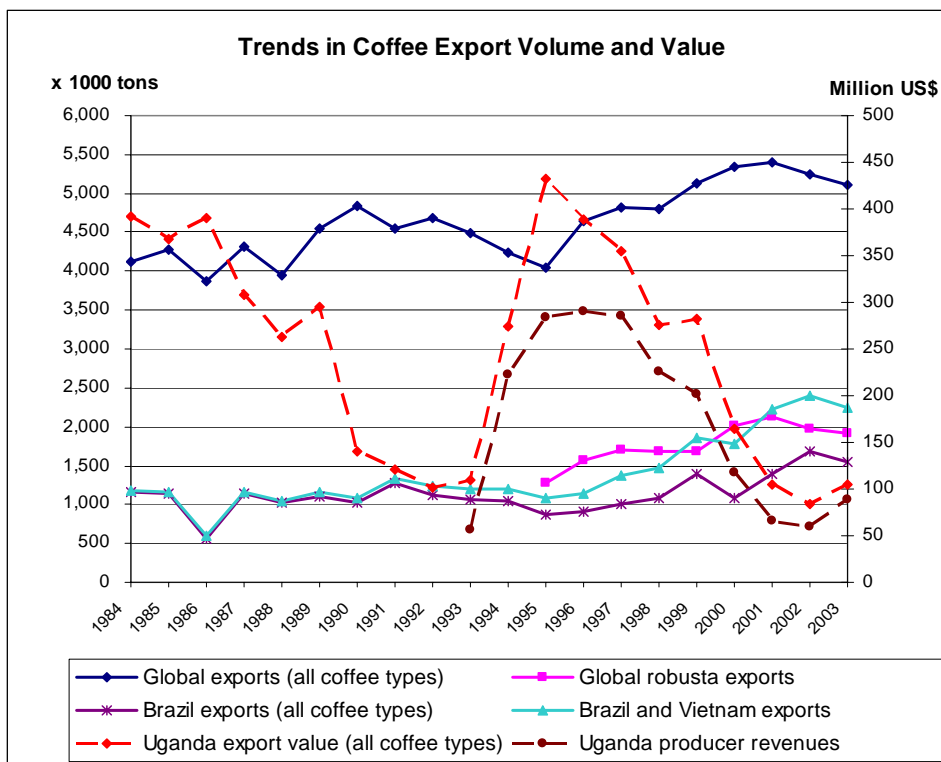
⁹ Given the low level of domestic coffee consumption, we use export data, which are more accurate than production data, as a proxy for production.

¹⁰ Farmers' share of the export price did not change significantly in this period; it had already reached 72% by 1993 as a result of the liberalization of domestic coffee marketing.

million in 2002, the lowest level since 1965. Uganda’s share in global exports has fallen since 1997, due to the continued high export growth experienced by Vietnam and Brazil and the decline in Ugandan exports after a period of high growth in the first half of the 1990s (Figure 2).

Ugandan producer revenues have been equally volatile in the last decade (Figure 2). In 1993, the first year with available data, coffee producers earned only US\$56.5 million in total, due to a combination of low production, low world prices, and low farmer share of the export price. Revenues soared five fold to US\$290 million in 1996, as the level all of the above factors increased simultaneously. This was followed by a steep decline to \$59.6 million in 2003, because of marked decreases in production and export prices, and a moderate squeeze on farmers’ price share. In 2003, revenues rose to \$88.6 million, as the continued downward trend in production was more than compensated for by increased export prices and a notable recovery of farmers’ price share. The purchasing power of Robusta producer revenues was 76% lower in 2002 than in 1996, and 8% lower than in 1993.

Figure 2. Trends in coffee export volume and value



Data source: ICO (2004) and UCDA (various years)

Changes in the quality of Ugandan mainstream coffee

Quality is a key factor for accessing the world coffee market and for the prices received, particularly in a situation of general over supply. The price premium of coffee in the mainstream commodity market depends on type, processing method, bean size (screen), taste, and other quality attributes, as well as the volume and reliability of supply. The quality of Ugandan coffee deteriorated rapidly in the first few years after domestic coffee market liberalization in the early 1990s, as exporters rushed in to establish market shares through vertical integration of coffee procurement and marketing. But since quality is less important for Robusta than for Mild Arabicas, these events did not result in a significant loss of Uganda's reputation in the global Robusta market (Ponte 2002c). While Uganda's coffee marketing chain became fully liberalized in the mid 1990s, an efficient system of export certification was established under the Uganda Coffee Development Authority. UCDA inspects, grades, and certifies all coffee before export shipment, with respect to type (Robusta or Arabica), bean size, processing method (wet or dry), and broken beans. Shipments are screened for defects such as wetness, extraneous matter, and discoloration that cause coffee bags to be referred for reprocessing before they can be export certified. Cup defects, i.e. categories of undesired taste characteristics, are regularly tested for (by coffee type and grade), but are not part of the export grading system. A 'clean cup' denotes a sample without any cup defects. Table 2 shows these quality indicators for the last six years to 2003, based on UCDA's records (UCDA 1998 – 2003). The most significant change is the improvement in the number of bags referred for reprocessing, which has decreased by 89% between 1998 and 2003. Wetness and extraneous matter continue to be serious problems, however. While the proportion of Robusta 'clean cups' improved from 66% to 93.5% between 1993 and 1997 (Ponte 2002c), cup defects have not changed significantly since 1993. The most prevalent cup defects in Robusta are Over-fermentation, Earthiness and Taints, caused by poor handling and storage practices (UCDA 2003).

Robusta bean size distribution has been fairly constant since 1998 (Table 2), with Screen 15 fluctuating around 60 % of total, although a consistent increase in the proportion of Screen 17–18 may be observed. UCDA ascribes this improvement to the increasing acreage planted with improved clonal coffee varieties. The price margins between different size Robusta beans are significant (Table 3). For example, Screen 18 earns 22% more than Screen 15, and 40% more than Screen 12. The aggregated revenue effect of larger Robusta screens are very large due to the high volumes involved compared to Arabica and differentiated coffees.¹¹ The price premia of

¹¹ Quality attributes such as aroma, taste, cleanness also command higher prices, but we do not have data to assess how much.

higher screens are fairly constant over time in absolute values, but were relatively much larger in 2001 and 2002 when average export prices were at their lowest. We do not have data on global trends in the premium of higher screens, but the export price trends in Uganda do not point to any such significant changes. The general quality differentiation of the coffee market may help raise the premium paid for larger beans in the longer term. Wet processing enhances the taste of Robusta, as witnessed by the fact that washed Robusta achieved 100% ‘clean cup’ in 2003 (UCDA 2003). Washed Robusta sold at 42 US cents/lb on average in 2001–03, or 79% higher than nonwashed Screen 15 Robusta, the second highest price of all Robusta types and grades. Uganda exported 74 tons of washed Robusta on average in 2001–03, a trifling 0.05% of total Robusta exports.

While most of Uganda’s land area lies too low for Arabica production, Arabica coffee is grown on only 9% of the agronomically suitable land, according to one estimate (CARANA 2003). This implies potential for improving the value of Ugandan coffee through the expansion of mainstream Mild Arabica production. In 2001–03, Uganda’s Arabica coffee was exported at 38 US cents/lb against 23 cents for Robustas (Table 3). The best five Arabica grades sold at 46 US cents/lb, compared to 28 US cents/lb for Screen 17–18 Robustas, a significant difference.

Table 2. Changes in quality attributes of Ugandan coffee

Quality Variable	Measure	1998	1999	2000	2001	2002	2003
Bean size	Proportion of Robusta Screen 17-18 (%)	11.9	6.5	8.9	12.2	13.9	13.5
	Proportion of Robusta Screen 15 (%)	63.7	56.5	63.7	62.1	60.8	58.1
	Proportion of Robusta Screen 12-14 (%)	20.2	32.7	23.8	23.6	21.2	24.3
Broken beans	Proportion of Robusta of grade BHP and B/Beans (%)	4.3	4.2	3.6	2.1	4.1	4.2
Physical defects	No. of bags referred for reprocessing (thousands)	424.7	178.4	85.2	154.2	48.1	45.2
Cup defects	Proportion of clean cups in Robusta Screen 15 (%) ^a	92.6	89.2	85.0	89.2	88.5	88.4

Notes: ^a The proportion of clean cups increased from 66% in 1993 to 93.5% in 1997 (Ponte 2002c).

