THE ROLES OF HUMAN CAPITAL AND MARKET STRUCTURE IN THE EXPORTS OF PROCESSED AGRICULTURAL GOODS FROM DEVELOPING COUNTRIES

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Chapter 1: Introduction

1.1 Background

The slow growth of exports over the last three decades in many Sub-Saharan African countries and other developing countries can be linked to the fact that the main components of their exports are limited only to a number of labor-intensive raw agricultural products. As the international prices for those agricultural commodities and the quantity exported declined, export revenue as a component of national income shrunk. Now as the WTO negotiations continue, many developing countries including Sub-Saharan African countries are faced with the task of identifying the causes of their poor export performance and of improving their foreign exchange earnings.

Enlarging the range of export goods to include manufactured products constitutes an alternative to spur export growth for small open economies. The rationale behind such an alternative is that, compared with the unprocessed goods, manufactured products provide more value-added and generally are less perishable than raw agricultural materials. In addition, prices of processed agricultural goods tend to be less volatile than the prices of raw commodities (Morisset, 1997; Mathies, 1999; Cashin and McDermott, 2000). The gains that producers of raw agricultural goods in developing countries, especially, in Sub-Saharan Africa, could make in processing the raw materials that these countries currently produce and export to the world market may vary, but they are not negligible. For example, processing all the cocoa beans that Côte d'Ivoire exported in 1999 just into cocoa paste would have increased the cocoa export revenue by $ 76 million (f.o.b.), which is about 2 percent of the country's total export in goods and services, and which represents a 5% increase in cocoa revenue. Similarly, if Kenya had exported

roasted coffee instead of green coffee, its revenue from coffee export in 1999 would have increased by $ 146 million (f.o.b), which is about 6 percent of the country's total exports in goods and services, and represents a 85 % increase in the coffee revenue.[1] The value-added captured by processing the raw could have an impact not only on export revenue but also on job opportunities in the countries. Some processing firms already exist in countries where the raw material is produced (e.g. chocolate and roasted coffee), but their markets are more often limited to local consumption and less often to export (Raikes and Gibon, 2000).

Thus, the central question is "Why are these processors, which are located in countries producing the raw material, unable to expand exports to the international market?" Traditional trade theories' answers to these questions have focused on the lack of technology (Ricardo-Viner) and low capital endowments (Hecksher-Ohlin) as processing of these raw materials is capital-intensive and requires high technology. Similarly, some studies that addressed this particular question based their explanations around the arguments of tariff escalation, high transportation costs, lack of technology and lack of investment (Yeats, 1974, 1976, 1981, and 1984; Ndulu, 1986; Malta, 1989; Shapouri and Rosen 1989; Tangerman, 1989; Yeats, 1991; Lindland, 1997).

[1] The details of the calculation are presented in Appendix A.

While not underestimating the findings from past literature, this study focuses on two important explanations emanating from the new developments in trade and growth theories in order to investigate the inability of a single open economy to expand production and export of manufactured goods. One explanation, which is directly related to a country's ability to produce and export manufactured goods, is the lack of human capital for production and research. Another explanation, which is related to the world market and independent of a small country's own ability, is the structural barriers in international markets of processed agricultural goods.

1.2 Problem Statement and Hypotheses

The problem and approach in this study can be portrayed as follows. The focus is on some traditional commodities that Sub-Saharan African countries are exporting now. Consider a developing country C that usually exports the raw material of a product y (such as coffee) to country M, a developed country. Also, firms in C process y mostly for the local market (C market) and rarely to the export market (M market). To increase revenues, firms in C are willing to expand their sales in M. Firms in country M are also supplying the M market. This study focuses on four hypotheses to explain the inability of firms in C to expand the export of processed goods to M.

(i) Human capital endowment.

The ability of firms in C to export to M depends on C's stock of human capital. The human capital endowment affects the production and the Research and Development (R&D) sectors that make C's product more competitive. In fact, food and agricultural

processing in the world's largest markets, such as the United States and the European Union (E.U.) has become increasingly more skilled labor-intensive and is strongly R&D-oriented. This will be addressed mainly in Chapter 3 and partly in Chapter 4 of this study.

(ii) Structural Barriers in *M*

Economies of scale in processing the product *y* leads to high industry concentration in country *M*, and may limit *C*'s firm access to *M*. Various authors such as Martins, Scarpetta and Pilat (1996) and data from the U.S. Census Bureau show evidence of the high industry concentration and high mark-up in the processing of products such as cocoa, coffee, and spice in many developed countries market. Chapter 4 will investigate the impacts of the industry concentration in *M* on *C*'s market shares.

(iii) International market structure of the raw material

There are two situations in which the international structure of the raw material may have an impact on the export expansion of the processed good *y*. In one situation, if *C* is a price taker in the raw *y* market and wants to export more of the processed *y* (instead of the raw material) to *M* and if *M* is a large importer, processors in *M* may just import the raw material from other sources. In this case, unless firms in *C* have greater access to market in *M*, *C* could lose its share of the market of the raw material *y* without being certain whether it can increase its share on the export market of the processed *y*. In another scenario, if *C* has some market power in the market for raw *y* and *M* is not a large importer, then *C* may be able to expand its exports of the processed products to *M*. As

this study focuses on the cases of agricultural commodities from developing countries, particularly, in Sub-Saharan Africa, the first scenario is more common.[2]

Under the first scenario, the impacts of the oligopsony power in *M* 's processing industry work two ways. On the one hand, the low cost of the raw material will increase profits of the concentrated industry in *M* with regard to the market in *M*. This will make entry by firms in *C*'to the *M* market more difficult as firms in *M* have more incentive to protect their gains. On the other hand, the low cost of raw materials also benefits the processing firms in *C* because of reduced costs, which increases their supply of processed *y* (a downward shift of the supply curve) which may lower the price of processed product in *C*.[3] This is likely to improve *C*'s firms' chance to enter the *M* market. So the overall impacts of the oligopsony on *C*'s firms to enter the market is ambiguous. The issue of international market structure of the raw will be incorporated in the analysis, mainly in Chapter 4 and 5.

(iv) Product differentiation

The distinction of processed product *y* produced by *C*'s firms plays an important role in the eyes of consumers in *M*. The market share of *C*'s firms in the *M* market is likely to increase if their products are distinct and of higher quality compared to products from other sources. Fixed costs such as advertising expenditures, and R&D, can be the source of product distinction and may also constitute an entry barrier to other competing suppliers of the processed product. Similarly, large fixed and sunk costs in *M*'s

[2] Even developing countries, large exporters of the raw agricultural goods such as coffee, or cocoa are not necessarily price makers in the international market of the raw. Morisset (1997) and Matthies (1999) are among many studies that discuss this issue. Reasons may include market segmentation, a high concentration of importers, and increased competition among suppliers.

processing industry may constitute a barrier to *C*'s firms. Product differentiation and impacts of fixed costs will be dealt with in Chapter 5 of the dissertation.

Although the barriers linked to market structure in (ii), (iii) and possibly (iv) may affect the ability of firms in *C* to export processed goods, there is little that these firms can do to affect these barriers. However, investment in human capital in (i) and product differentiation in (iv) can be controlled in part by the *C* firms or the country.

1.3 Research Objectives

The overall goal of this dissertation is to investigate the roles of market structure and human capital (or labor skill) on the ability of a single small country to expand exports of processed agricultural goods.

Specific Objectives

This dissertation has three specific objectives. The first specific objective is to estimate the impacts of human capital endowments on output and value-added manufacturing. Emphasis is put on how well models based on endogenous growth theory can explain the difference in the levels of value-added across domestic manufacturing industries. Manufacturing industries in Ethiopia, Kenya, and Mauritius are investigated.

The second specific objective is to estimate the impacts of structural barriers due to high industry concentration and of the level of labor skill on developing countries' export shares. The focus is on the U.S. import markets for cocoa paste and cocoa butter.

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[3] The low prices of the raw material may harm the welfare of exporters and producers of the raw material in *C*.

Exporters include developing countries such as Brazil, Côte d'Ivoire, Colombia, Ecuador, Indonesia, Malaysia and Mexico

The third specific objective is to estimate the residual demand elasticity, indicative of the level of market power, of developing countries exporting differentiated processed agricultural goods, and the effects of the relative input costs and the level of fixed (sunk) costs on their residual demand and market shares. The focus is on the U.S. import markets for roasted coffee and cocoa powder. The exporting countries include Brazil, Côte d'Ivoire, Colombia, and Mexico.

1.4 'New' Theories in Growth and Trade

This study employs new developments in growth and trade theories, which emphasize on the role of human capital and market structure to search for explanations about the lack of expansion of exports of manufactured agricultural goods in Sub-Saharan Africa. The focus is on new developments in growth and trade theories for two reasons. One reason is the failure of the "import substitution" industries, despite the large investment in physical and financial capital that had been devoted to these industries (Balassa, 1978, 1986a, 1986b; Owens and Wood, 1997).[4] In particular, Balassa (1986b), and Balassa and Bauwens (1988) argued that human capital endowments contribute to production and export expansion in manufacturing. Indeed, during the import substitution era in the 1980's, some researchers such as Belassa (1986a) and McMahon (1987) noted the low levels of human capital devoted to production and to R&D sectors of manufacturing in many Sub-Saharan African countries. This low level of human

[4] Import substitution corresponds to policies that limit the import of processed goods and instead encourage investment in domestic industries by building new plants and facilities to supply the processed good domestically.

capital may have contributed to the failure of the import substitution policy. More recently, Pack and Paxson (1999) indicated that African manufacturing is skilled constrained. Also, Söderbom and Teal (2000) showed that lack of skill in the workforce discourage investment in the manufacturing export sector in many African countries. This lack of human capital merits particular attention because under endogenous growth theories, human capital is not only an essential input in a production function, but also a source of innovation through R&D that determines output growth (Nelson and Phelps, 1966; Romer, 1987, 1990; Lucas, 1988).