Data source: UCDA (various years)

Table 3. Price margins between Robusta grades and types, and between Robusta and arabica (US cents per pound)

Coffee Types and Grades compared	2001		2002		2003		Average 2001 - 2003	
	<i>cents</i>	%	<i>cents</i>	%	<i>cents</i>	%	<i>cents</i>	%
Scr 15 – 18	7.6	32.3	5.2	28.0	3.2	10.8	5.3	22.4
Scr 12 – 15	3.2	15.8	3.3	22.0	2.2	8.2	2.9	14.0
Scr 12 – 18	10.8	53.2	8.5	56.1	5.4	19.9	8.2	39.5
Scr 15 – Organic	11.5	48.8	7.2	38.8	7.3	25.1	8.7	36.5
Scr 15 – Washed	27.4	116.4	20.9	112.7	7.8	26.8	18.7	78.7
Scr 15 – Fair Trade	82.5	351.1	87.5	472.5	76.8	263.3	82.3	346.7
Robusta – Arabica	18.0	77.9	16.1	89.4	11.2	40.1	15.2	66.1

Data source: UCDA (various years) and Ponte and Kawuma (2003).

Loss of market position of Ugandan Robusta?

Market developments over the last decade or so are threatening the special position of Ugandan Robusta coffee in the mainstream coffee market, which earns it a sizeable price premium on LIFFE (currently about 15 percent) (Ponte 2002c). The competitiveness of Uganda Robusta is based on quality, especially its unique taste, combined with a relatively high volume, rather than on low cost, as is the case for Vietnamese Robusta, for example. Yet new processing technologies and coffee sourcing strategies have given the large roasters more flexibility in their choice of coffee types for their blends. They can thus more easily substitute Ugandan Robusta for hard Arabicas, or combinations of lower grade Robustas and mild Arabicas (Ibid, Lewin et al 2003).¹² This flexibility is enhanced by a new steam cleaning technique, which improves the quality of lower grade coffee beans by removing some of their physical defects and harsh taste. The risk of a switch away from Ugandan Robusta is heightened by the recent improvement in the quality of the low-cost producers, Vietnam and Brazil.¹³ It has been argued that, fortunately for Uganda, these are not perfect substitutes in terms of price and quality, and that roasters will pay the price premium for Ugandan Robusta as long as they are assured of a reliable supply (Ponte 2002c). On the other hand, the concentration of roasting capacity and coffee trade in a few large companies has made the ability to provide a large and constant volume in a uniform quality more important than ever for the market position of producer countries.¹⁴ This is reflected, for example, in roasters setting minimum requirements on the quantity needed from any particular origin to be

¹² A similar substitution mechanism has increased the use of Brazilian Naturals at the expense of Mild Arabicas (Lewin et al 2003).

¹³ Nestlé and many Spanish roasters are said to have shifted from Ugandan to Vietnamese Robusta that is cheaper and of lower quality (Ponte 2002c).

¹⁴ Three giant coffee roasters, Kraft, Nestlé, and Sara Lee, buy 36% of the world's coffee each year, while the next two in size, Procter & Gamble and Tchibo, account for 4% each (Oxfam 2002).

included in a major blend (Ibid). If intensified, such demands may become a barrier to market entry for small producers like Uganda.

In light of the above, a key factor that could trigger a general switch away from Ugandan Robusta, and which Uganda may control, is the volume and reliability of its supply. Meeting this condition is threatened by several factors, the most critical being the spread of the coffee wilt disease. Based on a survey in 2003, UCDA (2003) estimates that the coffee wilt disease since 1993 has infected 45% of the original Robusta coffee trees (106,800 ha), equivalent to a production of 53,400 tons per year. The only measure against wilt is to uproot and burn the infected tree, while good management practices may limit the risk of infection. In addition, many trees are low productive due to old age. Supported by the government's Coffee Replanting Programme, farmers have since 1993 replanted old and wilt-infected coffee trees; yet low replanting rates have led to a substantial decline in the area under coffee and a drop in output (Ibid).

Other factors reduce the reliability of supply of Ugandan coffee, which we briefly mention here. There is a low ability to prevent crop losses caused by pests and droughts, due to low input use and the absence of irrigation. The low level of technology and input use result in low yields, despite a favorable climate for Robusta production. And, as mentioned, low and volatile prices discourage farm investments and squeeze marketing margins (Ponte 2002c). Increased flexibility by roasters also makes it more important for Uganda to maintain or increase its price competitiveness by enhancing farm productivity and lowering processing and marketing costs.

GROWING MARKETS FOR DIFFERENTIATED COFFEES

While the market for mainstream coffees is stagnating or at best growing very slowly, the last decade has seen a rapid and sustained growth in the demand for coffees produced in socially and environmentally responsible ways, and in reputable origins or appellations (Ponte 2002c, Lewin et al 2003). The North American market for these specialty or differentiated coffees is expanding by around 20% per year in retail sales terms and similar growth rates are observed in Europe and Japan (CARANA 2003, Ponte 2002b, Lewin et al 2003). We define differentiated coffees as all coffees that are not traditional industrial blends (mainstream coffees).¹⁵ They may be grouped into *sustainable* coffees, *gourmet and specialty* coffee, and coffee with *geographic indications of origin (appellations)*. We focus here on sustainable coffees, which is most relevant for Ugandan Robusta.

¹⁵ Differentiated coffees are also referred to as 'specialty coffee'. We follow here the terminology proposed by Lewin et al (2003), who treat the latter as a sub-category of the former.

Sustainable coffee is coffee grown in certified environmentally friendly ways (organic, eco-friendly¹⁶) and coffee sold through fair trade organizations such as Max Havelaar that guarantee a higher compensation to producers and workers. Aside the more established certification schemes, an increasing number of production standards are being developed by non-profit organizations (e.g. Utz Kapeh) and companies such as Starbucks and Nestlé. These sustainability certifications combine environmental, social, and food safety ('responsible') production standards that are less strict than organics and fair trade (Ponte 2002b, Ponte and Kawuma 2003, Lewin et al 2003). Some differentiated coffees combine two or more certifications, for example are fair trade coffees very often organically certified also.

Imports of sustainable coffee by the major consuming countries (North America, Western Europe and Japan) was approximately 1.1 million bags in 2002, representing nearly two percent of all green coffee imports and a rather higher value share (Lewin et al 2003). Sustainable coffee represents a much greater proportion of production from smallholders compared to conventional coffee, implying a relatively higher value for smallholders than indicated by these trade figures. Most estimates of future growth rates for sustainable coffees lie between 10% and 15% per year, depending on region and coffee type. This optimism is based on high annual growth rates in the last five years to 2003 and on the increasing interest in the sustainable coffee market of large coffee roasters such as Kraft and Nestlé (Ibid, Ponte and Kawuma 2003).¹⁷ All sustainable coffees command a significant price premium. Suppliers of shade-grown, organic, and fair trade coffee in North America fetched average premia of 53 – 62 US cents/lb in 2001 (Giovannucci 2001). There are no consistent data on how much of these premia are transferred to producers, but it is known to vary greatly due to such factors as certification type, processing, region, and availability (Lewin et al 2003). Yet despite high growth rates, production capacity often exceeds demand and much certified organic and fair trade coffee are sold at conventional prices.

Fair trade coffee earns the highest premia by far among the sustainable coffees, reflecting in part the current low market prices of conventional coffee. The Fair Trade Labeling Organization International is an umbrella organization for most fair trade certifiers and producer groups. The FLO mandatory export base price for unwashed Robusta in Africa is 106 US cents/lb, or more than three times the price of conventional Robusta in 2001–03 (ITC/UNCTAD 2002, ICO

¹⁶ Bird-friendly, Shade-grown, and Rainforest Alliance certified coffees.

¹⁷ Recent consumption growth rates are 12% for organics in the U.S., 10-15% for organics in Europe, and 16% for fair trade globally (1999-2001).

2003)¹⁸. Global sales of fairly traded coffee have grown by about 8% annually since 1996 and reached 16,000 tons in 2002 (Lewin et al 2003). Only 8.5% was Robusta. Global demand growth is estimated at 5–20% per year; yet the production capacity of existing certified producers is much higher than current demand leaving little room for new entrants into the market. In Uganda, the FLO base price was 82 US cents/lb over the export price of Robusta Screen 15 in 2001–03 (Table 3), which is much higher than for any other Robusta coffee types (Ponte and Kawuma 2003).¹⁹ Uganda’s export of fair trade coffee has been 200–300 tons per year since 1998 (67% Robusta).

The premium for certified *organic coffee* lies in the 15–40 cents range, 10–15% over the equivalent non-organic quality (Lewin et al 2003, ITC/UNCTAD 2002). In Uganda, producers of organic Robusta earned a premium of 18 US cents/lb in 2003 (Ponte and Kawuma 2003). At least half of these premia are due to improved quality brought about by organic production practices (Ibid). Several important non-monetary benefits derived from sustainable production practices must be added to the price premia, including improved soil structure and reduced erosion, reduced health hazards from agrochemicals, reduced expenses for external inputs, and organizational and marketing skills acquired through participation in more complex supply chains (Lewin et al 2003).