Another reason that has led to the focus on new growth and trade theories is the inability of processors in many Sub-Saharan African countries to expand exports of some processed agricultural goods such as roasted coffee and cocoa products, despite technology acquirement, low production costs, and in some cases low tariff. The study by Martins, Scarpetta, and Pilat (1996) revealed that the structure of agricultural processing industries in the world's largest markets is often characterized by high price mark-up ratios and high industry concentration. This led to the hypothesis that structural barriers in the international market for some processed primary products may limit export expansion of firms from developing countries. In this regard, new developments in trade theories suggest that market structures may provide a central explanation of the pattern, volume and composition of trade among countries, rather than comparative advantages in technology (Ricardo-Viner) or differences in resource endowments (Hecksher-Ohlin-Samuelson) model (Helpman and Krugman, 1985; Krugman 1986). In fact, the new trade theories have led researchers to investigate if there are "established" processing firms for a processed product in the international market and if so, whether these firms

exercise market power when they purchase the raw material and sell the corresponding processed products, effectively limiting other firms' access to the market. Moreover, the product differentiation argument in new trade theories indicates that innovation -- generated by human capital and R&D-- that makes a product distinct from other substitute products increases market power and eventually market share of the firm producing the innovated product. This suggests that one reason products from developing countries have limited access also could be the lack of distinction in the eyes of consumers, which needs further investigation.

In the past, the arguments about the lack of human capital, entry barriers due to market structure, and product differentiation, have not received much attention in explaining the limited exports of processing products from developing countries overall, and Sub-Saharan Africa in particular.

1.5 Outline of the Models

Three different models corresponding to the three specific objectives of the dissertation are employed. The first model uses the basic Romer model of endogenous growth (Romer, 1990) to estimate the impact of human capital on manufacturing output growth. In this model, value-added per worker is a function of the amounts per worker of physical and human capital, and the stock of knowledge.

The second model consists of conjectural variation models to investigate the role of market structure and human capital on export shares of individual firms. In this model, products are assumed to be homogenous. A single market of processed product supplied by two groups of firms is considered: the domestic and foreign group exporting

to the market. One of the assumptions is that the domestic group has double market power; that is, domestic firms are oligopsonists in purchasing the raw material and oligopolists in the processed product market. The foreign group includes firms from small countries producing the raw material, which are price takers in both the raw material and processed goods markets. The first order conditions for profit maximization problem for each firm, taking into account conjectural parameters and aggregation over all firms in the domestic group, lead to expressions of the foreign firms' market shares as functions of Herfindahl index, the spread between price of processed goods and cost of raw materials as well as input prices relative to the wages of unskilled labor. The derivative of the market share with respect to the Herfindahl index measures the impacts of concentration. Similarly, the derivative of the market share with respect to the ratio of the wage of skilled to the wage of unskilled labor measures the impacts of level of labor skill. The values and signs of these derivatives depend on the values of conjectural parameters to be estimated.

The third model is a conjectural variation model similar to the second model, but in a market where consumers have Dixit-Stiglitz type of preferences. Unlike the second model, it is assumed that the processed goods are differentiated by source and each foreign firm is assumed to charge a different price and faces a different downward sloping demand curve, called the residual demand curve. The residual demand equation facing an individual firm is derived as a function of output prices, the other competing firms' input costs and consumer's expenditure. The elasticity of the residual demand reflects the level of market power of the countries. Also, the first order condition of firm's profit maximization problem leads to the expression of the supply relation.

Moreover, imposing the zero profit condition leads to the relationship between the level of fixed costs and market shares.

1.6 Outlines of the Procedure and Methods

For the first specific objective, domestic manufacturing in Ethiopia, Kenya, and Mauritius is divided into nine different categories according to International Standard Industrial Classification codes (ISIC) at the two-digit level: food, beverages and tobacco; textile; wood products; paper and printing; basic metals; fabricated metal and machinery; and other manufacturing. For each country, the study employs a panel data where the industry categories form the cross-section units. Using a fixed-effect econometric model, value-added per worker is regressed against time and industry dummies, the level of human capital per worker and the levels of physical capital per worker.

For the second specific objective, the parameters of the export shares and the demand equations are estimated using the seemingly unrelated regression (SUR) methods. Values of the parameters provide interpretation of the role of concentration and level of skill on the market share. The estimation is conducted separately for the U.S. import market of cocoa paste and cocoa butter.

For the third specific objective the residual demand equation, the conjectural supply relation, and the market shares derived from zero-profit conditions constitute a system of equations for the estimation. The parameters are estimated using Ordinary Least Squares (OLS) and SUR methods. The estimation is conducted separately for the U.S. import markets of cocoa powder and roasted coffee.

1.7 Organization of the Study

The remaining part of the dissertation is organized as follows. Chapter 2 outlines the main thrust of the new trade and growth theories and the implications to production and trade for manufactured agricultural products from developing countries. Chapter 3 investigates the role of human capital (and the stock of knowledge) on manufacturing output in three African countries: Ethiopia, Kenya, and Mauritius. Chapter 4 provides analysis of the role of industry concentration and level of labor skill on the market shares of firms from developing countries, in the U.S. markets of cocoa paste and cocoa butter. Chapter 5 examines the impacts of relative costs of inputs, which includes the proxy for the level of labor skill, and the amount of fixed costs on the export of cocoa powder and roasted coffee under the assumption of differentiated products. Chapter 6 concludes the dissertation by discussing some implications of the findings and addresses some ideas for future research.

Chapter 2: New Developments in Growth and Trade Theories

The objective of this chapter is to outline the main theories supporting the models employed in this research. One of the main theories on which the analysis in this dissertation is based is the endogenous growth theories, which emphasize the role of human capital, R&D and increasing return to scale (IRS) technology as sources of growth. Also, the analysis employs some of the new developments in international trade theories that give importance to product differentiation and to the role of market structure in explaining what limits the expansion of export of processed agricultural products from developing countries. This overview of the theories has three sections. The first section recalls some of the main criticisms of the neoclassical growth theories and reviews the main thrust of the endogenous growth model. The second section explains new developments in trade theories related to the idea of product differentiation and the role of market structure. The third section includes some of the implications of the new growth and trade theories on commodity processing from developing countries.

2.1 Endogenous or 'New' Growth Theories

2.1.1 Criticisms of the Neoclassical Theories

In the neoclassical growth theory (Solow, 1956; Swan, 1956), the underlying assumption is that of constant returns to scale (CRS) production function. As a result, growth rate per worker is determined by the rate of technological progress. One of the conditions that lead to a steady-state is the diminishing marginal product of capital. For

the sake of comparison, it is necessary to summarize the steps in the derivation of the neoclassical model, starting with the derivation of the law of motion.

The country's investment and saving is assumed to be proportional to the country's output and defined as

$$I=S\equiv sY, \tag{2.1}$$

where I is investment, S is saving, s is the rate of saving, and Y is the country's output. Also the level of investment is defined as the sum of the instantaneous rate of change of capital and the depreciation of capital:

$$I = \dot{K} + \mu K, \tag{2.2}$$

where K is capital, the dot (.) indicates instantaneous rate of change of a variable; $\dot{K} = dK/dt$, and μ represents the capital depreciation rate.

Eliminating I using (2.1) and (2.2) and dividing both sides by K, we obtain

$$\left(\dot{K}/K\right) = s\left(Y/K\right) - \mu. \tag{2.3}$$

The capital per "effective" worker is defined as $k=K/AL$, where L is the number of workers (or population) and A is labor productivity index or sometimes called the level of technology index. Using this definition we can write

$$(\dot{k}/k) = (\dot{K}/K) - (\dot{L}/L) - (\dot{A}/A). \tag{2.4}$$

Similarly, we define the population growth $n = (\dot{L}/L)$ and the rate of technological progress $g = \dot{A}/A$. Bringing this definition and (2.3) into (2.4) and rearranging terms, we obtain the law of motion:

$$\dot{k} = sy - (\mu + n + g)k. \tag{2.5}$$

where $y = Y/L$ is the output per worker. Equation (2.5) indicates how the accumulation of capital per worker is related to saving rates, the depreciation rate, population growth, and technological change. The steps from eq. (2.1) to eq. (2.5) are common in all derivation of growth models. The difference is based in the way the output per worker y is specified.

Besides, there is a value of k that brings (2.4) to zero and this stage is called the steady-state, where rate of growth of capital per worker is zero and the economy is at rest. Referring to (2.4) this means that the growth of capital is equal to the sum of the growth of population and the rate of technological progress.

With the neoclassical growth theory, output is produced in constant returns to scale (CRS) technology. A basic form of the Solow-Swan model with a CRS production function is written as:

$$Y = (AL)^{\alpha} K^{1-\alpha} \tag{2.5}$$

where Y is output, K is capital and L is labor, A is a productivity parameter and refers to technological progress. α is the value share of labor to total value of output. The CRS restriction requires that $0 < \alpha < 1$. Eq. (2.5) can also be rewritten to represent output per 'effective' worker by dividing each side of the equation by "effective" labor AL.

$$y = f(k) = k^{1-\alpha} \tag{2.6}$$

where $f(\cdot)$ is the output per effective worker function and $k = (K/AL)$ as before. An implication of (2.6) is that in a steady-state, when the growth of k is zero, so is the growth rate of output per "effective" worker. As a result, output per worker, Y/L, grows at the rate of technological progress. Similarly, the rate of growth of output is equal to the sum of the population growth and the rate of technological progress:

$$(\dot{Y}/Y) = n + g \tag{2.7}$$

One of the conditions that must hold however for the uniqueness and stability of the steady state is that $df(\cdot)/dk > 0$ and $d^2f(\cdot)/dk^2 < 0$ meaning that there must be diminishing return to capital per effective worker. That is

$$f'(k) = (1-\alpha)\, k^{-\alpha} > 0 \text{ and } f''(k) = (-\alpha)(1-\alpha)\, k^{-\alpha-1} < 0 \tag{2.8}$$

Because $\alpha < 1$ under CRS, the second derivative of the output per worker $f''(k)$ is negative, indicating that there is a diminishing marginal product in the Solow-Swan model so that steady state will be reached and the economy will be at rest. According to (2.5), the higher the gap between the investment per worker and the saving curve, the greater is dk/dt (which is the speed of the convergence); this is the case for low level of k, meaning that assuming that countries have the same technology, poor countries with lower level of capital per worker will have higher rate of growth in capital and output per worker than countries with high level of capita per worker. But in the long-run, all countries will reach the same steady state and stay at rest.[1]

One of the most cited drawbacks of the neoclassical growth theory, however, is its inability to reconcile its predictions with the evidence of a widening gap across countries in both the level and growth rate of incomes between industrialized countries and less developed countries. Another shortcoming of the neoclassical theory is the inability to explain the unbounded growth experienced in most industrialized countries, including newly industrialized ones (Singapore, Thailand, Taiwan, and South Korea). Romer (1994a) summarizes the criticisms as follows:

[1] Barro and Sala-i- Martin (1992 and 1995) explained in details the speed of convergence. Aghion and Howitt (1998) and Jones (1998) offer examples of overviews of the evolution of the growth theories including the issue of convergence in their introductory parts.