The non-profit foundation Utz Kapeh is by far the fastest growing amongst the *emerging sustainable certifications*, with an estimated 54,000 tons of coffee certified in 2003 (60% Robusta), 35% of the global sustainable market (Ponte and Kawuma 2003). Its Code of Conduct is adapted from the EUREPGAP Protocol for Good Agricultural Practice for fruits and vegetables, and includes food safety and social and environmental responsibility criteria. There is only one certified Utz Kapeh coffee scheme in Uganda, which is combined with organic certification. Several new initiatives will lead to more sustainable certification schemes in Uganda.²⁰

¹⁸ The FLO base price for washed Robusta is 110 US cents/lb. Certified organic coffee attracts an additional premium of 15 US cents/lb

¹⁹ The farm gate price premium was 60-100%. There are no data on how much certified fair trade coffee is sold at regular prices. No official data exist on fairly traded coffee in Uganda. Studies on fair trade coffee in Uganda include Ponte and Kawuma (2003), Tallontire et al (2001) and Belling (2002).

²⁰ For example a planned Robusta out grower scheme around a 2,000 hectare coffee plantation, established in 2001 by the Neumann Kaffee Gruppe (NKG). The scheme will apply ‘NKG Standards for Sustainable Coffee Production’ including various environmental and social criteria (www.nkg-tropical.com).

DEVELOPMENT STRATEGIES FOR UGANDAN ROBUSTA

The trends in coffee production and markets outlined above lead us to focus on two types of strategies whereby the coffee industry in Uganda may sustain or increase Robusta producer and export earnings: increase production or enhance quality. We summarize here the technical aspects of each strategy. *Increased production* may be achieved by increasing yields on existing farms or by expanding the area with coffee. Yields may be raised through replanting farms with younger trees, using clonal varieties that are more resistant to wilt and more productive under improved management conditions. Improving soil fertility and pest management practices and more timely and selective cherry harvesting would also increase yields. Use of irrigation and more drought resistant varieties would enhance the reliability of the volume of supply of Ugandan coffee, since rainfall is the key factor in annual variations in coffee yields. Area expansion will also tend to raise average yields since clonal varieties dominate new plantings.

Quality improvement strategies may involve increasing the production of differentiated coffees or improving the quality of mainstream coffee. Technical aspects of the latter include: produce larger beans through the planting of clonal varieties and adoption of improved management practices, including more timely cherry harvesting; reduced cup defects through improved farm-level processing and storage; reduced incidence of wetness and extraneous matter through better handling throughout the domestic supply chain; and wet processing of Robusta through investments in wet mills. Expanding Arabica production may also be considered an improvement in Ugandan mainstream coffee, but is beyond the scope of this paper. Increasing the production of differentiated coffees in the case of Ugandan Robusta would focus on sustainable coffees, possibly combining several certifications, and perhaps the promotion of selected, washed Robustas as single origins. Recent experiences with advanced in-country processing, especially instant coffee production, show promising results.

In the following we use the DREAM model to estimate the economic (gross) benefits to Ugandan producers (all agents in the domestic supply chain from farmer to exporter) of different scenarios representing production increase and quality improvement strategies.

3. DREAM model simulations of coffee development strategies

THE DREAM MODEL

The baseline simulations were undertaken using the Dynamic Research Evaluation for Management (DREAM) model developed by the International Food Policy Research Institute (Alston et al. 1995; Wood et al. 2000). DREAM is designed to measure economic returns to commodity-oriented research under a range of market conditions, allowing price and technology spillover effects among regions because of the adoption of productivity-enhancing technologies or practices in one innovating region. Linear equations are used to represent supply and demand in each region with market clearing enforced by a set of quantity and price identities. It is a single-commodity model without explicit representation of cross-commodity substitution effects in production and consumption. DREAM treats the commodity as tradable between regions (although a spectrum of possibilities from free trade to autarky can be represented). The supply, demand and market equilibrium are defined in terms of border (fob) prices, which will differ from the prices received by farmers (or paid by consumers) because of costs of transportation, market transactions, product transformation, and so on that are incurred within regions between the farm and the border. Alston and Wohlgenant (1990) showed that changes in benefits estimates from comparatively small equilibrium displacements of linear models provides a reasonable approximation of the same shifts with various other function forms. Small shifts have the added virtues that cross-commodity and general equilibrium effects are likely to be small (and effectively represented within the partial equilibrium model), and that total research benefits will not depend crucially on the particular elasticity values used (although the distribution of those benefits between producers and consumers will). Even with all these simplifications, which make the DREAM model tractable, significant effort is needed to parameterize and use the model to simulate market outcomes under various scenarios.

The primary parameterization of the model's supply and demand equations is based upon a set of demand and supply quantities, prices, and elasticities measured in a defined "base" period. DREAM also allows for exogenous shifts in supply and demand, thereby allowing for a sequence of yearly equilibrium prices and quantities to be generated in "without research" scenarios. These "without research" outcomes can be compared with "with research" outcomes, which are obtained by simulating a sequence of supply curve shifts attributable to research, incorporating research-induced supply shifts. The research-induced supply shifts are defined by combining an

assumption about a maximum percentage research-induced supply shift under 100 percent adoption of the technology in some future year, with an adoption profile representing the pattern of adoption of the technology over time. Finally, measures of producer and consumer surplus are computed and compared between the “with research” and “without research” scenarios, and these are discounted back to the base year to compute the present values of benefits. In those cases where we know the costs of the research that are responsible for the supply shift being modeled, DREAM will compute a net present value or internal rate of return (IRR).

DREAM has been developed into a computer software package. It has a menu-driven, user-friendly interface that hides the complex computation to allow the user to focus on methodology, data collection and policy interpretation. DREAM explicitly includes four market types: horizontal multi-market (including a local or innovating market and an arbitrarily defined number of other markets linked by trade or technology), three-level vertical market (multiple markets vertically across stages of production or among factors of productions), small open economy, and closed economy. The region in DREAM can be any spatial unit, either a geopolitical region such as a country, province, or county, or an agroecological zone (e.g., humid or arid). DREAM allows users to specify technology shifts, technology adoption profiles, elasticities, and exogenous growth rates that change over the simulation period, and it provides a framework for exploring various kinds of policy, technology, extension and trade issues (Alston et al. 1995; Alston et al. 2000).

BASE DATA FOR DREAM MODEL SIMULATIONS

Regional aggregation is one of the fundamental factors in the DREAM model. In this paper the regional focus is Uganda since we are interested in the overall impact on Uganda rather than variations within the country. Because virtually all (estimated 97%) of Uganda’s coffee production is exported, the world coffee market is of crucial importance for the analysis of Ugandan coffee growth scenarios. Our DREAM regions are therefore Uganda and the Rest of the World (ROW). The variation in coffee quality within each region is also important, so we divide both Uganda and ROW into two regions separated and characterized by a different product quality. We thus end up with four DREAM regions: Uganda High-Quality, Uganda Low-Quality, ROW High-Quality, and ROW Low-Quality. Table 4 shows the overall structure of the present DREAM simulation. The base year is 2002 that takes on the average values for 2001 – 03. The simulation period is 14 years, i.e. up to 2015, the target year for achieving the Millennium Development Goal of reducing poverty to half. The following market conditions are defined for the base year and described below in detail: initial quantities of production and consumption,

initial region-specific market prices, elasticities of supply and demand, and exogenous growth in supply and demand. The corresponding base data are presented in Table 5.

Table 4. Overall structure of coffee simulations

Model Parameters	Value	Remarks
Scenario Constants		
Base year	2002	2001 – 03 average.
Simulation period	14 years	2002 to 2015.
Real discount rate	3%	Used to calculate present values.
Market		
Initial price	--	Border prices (f.o.b.).
Price transmission elasticity	1.0	Reflects imperfect transmission of price change effects.
<i>Supply</i>		
Initial quantity	--	2001–03 domestic/regional production for all commodities and regions.
Elasticity	0.4 / 0.3	Price elasticity of supply for coffee in Uganda / ROW
Exogenous growth	--	ROW: 1994 – 2003 production growth rate. Uganda: Assumed based on analysis of Kenyan smallholders.
Tax/Subsidy	0	
<i>Demand</i>		
Initial quantity	--	2001–03 domestic/regional consumption for all commodities and regions.
Elasticity	-0.20 0.47	Price elasticity of demand for coffee Income elasticity of demand for (low quality) coffee
Exogenous growth	--	Derived from projected population and income growth for each region.
Tax / Subsidy	0	
R&D Parameters		
Probability of success	100%	
Gestation lag	1 year	Technology will be available after 1 year.
<i>Adoption profile</i>		
Time to ceiling	3 years	Maximum adoption after 3 years.
Ceiling level	100%	Maximum adoption level.
Functional form	Sigmoid	Sigmoidal from technology available to maximum adoption, no disadoption.
<i>Spillover</i>		
Spillover coefficient	0	Technology spillover from innovating region to others.
Spillover lag	0 years	Time lag for technology available to spill-in region.
<i>Supply shifts</i>		
Supply shifts	1~10%	Percentage of innovating region's producer price, or of quantity or quality change.