> In each of the areas where our understanding has changed, evidence that challenged the models of perfect competition had been apparent all along. Everyone knew that there was lots of intra-industry trade between developed nations and little trade between the North and the South. Everyone knew that some developing countries grew spectacularly while others languished. Everyone knew that people do things that lead to technological change. Everyone knew that the number of locally available goods was limited by the extent of the market in the city where someone lives and works... (Romer, 1994a).

Among some of empirical studies refuting the neoclassical growth theory are in Dollar and Wolf (1995) on the cases for trade performance of the US and the newly industrialized countries in East Asia. A wider summary of the criticisms of the neoclassical growth theory was reported in Aghion and Howitt (1998).

2.1.2 Endogenous Growth Theories

Romer (1994a) indicates that endogenous growth theories were spurred by (i) the apparent lack of convergence to a common steady state for the world highest and lowest income countries and (ii) the evidence that markets are often imperfect and the assumptions of perfect competition and constant return to scale no longer hold. The literature supporting endogenous growth theories points out that growth is "not a result of a process from outside forces" (Romer 1994a). In fact, the term "endogenous" growth theory indicates that the source of growth is not determined from outside (or given to) the model, as the neoclassical model suggested. Rather growth is determined from the model itself and mainly from the accumulation of human capital, and knowledge spillovers among other factors. The common characteristics of endogenous growth models are the inclusion of human capital as one of the inputs for production and R&D sector, and especially the idea that increasing returns to scale (IRS) technology better represents the production function in the growth model.

Role of Human Capital, R& D and Increasing Return to Scale Technology

The importance of human capital has never been dismissed, even under the neoclassical model. An example is the work of Mankiw, Romer, and Weil (1992) using the neoclassical growth with human capital or the "Solow-Swan augmented-human capital" model of the form $Y = (AL)^{(1-\alpha-\beta)} K^{\alpha} H^{\beta}$, where H represents human capital, β is the share of human capital over total output and the rest of the variables are as defined previously. They conclude that this model predicts well. The technology is, however, of the CRS type because of the restriction they imposed, $\alpha + \beta < 1$.

Human capital and R&D, however, become particularly important in the new growth theories, not simply as inputs, but as sources of growth through innovation by capturing knowledge (Boskin and Lau 1992; Coe and Helpman, 1995; Ballot and Taymaz, 1998). Two different and competitive lines of thought dominate endogenous growth theories regarding the role of human capital. On the one hand, in the Lucas (1988) model, the quantity or stock of human capital is important; with an IRS production function, output growth depends in part on the growth of human capital. On the other hand, Nelson and Phelps (1966) argued that the quality of human capital is more important than quantity. Nelson and Phelps contended that high quality human capital induces innovation and creates capacity to adjust and to master existing technology. A more reconciliatory idea suggests that the two views are complementary rather than competitive (Aghion and Howitt, 1998). In this view, economic growth requires both the accumulation of human capital, such as providing basic education for the entire

population in a country, and the high level of skill such as providing higher education and advanced training, even if it is only for a small part of the population. However, data limitations often force the use of one measurement over the other in many empirical studies. In this study, we lack data on the level of human capital, but can infer the level of skill from the differences among inter-industry wages, so we follow the Lucas model.

Taking into account the thrust of the Lucas and Nelson and Phelps new growth theory models, human capital is separated into human capital input for production sector and human capital input for the research sector or R&D sector. Human capital going into production refers to the labor skill while human capital going to the R&D sector refers to the knowledge generating (technological and managerial) innovation for the firms and the industry. The model specifying the relation between the R&D sector and the production sector in manufacturing is explained in detail in Grossman and Helpman (1991). In this model, it is the R&D sector that enables a firm or an industry to produce differentiated goods and gives them monopoly power, as these innovated products are distinct from existing ones. Similarly, knowledge spillovers from public knowledge is assimilated through the R&D sector (Romer, 1994b; Corriveau, 1998). In other words, human capital going into production alone cannot produce innovation without the human capital of the R&D sector. This role played by the R&D sector is one of the important distinctions between endogenous growth model and the neoclassical model.[2] Moreover, in many endogenous growth models, the level (quality) of R&D is more important than

[2] Earlier models, such as Gruber, Mehta, and Vernon (1967) and Bernstein (1989) only viewed R&D as a factor employed for marginal cost reduction that may spill over other industries as well.

the stocks (quantity) of R&D because it's the level (stock) of R&D that affect growth in productivity.[3]

One of the most important features of endogenous growth theory, which is also connected to trade is the reasoning that trade conveys knowledge to the importing country, especially through the technology embedded in the product. The knowledge will be used by local manufacturers to increase their competitiveness in the local and world markets. It is necessary, however, to have a domestic R&D sector capable of exploiting the conveyed knowledge for local manufacturing sectors.