Source: Authors

Production and consumption

Data on Robusta coffee production in Uganda were obtained from the Uganda Coffee Development Authority. UCDA keeps monthly records of the value and volume of all coffee

legally exported from Uganda, by type and grade, based on licensed exporters' reporting to UCDA. Data on certified fairly traded coffee are from Ponte and Kawuma (2003). We assume production to be the sum of exports and domestic consumption, since UCDA's export data are more accurate than their production ('procurement') data.²¹ Total coffee consumption in Uganda is estimated at 6000 tons annually (UCDA 2003), in which the share of Robusta is assumed to be equal to the share of Robusta in total exports (0.85). Data for the calculation of production for ROW were obtained from the International Coffee Organization (ICO) and Lewin et al (2003). Demand is balanced with supply at the global level and consumption in ROW is the difference between global demand and Uganda consumption.²² We define high-quality Robusta coffee in Uganda to comprise the following grades and types: 'mainstream' beans of Screen 15 and larger, and wet processed, fair trade, and organic Robusta. Low quality Robusta is mainstream beans of grade 14 and lower. According to this definition, the share of high-quality Robusta in total Robusta production (and consumption) in Uganda is 0.72 (UCDA 2003, Ponte and Kawuma 2003). Without quality-specific data for ROW, we assume the same share of high quality Robusta as in Uganda.

Table 5. Base data for Robusta DREAM analysis. average values 2001-03

Robusta Regions	Supply <i>tons</i>	Demand <i>tons</i>	Price <i>US\$/ton</i>	Elasticity			Growth	
				Supply	Demand	Income	GDP/capita	Pro-duction
							<i>% p.a.</i>	
Uganda Low-Quality	43,535	1,424	424	0.4	-0.2	0.47	2.55	2.0
Uganda High-Quality	112,350	3,675	534	0.4	-0.2	0.71	2.55	2.0
ROW ^a Low-Quality	659,439	701,549	581.1	0.3	-0.2	0.47	1.50	2.8
ROW ^a High-Quality	1,701,814	1,810,489	732.8	0.3	-0.2	0.71	1.50	2.8
World	2,517,138	2,517,138						

Notes: ^a ROW = Rest of World. Based on data obtained from the International Coffee Organisation, Uganda Coffee Development Authority, and published literature. Source: Authors.

²¹ Uganda coffee imports are negligible and we apply the reasonable assumption that the net increase in coffee inventories are zero.

²² Production for ROW is defined as global production minus Uganda production. ICO does not report production by coffee type, so we derive this by assuming that the share of Robusta in global production is the same as in global exports, i.e. 0.3813 on average in 2001–03. Data on global Robusta exports were obtained from Lewin et al (2003: 91). In the absence of type-specific consumption data, we likewise calculate global Robusta consumption based on the share of Robusta in global exports.

Market price

All commodities in DREAM are tradable, so the relevant price is the border price (FOB), here the average price 2001–03 obtained by exporters in Uganda. For Uganda, the price of ‘high’ and ‘low’ quality Robusta, respectively, is calculated as the average of the price of each Robusta grade that constitutes the quality class, weighted by export quantity, using UCDA data on export quantities and values by grade (see Table 5; Table 3 shows derived price margins between types and grades). The price of ‘high quality’ coffee was thus 26% higher than that of ‘low quality’ coffee. For ROW, we use the average Robusta ICO indicator price for 2001–03, and adjust it by the price difference between low and high quality observed for Uganda. The weighted average price in 2001–03 of all Robustas is \$503 per ton in Uganda, and in ROW \$690 per ton.²³

Income and price elasticities

World coffee consumption is generally price and income inelastic. Low price and income elasticities of demand are i.a. related to the addictive properties coffee and to its very low share in household budgets in the major consuming countries. They are higher in lower income countries and for more expensive coffees, but the lower volume consumed reduces their aggregated effects. The individual consumer’s daily tolerance limit for caffeine also contributes to low demand elasticities, especially for Robusta, which has the highest caffeine content of all coffee types. Based on the estimates of coffee demand elasticity found in the literature, we choose a price elasticity of demand in Uganda and ROW of -0.20 .²⁴ The global *income elasticity of demand* is estimated at 0.47 by Islam and Subramanian (1989), while Kutty (2000) finds income elasticities in the 0.15 – 0.85 range for Japan and three European countries. We thus assume the income elasticity for low–quality coffee to be 0.47, and the income elasticity for high–quality coffee to be 0.71 (50% higher) to reflect the propensity to consume relatively more high–quality coffee as income rises.

²³ The two prices are not directly comparable. The ICO indicator price for Robusta is the arithmetical mean of the price of Screen 15 from a number of origins on the New York Commodity Exchange (NYCE). The unweighted average export price of Ugandan Screen 15 was \$525 per ton in 2001–03.

²⁴ These estimates vary a lot. Islam and Subramanian (1989) estimate world coffee price elasticity of demand to be -0.27 , while Junguito and Pizano (1999) found elasticities between -0.2 and -0.4 . For the US, Lewin et al (2003) report the elasticity of demand to be -0.1 , similar to that of -0.11 found by Pagoulatos and Sorensen (1986), but lower than -0.25 and -0.53 reported by Roberts (1984) and Bhuyan and Lopez (1997), respectively (cited in Brettendorf and Verboven, 2000). In Europe, the largest market for Ugandan Robusta, Brettendorf and Verboven (2000) calculated elasticities of demand between -0.21 and -0.23 for the Netherlands, while the estimate for Germany by Feuerstein (1986) is -0.18 (cited by Brettendorf and Verboven, 2000).

Several factors affect coffee producers' low level of response to price changes or supply elasticity. First, the uncertainty of future prices, which has increased since the end of the International Coffee Agreement (Mehta and Chavas, 2004), combined with the long maturity (3-4 years) of coffee trees, make investments in new coffee plantations risky. Second, poor access to investment capital, especially following periods of low prices when many farmers are indebted, impact the ability to exploit higher prices (Lewin et al 2003). Financial and other resource constraints are more binding in poor countries and for small producers and thus are characteristic of Africa, while producers in a country like Brazil can access state subsidized credit (Lewin et al 2003). Third, smallholders' exit from coffee production when prices collapse are delayed by the lack of alternative income sources combined with the long term nature of investment in (and disinvestment from) coffee trees and the low short-run production costs (Mehta and Chavas, 2004). This may well have been the situation in Uganda during 2000 – 03 when prices were historically low, and during the 1980s when civil strife severely limited opportunities for income diversification. Lewin et al (2003) estimated in econometric analysis the world Robusta *price elasticity of supply* at 0.20 with a three year lag (estimated time from planting of coffee tree to harvest of first crop) on prices and excluding Brazil and Vietnam. Townsend (1999) reports estimates of much higher supply elasticities of 0.64 in the short run, and 1.48 in the long run, for Kenyan smallholder coffee farmers during 1947 – 64.

Coffee supply elasticities have not been estimated for Uganda, but Figure 1 gives an impression of farmers' response to price changes. It shows trends in Uganda's export volumes, export prices, and farm gate prices (converted into 'clean coffee equivalents' for comparison with export prices, and only available for 1993 – 2003). A visual interpretation suggests that farmers responded positively to the large increase in export prices in 1992 – 95.²⁵ Export volumes and farm gate prices both declined during 1995 – 2000, but after 2000 output increased slightly while prices continued to fall. Output declined in 2003, possibly as a response to the persistence of low and falling prices in the previous three years, combined with the effects of the coffee wilt disease (UCDA 2003). The same pattern is observed for the price collapse in 1986–1992. Ugandan coffee farmers thus seem to respond faster to increasing than to falling prices. This may be because most depend on coffee for basic household needs such school fees and clothing, and so must keep producing even at very low prices until they find alternative income sources. Also, land scarce farmers may well be reluctant to uproot coffee trees (which are productive for more

²⁵ This conclusion cannot be sustained if we lag prices by three years to account for the time between planting a coffee tree and the first crop harvest (see Figure 1). Yet farmers may also increase production from one season to the next by various yield-increasing management practices.

than 20 years) to make space for more profitable crops until they are convinced that low prices will persist. Authors' attempt to calculate supply elasticities based on the data underlying Figure 1 did not produce meaningful results.²⁶ Guided by the above descriptive analysis and the short-term elasticity for Kenyan smallholders cited earlier, we thus conservatively assume the supply elasticity for Uganda to be 0.40. We assume a supply elasticity of 0.30 for ROW given the large production increases in Brazil and Vietnam witnessed during the 1990s, which are not considered in the estimate of global Robusta supply elasticity of 0.20 by Lewin et al (2003).