Non-Diminishing Marginal Returns and Non-Convergence

Inclusion of human capital alone does not characterizes the endogenous growth model. The main feature of endogenous growth is that technology is of IRS type, which makes growth unbounded (Romer, 1986, 1987, 1990), which was a characteristic of Schumpeterian growth model (Schumpeter, 1934). Among many different functional forms of the production function in the endogenous growth model and for the sake of comparison, we choose a basic specification of the form:

$$Y = (AL)^{\alpha} K^{(1-\alpha)} H^{\alpha} \ , \tag{2.9}$$

where H represents human capital and the rest of the variables and parameters are as defined before. The sum of the exponent of the inputs is $1+\alpha$, which is greater than one (since $\alpha > 0$) and implies IRS technology. The differences between (2.5) and (2.9) are the inclusion of the quantity H^{α} in the model and, more importantly, the fact that in (2.9)

[3] Braconier and Sjöholm (1998) studied manufacturing in OECD countries and concluded that is the level, not the growth, of R&D that affects growth of TFP.

the sum of the exponent on the inputs K, L, and H is greater than one. After dividing both sides of (2.9) by AL, the output per effective worker can be written as:

$$y=f(k,H)=k^{(1-\alpha)}H^{\alpha} \tag{2.10}$$

As before, the lower letter-cases represent the variables per effective labor. The marginal physical product of the output per "effective" worker, which is the first derivative of (2.10) with respect to k, can be written as

$$f'_k(k,H)=\partial f/\partial k=(1-\alpha)k^{-\alpha}H^{\alpha} > 0 \tag{2.11a}$$

The second derivative with respect to k and H is

$$df'(k,H)=[-\alpha\ (1-\alpha)\ k^{-\alpha-1}H^{1-\alpha}]dk+[\alpha\ (1-\alpha)\ k^{-\alpha}H^{-\alpha-1}\ ]dH. \tag{2.11b}$$

Whether the marginal physical product of k in (2.11a) increases or decreases depends on the two terms in the right hand side of (2.11b). The case where the second term is greater than the first term ($df'(\cdot)/dH>df'(\cdot)/dk$), $f'_k(\cdot)$ is increasing rather than decreasing. In this case, as capital per "effective" worker accumulates, the increase in marginal product due to human capital offsets the diminishing marginal product due to capital accumulation. As long as (2.11b) is positive, the economy will not reach a steady-state but will grow indefinitely. Mountford (1999) also shows that with an endogenous growth model, international trade is one of the factors that preclude income convergence of the level and speed of growth between countries.

There are in general two different types of model that explain in detail the sources of endogenous growth and interpreting the equation (2.10a). The first type of model shows that unbounded growth is driven by knowledge spillovers (Romer, 1986). The idea is that private knowledge (skill, innovation, and invention) has spillover effects on public knowledge and the productivity parameter becomes a function of the private and

public knowledge.[4] In this case, the unbounded growth is ensured by the exponential increase in private and public knowledge. This type of model implies a specific direction of the causation between growth and trade, that trade will bring knowledge spillover that will increase income level and growth.

The second type of models argues that unbounded output growth is the results of the firms' incentive to continuously undertake R&D and innovate as they identify opportunities to earn and to maximize their profits (Romer, 1990; Grossman and Helpman, 1991). Innovation may take different forms such as improved methods (Aghion and Howitt, 1992), or improvements of the quality of the product (Grossman and Helpman (1991) or the creation of new varieties of products (Romer, 1990 and Grossman and Helpman 1991).[5]

2.2 'New' Trade Theories

2.2.1 Criticisms of the Hecksher-Ohlin Theories

The Heckscher-Ohlin theory of international trade, which is based on the idea that factor endowments explain trade flows, had been put in doubt by the Leontief paradox. Leontief (1956), and later confirmed by Baldwin (1971), concluded that in the case of the U.S., a capital-abundant country its exports embodied less capital-per worker than its imports for 1947 data. Baldwin (1979) indicated that the evidence of the Leontief paradox is found also in other capital-abundant countries.[6]

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[4] Private knowledge refers to a person or individual firms knowledge (invention) protected, for example, by patent rights. Public knowledge is invention or knowledge no longer held by the inventor and is already be used by the public (e.g. some food recipes).

[5] Role of R&D in industries and difference between process and product innovation are also found in Shy (1998).

[6] Learner (1980) challenged Leontieff's finding and concluded that the net U.S. exports embodied higher capital per worker than consumption.

More recent criticisms, as are summarized in Krugman (1986), argue that differences in factor endowments or in technological progress alone cannot explain neither the growing two-way trade of products of the same type among developed countries nor the poor export performance of many low-income countries, even for labor-intensive products.