Exogenous supply and demand growth

Exogenous demand growth is projected for each region using the projected growth rate of population, $n_{j,t}$, as well as the projection of growth in per capita consumption arising from income growth. The per capita consumption growth rate is estimated on the basis of the growth rate in real income, proxied by the 1990-2002 growth rate of GDP per capita, g_j , and the crop-specific income elasticity of demand, μ_i . Therefore, we can calculate the growth rate of demand for crop i in region j and year t

$$\pi_{i,j,t}^C = n_{j,t} + g_j \mu_i$$

Since the major coffee consumption countries in the world are the OECD countries and considering the expanding coffee markets of China, Russia and Singapore, we choose OECD plus these three countries to represent ROW in estimating the demand growth rate. In addition, we distinguish the demand growth rates of low quality coffee from high quality coffee by using a higher income elasticity for high quality coffee than for low quality coffee, as mentioned above. The growth rate for high-quality coffee will therefore be greater than for low-quality coffee, in line with the current trends in the market for differentiated coffees.²⁷

²⁶ This is due to the large, short-term variability in prices in the 1990s and the related inability to control for the effects of important non-price factors, notably climate and the effects of the coffee-wilt disease. Supply elasticities based on trends in the 1970s and 1980s have limited predictive value, since this was a period of civil strife in Uganda and therefore very different production conditions prevailed. Thus, during the 1970s, a sharp increase in export prices from 1973 – 77 coincided with a steep fall in volume during 1973 – 78. From 1977 – 90 export prices decreased from 172 to 45 US cents/lb (74%), while export volume fell by only 14%.

²⁷ The future annual demand growth rates estimated by DREAM for ROW are 1.71—1.55 (2002—15) for Low Quality and 2.19—2.03 for High Quality coffee. In comparison, global demand growth in 1993—2002 were 1.48% for all coffee types and 3.13% for Robusta.

In ROW we decide on an exogenous growth rate for Robusta coffee supply based on the average annual production growth rate in 1994–2003 for Arabica and Robusta combined, i.e. 2.8% (Table 5).²⁸ Ideally we would have applied a cyclic rather than a linear production trend, but this is not possible due to the random timing of the events (droughts and frosts in Brazil) that trigger global coffee production (and derived price) cycles. It is not meaningful to apply an average growth rate for this period for Uganda, given the volatility in exports shown in Figure 1, nor would earlier periods be a valid basis on which to make predictions, due to the very different economic conditions.²⁹ The baseline production growth rate for Ugandan Robusta is estimated at 2.0%. Unlike for ROW, the baseline growth rate for Uganda does not include the effects of technology improvements since these will form part of the simulations, but is only due to increases in the amount of productive factors (land, labor, and real capital). It is also assumed lower than for ROW due to the continued ravaging of the coffee wilt disease in Uganda, and because ROW includes the fast growing Robusta origins of Brazil and Vietnam.

DREAM Robusta coffee development scenarios

The DREAM model is designed for comparative static analysis and calculates productivity benefits as the difference between “with research” and “without research” scenarios. We apply it here to evaluate the two coffee development strategies outlined in Section 3 in terms of gross benefits to producers.

(1) Increase production through either area expansion or increased yields (both will most often involve increases in total factor productivity). In DREAM terms, both involve downward supply shifts, either from exogenous growth (area expansion) or technological change (raising productivity per area unit). In Scenario 1, which is also our baseline scenario, both Uganda and ROW keep their baseline production growth rates of 2.0% and 2.8% per year, respectively. In Scenario 2, Uganda gradually reduces its production growth rate from the baseline level to zero percent in 2015, while ROW maintains a 2.8% growth rate. In Scenario 3 Uganda has an annual growth rate of 7% per year, while ROW maintains a 2.8% growth rate. This would increase Uganda’s share in world Robusta production from the current 6.2% to 10.4% in 2015. Scenario 4 simulates the Government of Uganda Strategic Export Plan (2001) for coffee, which is to increase total coffee production to 12 million bags by 2006, and then keeps the baseline growth

²⁸ Disaggregated production data for Robusta only go back to 1998.

²⁹ The average annual production growth rate for Uganda in the 1984 – 2003 period is 1.9%, –1.6% in 1994 – 2003, and –2.9% in 1998-2003.

rate of 2.0%. This would imply a share of Ugandan Robusta in world production of 21.0% in 2006 and 19.8% in 2015.

(2) Enhance the quality of Ugandan mainstream coffee and/or increase the production of differentiated coffee. This is equivalent to switching output from low to high quality coffee and experiencing a higher growth rate of demand as a result. These changes are modeled based on the above definitions of 'high' and 'low' quality Robusta and the current export price margin (26%) between these classes in Uganda. Scenarios 1 and 2 simulate a 10% and 25% quality improvement, respectively, which in the model means producing 10% and 25% more high-quality coffee while reducing the low-quality coffee in Uganda by the same amount. In Scenario 3 all Robusta coffee is of high quality. The percentages simulate the combined effects of the various quality enhancement options discussed in Section 2. These changes are gradually implemented from 2002 to 2005, and kept constant thereafter, as specified by the adoption profile in Table 4.

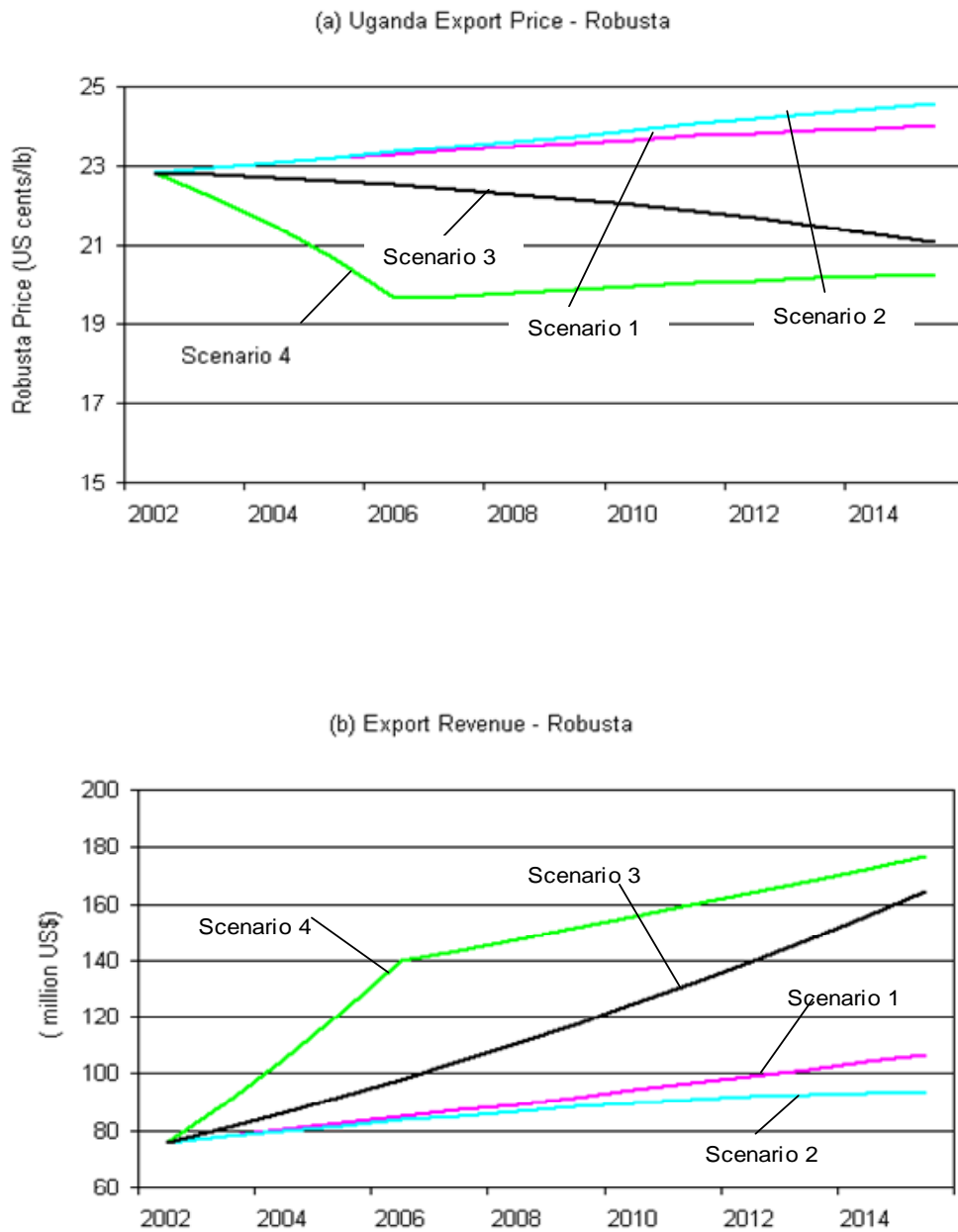
4. Results of the DREAM analysis: gross producer benefits of Robusta coffee development scenarios

THE 'PRODUCTION INCREASE' SCENARIOS

Figure 3 shows for each production increase scenario the trends in Ugandan Robusta export prices and revenues for 2002 – 2015. In scenario 1 (the baseline) and scenario 2, both price and revenue increase slowly because production grows slower than consumption. Comparing scenario 2 with the baseline shows that Uganda foregoes export revenue by unilaterally reducing its production growth rate. This is because Uganda's share in global supply is so small that the small positive price effect of reducing production growth cannot compensate for the negative effect of a reduced export quantity. In scenario 3, the higher growth in Uganda's production than in ROW means a slight reduction in prices, which still allows for a moderate growth in export revenues. In scenario 4, the Ugandan export price falls sharply until 2006 because of the oversupply in the world coffee market, to which Uganda's aggressive production increase (from 156,000 to 720,000 tons per year) contributes quite significantly. Export revenues rise sharply to \$140 million in 2006, or 84% above the initial level. While this may seem like a significant gain, it necessitates an increase in coffee production of 36% per year over five years. Thus, even if the Government of Uganda reaches its production goal in 2006, the negative price effect is likely to erode the economic benefits of these investments. The erosion in benefits would be even greater

if competing countries followed suite and accelerated their own rates of growth in coffee production. In fact, it would be relatively easy to create scenarios in which all coffee producing countries suffer net revenue losses as a result of such “race-to-the-bottom” production strategies.

Figure 3. Uganda export price and revenue trends for the production increase scenarios



Source: Authors

Table 6 shows the effect of each scenario on gross benefits to Ugandan Robusta producers, export revenues, and export prices. All values in constant 2000 US\$ and are computed as the difference between the cumulative effect in 2002 – 2015 of the scenario in question and the cumulative effect of the baseline scenario (2.8% and 2.0% annual production increase, respectively, in ROW and Uganda), divided by the number of years (14) in the simulation period. The distribution over time of the effects may be observed in Figure 3. Since Ugandans consume only a small fraction (about 3%) of their coffee production, the share of consumer benefits in total benefits is negligible, and we therefore refer to the latter as producer benefits. It is observed, for example, that the 7.0% production increase scenario results in producer benefits of \$54.6 million per year, compared to the 2.0% baseline growth rate. Note that the realization of these benefits is only possible if other producing countries do not also increase their production growth rates above the baseline level. Decreasing Uganda’s production growth rate, on the other hand, would result in a small loss in benefits of \$2.1 million per year.

Table 6. Summary of Ugandan Robusta coffee producer benefits, export revenues, and export prices for the production increase and quality improvement scenarios. annual average values, 2002 – 2015.

Development Strategy	Development Scenarios	Change Relative to Baseline ^a		
		Export Price <i>US cents/lb</i>	Export Revenue <i>million US\$/year</i>	Total Benefit ^b
Baseline	2.0% Growth Rate			
Production Increase	Decreasing Growth Rate	0.2	-4.2	-2.1
	7% Annual growth rate	-1.4	25.5	54.6
	Gov. of Uganda Export Plan	-3.0	49.9	98.3
Quality Enhancement	10% Quality Enhancement	0.3	1.2	3.7
	25% Quality Enhancement	0.7	3.0	14.8
	All High-quality Robusta	1.2	4.1	30.9

Notes: ^a Annual averages in constant 2000 US\$, computed as the difference between the cumulative effect in 2002 – 2015 of the scenario in question and the cumulative effect of the baseline scenario (2.8% and 2.0% annual production increase, respectively, in ROW and Uganda), divided by the number of years (14) in the simulation period. ^b Producer and consumer benefits combined, of which producer benefits account for more than 99% of total benefits. All values are approximate due to the technology adoption process and changing market situations from year to year. Source: Authors.

THE ‘QUALITY IMPROVEMENT’ SCENARIOS

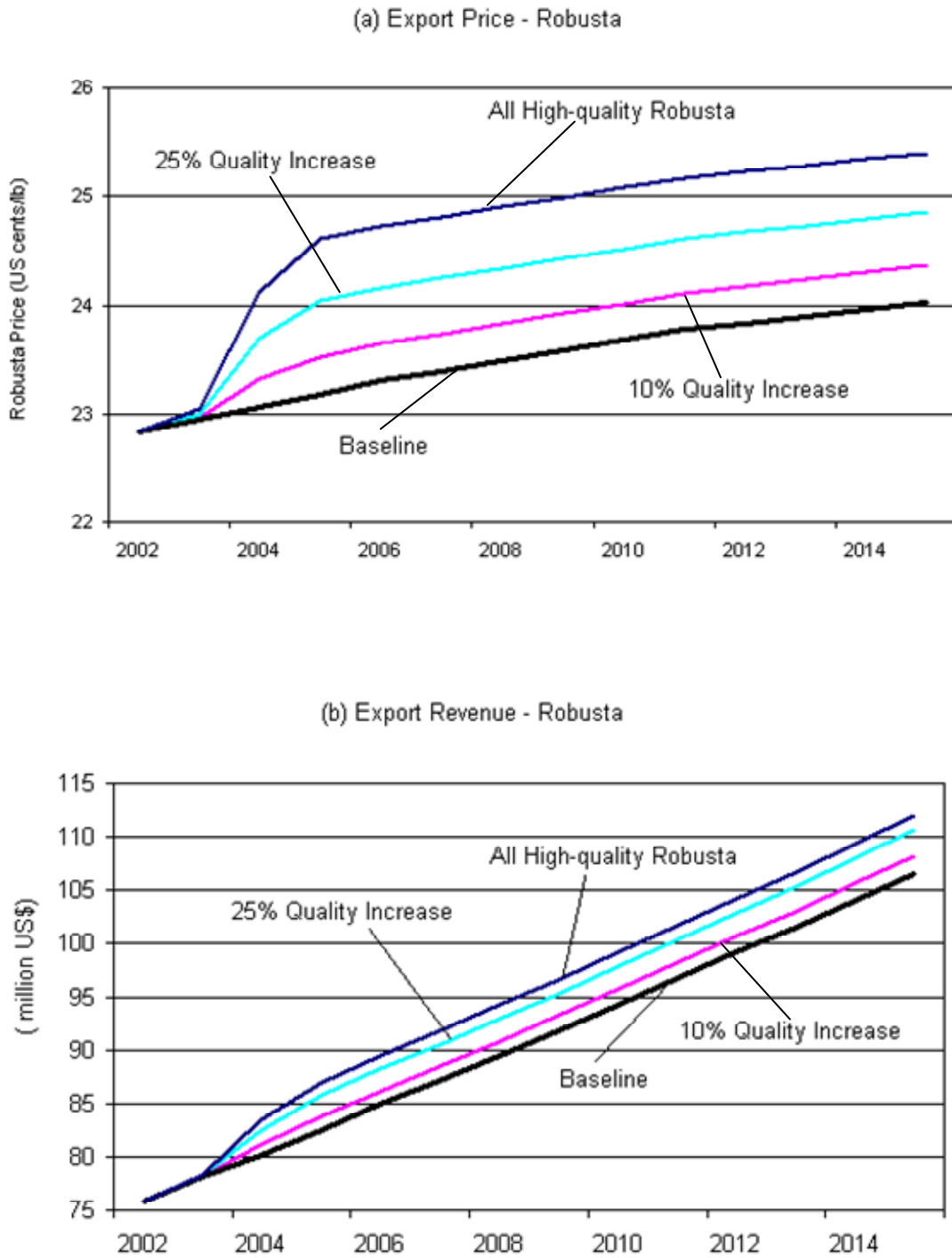
The previous analysis suggests that simply increasing coffee production might engage Uganda in a “race-to-the-bottom” competition with other producer countries. It is therefore worthwhile to assess the potential benefits of improving the quality of Ugandan coffee, which in DREAM terms means reducing the current (negative) price difference between Uganda and the Rest of the World (ROW). DREAM models quality enhancement with a short-cut method using economic

surplus within a multiple-market framework. Different qualities of a commodity are defined as different commodities (e.g., high-quality coffee and low-quality coffee are treated as two separate commodities), and a technical change that leads to a change in quality is modeled as compensating shifts in the supply of the commodities in question. DREAM can approximate the gross returns to quality change by specifying an upward shift in the supply of higher quality coffees. We acknowledge that there may be errors in the benefit measure due to cross-commodity effects, which DREAM cannot account for (Alston et al. 1995, Brennan et al. 1989).