2.2.2 'New' Trade Theories

The new theories in international trade, formulated in Krugman (1979), Lancaster (1980), Helpman (1981), Ethier (1982) and Markusen (1986), and summarized by Helpman and Krugman (1985), emphasize the importance of market structure and of product differentiation in explaining the direction, the volume, and the composition of world trade. They argue that increasing returns and economies of scale are generally consistent with imperfect competition in the world market and, more importantly, entice countries with the same factor endowments to trade the same product with each other. Also, the new trade theories argue that markets for many products are rather segmented; and with regard to developing countries, factors such as colonial ties, geography, location, and access to information affect trade performance. Moreover the new trade theories advocate that the size of the countries' economy matters; trade is more likely to grow between countries of comparable economic size, especially among countries having high GDP levels (Krugman ,1986; Venables,1987; and Krugman 2000).

Some of these arguments, such as product differentiation and imperfect competition, are not new.[7] Their uses, however, become more relevant in reviewing

[7] For example, Hughes (1976) studied the impact of economies of scale on trade and investment planning in a developing economy.

some of the failed trade policies based on theoretical and empirical studies that relied on the assumptions of constant returns to scale, perfect competition, and product homogeneity and ignored country size or geography.

Market Structure

Proponents of new trade theories emphasize that increasing returns to scale (IRS) technology is one of the important factors that determines trade patterns in international market. The argument is that specialization of inputs (skilled labor or privileged access to inputs) or the scale of the operation in manufacturing may lead to economies of scale and natural monopolies.[8] This will prevent firms from other countries from entering the world market and imperfect competition arises. Using the economies of scale argument, the new trade theories explain the two-way trade for products with similar factor-content (say, capital-intensive products) or inter-industry trade between two countries with the same factor endowment (say, capital abundant countries).

Suppose production of a product 1 exhibits economies of scale and already takes place in country A (due to specialization or the size of scale of the operation itself). Then other countries cannot produce small amounts of product 1 at a competitive cost, although they may have the same factor endowments as A. Similarly if production of a product 2 take place in a country and B exhibits economies of scale, then other countries including A cannot produce small amounts of product 2 at a competitive cost, although

[8] Clarkson and Miller (1982) pointed out the difference between "economies of scale" and "returns to scale". Returns to scale refers to the firm's technology, which corresponds to least cost input combination to achieve certain level of production. In contrast, economies of scale refer to the case where the industry market demand lies entirely in the section where the industry average cost is declining.

they may have the same factor endowments as B. If consumers everywhere have homothetic preference, and if products 1 and 2 have similar factor content (e.g. both capital-intensive), the result is a two-way trade of goods with similar factor-content between the two countries A and B, if they have the same factor endowments. Apparently, inter-industry trade is not inconsistent with comparative advantage arguments in that input access and specialization lead to specialization in trade[9]. The economies of scale explanation of intra-industry trade, however, refers not only to input access and specialization but mainly to the characteristics of the manufacturing operation itself, which Scherer called "the product-specific economies" (Scherer, 1980).[10] This is the case where only a few firms can satisfy market demand at lower cost (e.g. aircraft manufacturing).

New trade theory arguments can also explain intra-industry trade, which is the trade of product of the same type (e.g., wine) but of different varieties between two countries of the same factor endowments. The reasoning is the same as before in that one country may have specialization, or the production of a particular variety requires a large scale-operation that can only be done in that country, and vice versa. The result is that each country will export the variety it produces and import the other varieties from the

[9] Ricardian analysis in Dornbush, Fischer, and Samuelson (1977) can be taken for comparison.

[10] Some studies pointed out the distinction between economies of scale that is internal and external to the firms. Internal economies of scale refer to the firm's technology of processing, and indicate the structure of the domestic market (Krugman, 1986). External economies of scale refer in general to the industry structure of international market of manufactured good. External economies of scale are external to the firm but internal to the industry. Helpman further explained: "...Explanations of external economies of scales ...rest on the argument that a larger industry takes better advantage if within industry specialization the division of labor is limited to the extent of the market, and so is probably the division of other factors of production, as well as better advantage of conglomeration, indivisibliities, and public intermediate inputs such as roads ..." (Helpman,1984). External economies of scale is in line with the idea of international returns to scale explored by Viner (1937) and Ethier (1982), for the situations where the productivity of a sector in a country depends on the total output in that sector for the world. Because firm level data are scarce and the focus is on international trade at the country level, this study leans more on the external aspect of economies of scale.

other country and vice versa, regardless of their factor endowments or technological progress.[11] However, intra-industry trade involves consumer preferences for variety, not just industry economies of scale. This argument involving consumer preferences is central to the new trade theory and will be explained in detail over the next sub-sections. There are many cases of intra-industry trade between countries. Some examples are wine (U.S. vs. Europe) and automobiles (U.S. vs. Japan).

Moreover, the new trade theories advocate that imperfect competition also arise from market segmentation. Many product markets are not well integrated as theories often assume because of geography or colonial ties for example. Redding and Venables (2001) show that geography alone account for more than 50% of the difference in output per capita between rich and poor nations.

Product Differentiation

The new trade theories suggest that product differentiation is one of the important reasons why two-way trade may occur between two developed countries with the same factor endowments. That goods are homogenous is often too strong an assumption and overshadows the role of consumers' tastes and preference for variety. Chamberlin (1956) defines product differentiation as follows.