Figure 4 shows the trends during 2002 – 2015 in Ugandan Robusta export prices and revenues for the three quality improvement scenarios, and for the baseline scenario (production increase scenario 1). For all three scenarios there is a rapid increase in the export price in the first three years to 2005 because of the adoption of quality improving technologies. The price gains are very small in absolute terms; even in the best scenario the difference is less than two US cents per pound compared to the baseline once the quality improvements have been realized (Table 6). One reason is that the top Robusta grades (i.e., Screen 17-18, washed Robusta, sustainable coffees) are produced in very low quantities, implying a small effect on the average price of the high quality class. This points to the limitations of a ‘high quality’ strategy in terms of aggregated effects on income. This said, the weak price effect is mainly related to the way the quality classes were defined, with a relatively large share (72%) of coffee in the high quality class and a corresponding price difference of only 26%.³⁰ The trend in export revenues is similar to that for export prices. The three quality improvement scenarios generate only \$1.2 – 4.1 million in export revenue per year, compared to the baseline, because of the small price gains (Table 6). The producer benefits are much higher and vary appreciably among the scenarios: a 10% quality increase results in an additional benefit to producers of \$3.7 million per year, while a total switch from low to high quality Robusta benefits producers with \$30.9 million per year.

³⁰ The problem here is the dominance of Screen 15, which makes up 59% of all Robusta, and which was included in the high-quality class.

Figure 4. Uganda export price and revenue trends for the quality improvement scenarios



Source: Authors

SENSITIVITY ANALYSIS

Although much was done to correctly determine the values of parameters used in the simulations, much uncertainty still remains, particularly regarding the price elasticities of supply and demand. We therefore did a series of simulations using combinations of different price elasticities of demand (-0.05 and -0.50) and supply (0.10 and 1.00) for Uganda to see how they would affect the results (Table 7). For the production increase strategy, Uganda's benefits are affected little by price elasticities of supply and demand, while these same elasticities cause up to a 60% reduction in producer benefits for the quality enhancement strategy. In this regard, the DREAM analysis of the production increase scenarios is more robust than for the quality improvement scenarios (the higher quality improvement scenarios are particularly sensitive to variations in price elasticities). This is because price is the main determinant of benefit gains in the latter. For all scenarios, the combination of high supply and high demand elasticities results in the lowest benefits.

Table 7. DREAM sensitivity analysis using different price elasticity values

Development Strategy	Development Scenarios	Elasticity		Change Relative to Baseline ^a		
		Supply	Demand	Export Price <i>US cents/lb</i>	Export Revenue <i>million US\$/year</i>	Total Benefit ^b
Production Increase	Decreasing Growth Rate	0.40	-0.20	0.20	-4.20	-2.10
		1.00	-0.50	0.12	-2.67	-1.23
		0.10	-0.05	0.25	-5.10	-1.17
	7% Annual Growth Rate	0.40	-0.20	-1.40	25.46	54.60
		1.00	-0.50	-1.28	24.02	45.30
		0.10	-0.05	-1.43	26.37	57.80
	Gov. of Uganda Export Plan	0.40	-0.20	-2.98	49.89	98.30
		1.00	-0.50	-2.68	45.80	88.55
		0.10	-0.05	-3.18	52.37	100.50
Quality Enhancement	10% Quality Enhancement	0.40	-0.20	0.29	1.19	3.70
		1.00	-0.50	0.22	2.42	2.48
		0.10	-0.05	0.31	0.60	5.60
	25% Quality Enhancement	0.40	-0.20	0.71	3.01	14.80
		1.00	-0.50	0.65	4.23	5.90
		0.10	-0.05	0.74	2.35	19.02
	All High-Quality Robusta	0.40	-0.20	1.19	4.11	30.90
		1.00	-0.50	1.05	5.85	12.53
		0.10	-0.05	1.70	3.23	39.80

Notes: ^a Annual averages for 2002–2015 in constant 2000 US\$. See notes to Table 6. ^b Producer and consumer benefits combined, of which producer benefits account for more than 99% of total benefits. Source: Authors.

It is important to note that the above analysis only estimates gross benefits and does not take account of the costs and feasibility of the investments required to achieve each strategy. Since

alternative strategies would mean different investment costs, the net benefits attainable from each strategy will depend on the combination of benefits and costs in each case.

5. Feasibility of alternative coffee investment options

Sufficient information is not available for this study to provide an *ex ante* cost analysis of alternative coffee development strategies. Instead we discuss the kinds of organizational, technological and other changes required to enhance quality and increase production. This includes an assessment of the feasibility of alternative investment options benchmarked around existing coffee development interventions in Uganda.

PRODUCTION INCREASE INVESTMENT OPTIONS

The above DREAM analysis suggests that a moderate growth in production would result in considerable gross benefits to producers, and that a decreasing growth rate will lead to a loss in benefits. The qualitative analysis showed that Uganda must maintain or even increase the level of Robusta production in order to secure its advantaged position in the mainstream market. Given the low world market prices, improved productivity in production or marketing, with resulting lower cost of producing and trading a bag of Ugandan coffee, seems necessary to maintain incentives to invest in coffee production. Increased productivity should be combined with measures that reduce variability in output, which is mainly related to rainfall. In this regard, Table 8 summarizes alternative ‘production increase’ investment options, their expected effects and constraining factors, current programs, and estimated feasibility. We find that most productivity increasing options are moderately feasible. Among these, by far the most important public investment in the Ugandan coffee industry is government support to the breeding, multiplication and distribution of improved (clonal) coffee varieties/seedlings, which are higher yielding and more resistant to the coffee wilt disease. During 2000 – 2003 an estimated 30,800 hectares of Robusta coffee was planted under the Coffee Replanting Programme (UCDA 2003) representing 23% of the estimated total Robusta area in 2002.³¹ Low producer prices and insufficient funds for the distribution of free seedlings to farmers are believed to limit replanting rates (Ibid), but no

³¹ This official figure is believed by some observers to be inflated. An estimated 60,000 ha of clonal Robusta were planted between 1993/94 and 2001/02, according to UCDA (UCDA 2002).

formal analyses exist that identify the most binding constraints to farmers' adoption of clonal coffee.

Productivity investments that also help stabilize the level of output, notably irrigation, appear less viable and are not currently implemented. Targeting production-increase interventions in areas with the lowest risk of drought might help stabilize output at the national level. The expansion of coffee into new areas with favorable climates, such as parts of Northern Uganda, would contribute to both the size and stability of coffee exports. In this regard, a government program to introduce coffee production into Northern Uganda has existed since 1997, but marketing constraints and continued insecurity limits the adoption of coffee in this vast region.

Table 8. Feasibility of production increase investment options

Investment Option	Expected Effects	Constraining Factors	Current Programs	Feasibility
Support to replanting of existing and new coffee farms with clonal varieties that are higher yielding and more resistant to coffee wilt disease (CWD).	More and higher yielding coffee trees.	Low incentive to invest in new coffee trees due to low and volatile prices. Risk of loss of investment due to CWD. Lack of affordable credit.	UCDA replanting program since 1995. Program is expanding but suffers from insufficient funds. New coffee farmer groups formed.	<i>Moderate feasibility</i> – high availability of clonal seedlings from nurseries, but limited demand for seedlings from farmers due to high cost of planting relative to current coffee prices.
Breeding for higher coffee wilt disease (CWD) resistance.	More disease tolerance.	Development of wilt resistant varieties is slow and difficult. Insufficient funds for programs.	Various research projects by the Coffee Research Institute (CORI).	<i>Moderate feasibility</i> due to technical constraints. Long term effort with likely high pay offs.
Promotion of yield enhancing technologies and practices	Higher yields	High cost of inputs. Cost and availability of labor. Poor access to affordable credit. Use of traditional extension methods.	Ongoing UCDA training program for farmers & extension workers.	<i>Moderate feasibility</i> – most practices are simple and low cost, but low prices and lack of resources constrain adoption.
Support to the development of irrigated coffee	Higher and less variable yields	High cost makes investment in irrigation risky when prices are volatile.	No programs exist.	<i>Very low feasibility</i> – high costs and uncertainty about profitability
Support to the expansion of coffee production into Northern and Eastern Uganda.	Increased production in new areas	Insecurity in Northern Uganda. Lack of traders and processors. Low farm profitability compared to other crops (Pender et al. 2004)	UCDA program in Northern and Eastern Uganda since 1997.	<i>Low feasibility</i> as long as insecurity prevails in Northern Uganda.

Source: UCDA (2003), various sources, authors' field research.

QUALITY IMPROVEMENT INVESTMENT OPTIONS

The analyses so far have shown that there are many ways of, and considerable potential (gross) benefits associated with, increasing the value of Ugandan coffee through quality improvements and product differentiation. Quality attributes such as bean size, aroma, taste, and cleanness may be improved through the adoption of the improved production and processing methods discussed earlier (clonal varieties, soil and water management, systematic pruning, better harvesting, better on-farm drying and storage). Most such methods are relatively simple and do not require large cash outlays or complex organizations, which makes them accessible to most smallholders. Higher or timelier labor requirements appear to be the main adoption constraint, but information on this aspect is lacking. Many organizations in Uganda are promoting quality-enhancing technologies and management practices. Table 9 includes the most important of such options and interventions. Improving quality through wet processing appears less feasible, especially if using central mills, whose daily processing capacity is much larger than local coffee supply.

While there are many technical possibilities of raising the intrinsic qualities of coffee beans, the transmission of quality-based price incentives to the farmer remains a major constraint to a general improvement in quality. Quality grading at the local level is expensive due to weak infrastructure and low output per producer. It is also technically difficult because the dry processing method implies that the dry pulp covers the bean at the time of delivery (Ponte 2002c). Such constraints mean that cost-effective quality grading requires enhanced farmer organization in processing and marketing. This may be combined with contractual arrangements whereby a buyer, typically an exporter, provides farmers with various support services against the delivery of higher quality coffee. Yet the development of these types of local institutions is limited by the weak legal enforcement of commercial contracts (IITA & NRI 2002) and by the reluctance of farmers to commit resources to collective action due to the poor performance of cooperatives in the past. Programs support to such institutions is increasing but still limited.

Engaging in higher value markets for sustainable and other differentiated coffees requires more human and financial resources and more complex organizations than for conventional coffee, especially in marketing and certification. Such barriers to market entry mean that the production of differentiated coffee will likely remain feasible only for a relatively small number of farmers and require intensive support from development organizations (e.g. to organic and fair trade certification) and private companies (e.g. input credit and information about quality requirements). Several projects support the development of sustainable coffees in Uganda, often in partnership with exporters. Reducing the cost of certification is critical to the expansion and

profitability of sustainable coffees (Ponte and Kawuma 2003). Current initiatives to form a local organic certification company and to develop common organic standards for Uganda are likely to reduce such costs appreciably.

Because the world coffee market is so important to the Ugandan economy, and being the third biggest Robusta producer in the world, Uganda has a high stake in international coordination efforts to raise and stabilize international coffee prices. One such initiative is the ICO Coffee Quality Improvement Program, established in February 2002 through Resolution 407. The main objective of the program is to reduce the supply of exportable coffee through the imposition of minimum export quality standards, thereby raising prices. Its success may be limited by the fact that the largest consuming country, the United States, is not presently a member of ICO, and that the US at the same time allows the import of large quantities of very low quality coffee. Lack of sanctions towards defaulting member countries is also likely to reduce its impact. In September 2004, four of the world's largest coffee roasters signed an agreement, which among other items, includes a voluntary commitment to pay a higher price differential for high quality coffee in selected countries (at present not including Uganda). The pact forms part of an initiative led by the German Coffee Association (DKV) to develop an International Code of Conduct for Sustainable Coffee Production (www.sustainable-coffee.net).

Table 9. Feasibility of quality enhancement investment options

Investment Option	Expected Effects	Constraining Factors	Current Programs	Feasibility
Provision of technical services to farmers, traders, and processors.	Improved handling & processing practices.	Lack of local quality grading reduces farmer incentive to improve practices.	Several UCDA programs. Ongoing survey focused on quality.	<i>High feasibility</i> – but little more to gain in this area. Main problem is at the farm level.
Establishment of local quality grading and control systems.	Improved farmer incentives to raise quality.	Farmers must pool harvests for local quality control to be economical. This is constrained by low organizational capacity and poor access to transport and equipment.	UCDA-led formation of farmer groups. Programs fostering direct links between farmer groups and exporters.	<i>Moderate feasibility</i> – due to organizational and infrastructural constraints.
Promotion of improved practices that increase bean quality (size, taste, etc).	Higher price premium.	Lack of local quality grading reduces farmer incentive to improve practices. Most improved practices demand higher labor inputs.	Since 2003 USAID program based on demonstration sites and group formation.	<i>High feasibility</i> – price gain is high and technologies simple.
Prevention of mould and Ochratoxin A by improved handling	Improved bean drying methods.	Insufficient regulation. Weak institutions to enforce regulation	Global program with Ugandan participation	<i>High feasibility.</i>
Support to wet processing of Robusta coffee	Improved bean quality	High cost of equipment. Central mill capacities are too high compared to local supply.	16 government-owned wet mills installed in 2003-04.	<i>Low feasibility</i> – low aggregate impact: too costly and resource demanding for most farmers.
Support to the expansion of sustainable coffees through reducing the cost of sustainable certification and other measures.	Higher output and reduced production costs of sustainable coffees.	High certification costs and more demanding practices. Small size of schemes means high unit costs. Low organizational capacity. Limited demand for fair trade and organic coffee.	Many projects, e.g. EPOPA. Establishment of Ugandan organic certification company. Drafting of Common Organic Standards for Uganda.	<i>Moderate feasibility</i> – Costs of certification and operation is high. Yet certification pays and entails lower price risks. Organic production practices raise yield and quality. Favorable agronomic conditions for organics.

Source: UCDA (2003), various sources, authors' field research.

6. Conclusion

This paper has identified key challenges and opportunities for the Ugandan coffee industry and evaluated development strategies and investment options through which Uganda might promote the viability and growth of its largest export commodity. Notwithstanding the oversupply of coffee in the world market, our analyses suggest that Uganda would benefit from moderately increasing Robusta coffee production as well as from enhancing bean quality and diversifying

into sustainable coffees. In-depth cost – benefit and feasibility analyses are needed to identify the most profitable among alternative interventions, including the ‘best’ balance between different productivity and quality enhancing investments. These should take account of the diverse and potentially conflicting national development goals, especially income growth, poverty alleviation, and environmental conservation.

The analysis of changing market conditions suggested that Uganda must increase or at least uphold its production of high-quality Robusta in order to defend its favorable position in the mainstream market. High and reliable output must be accompanied with, and depend on, reductions in the unit cost of production in order to maintain or raise farm profitability and investment incentives given that prices are likely to remain low. The DREAM simulations showed that a moderate growth in production would result in considerable gross benefits to Ugandan producers, and that a decreasing growth rate will lead to a loss in benefits. They also cautioned that a very high growth in Ugandan coffee exports, at the scale achieved by Vietnam in the 1990s, may significantly erode producer benefits by reducing international prices. An aggressive production growth strategy would also engage Uganda in a ‘race-to-the-bottom’ competition with other producer countries if these adopt similar strategies. Interventions that focus on increasing productivity rather than merely expanding the area planted with coffee are appropriate in this situation. In this respect, analysis is needed to identify the most binding constraints to the adoption of productivity-enhancing technologies for different farm types, particularly for clonal coffee.

We have also shown that there are many ways of, and considerable potential (gross) benefits associated with, increasing the value of Ugandan coffee through quality improvements and product differentiation. Interventions that focus on increasing bean size for mainstream coffee appear attractive due to the significant and direct effect of prices, the relatively low resource requirements of most technologies, and the added effects of larger beans on yields. Such interventions would benefit from analyses of farm-level constraints to the adoption of quality-enhancing technologies in Robusta, particularly regarding labor. Support to the production and marketing of differentiated coffees, particularly productions that combine organic and other sustainability certifications, also appear attractive. Such interventions should be carefully targeted, since relatively few farmers possess the necessary resources to produce for this market, and must be based on careful market analysis given the high entry barriers and complexity of the specialty coffee market.

The implementation of both productivity and quality enhancing strategies require a higher level of organization in the industry: horizontally among small farmers, and vertically among

producers, traders, and roasters. The proper design of such programs will depend on a better understanding of producer-level institutions, coffee farmers' market relations, and the linkages to improved technology adoption.

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