> "A general class of product is differentiated if any significant basis exists for distinguishing the goods or services of one seller from those of another. Such a basis may be real or fancied, so long as it is of any importance whatever to buyers, and leads to a preference of one variety of the product over another. Where such a differentiation exists, even though it be slight, buyers will paired with sellers, not by chance and at random, but according to their preference..." Chamberlin, (1956).

[11] Brander (1980) added that strategic interactions among firms also can lead to two way intra-industry trade.

This Chamberlinian definition alone, however, leaves some doubts in the arbitrary manner of classifying goods and implies that whether two varieties of products are different depends on consumer views.

The monopolistic competition model is the standard model in the production of differentiated products. One characteristic of the monopolistic competition model is that individual firms producing a single variety face an elastic demand curve. In the short run, firms in the industry make positive profits but in the long-run because of entry, they all make zero profits. Monopolistic competition structure and conducts are being criticized for two reasons.

(i) That individual firm produces less output than optimal—because of the monopoly feature---and operates at a cost higher than the minimum average cost (too costly). This is referred to as the excess capacity. At the same time, this allows more firms and more varieties than optimal so economies of scale are not exploited since more firms are in the industry. This is referred as the "excess diversity".

(ii) That the total industry output is not the optimal one, which incurs welfare losses like the monopoly case.

These criticisms however can only be tested through thorough welfare studies. In fact, the loss from "excess capacity" and "excess diversity" can be compensated by increased consumer surplus (welfare) from having more variety. Similarly, Browning and Browning (1992) show that the welfare loss from the wrong total output being produced

in the industry is smaller than previously thought because the slope of individual demand facing the firm is relatively small.

Preference for Variety Monopolistic Competition and Total Welfare

The theory of product differentiation relies mainly on the assumption that consumers perceive the distinction among varieties and, more importantly prefer more varieties to less. These ideas were formalized into a framework, dubbed the "love of variety" model (Spence, 1976; Dixit and Stiglitz, 1977). In this model, the utility function of a representative consumer is a function of a good x_0 and a sub-utility function $V(\cdot)$ which is a function of variety of product y:

$$U = U(x_0, V(y_1, y_2, y_3, \ldots y_n)),$$

where x_0 is (the combined amount of all goods over than y) and y_i, $(i = 1, 2, 3, \ldots n)$, is the amount of differentiated product y of variety i. A more familiar and practical form of the Dixit-Stiglitz utility function is the case where there is constant elasticity of substitution between each pair of differentiated goods, so that $V(\cdot)$ is a CES utility function. In this case, the representative consumer maximizes the utility function

$$U = U\left(x_0, \left\{\sum_i^n y_i^{\rho}\right\}^{1/\rho}\right), \tag{2.12}$$

subject to a spending constraint

$$I = p_0 x_0 + \sum_{i=1}^{n} p_i y_i, \tag{2.13}$$

where values of the parameter ρ are restricted as $0 < \rho < 1$, I is the consumer income, and p's are the goods' prices. Basically, this expression of $V(\cdot)$ -- the second argument of

the utility function -- shows that varieties are not perfect substitutes, so that consumer's optimal choice will always include all varieties when they are available. A familiar expression of the solution to the consumer's problem is:

$$(y_i/y_j)=(p_i/p_j)^{1/(\rho-1)}, \tag{2.14}$$

where the exponent $1/(\rho -1)$ is the elasticity of substitution between variety i and j.

Using the consumer preference in (2.12) and assuming that monopolistically competitive firms constitute the supply side of the market, Dixit and Stiglitz determined prices, output and number of firms in equilibrium. These equilibrium values are then compared with prices, the level of output and number of firms with outcomes under two optimal conditions using the same consumer preference in (2.12). One of the optimal conditions is defined as the case where each firm's profit has to be nonnegative and no compensation is given. They concluded that the optimal condition where firms are not given any compensation is identical to the market equilibrium outcome. The other optimal condition is that firms set prices below average cost, but are given compensation to cover the loss from their fixed costs. This optimal condition, as they conclude yield the same level of output as with the monopolistic competition model. This case rules out the excess capacity criticism for the case in which the representative consumer loves variety. There is no need to expand output to exhaust the economies of scale because the equilibrium output under monopolistic competition is already the optimal one. In other words, the social welfare loss from excess capacity (the fact that monopolistic competition produces less than social optimum) would be still the same even if the firms set prices below average costs. Moreover, they concluded that when firms are given compensation from operating below average costs, the number of firms and number of

varieties under the social optimum is greater than under the market equilibrium. This also rules out the criticism of excess diversity under the market equilibrium.

The Dixit-Stiglitz model constitutes one of the most important theories on product differentiation and monopolistic competition. They show that in a market where consumers have 'love of variety' preference, production of differentiated goods by monopolistically competitive firms can be socially optimal.

New trade theory did not bring much new determining factors of trade into the field of international trade, since imperfect competition, product differentiation and geography and transportation costs have been known for a long time as major factors distorting trade. Its major contribution, however, has been the emphasis on these elements into theoretical and empirical work to answer some of the important questions in international trade (such as the explanation of the two-way trade), which cannot be explained under the early theories of trade based on technology or factor endowments.

2.3 Implications of the 'New' Growth and Trade Theories on Studies of Manufacturing Export from Developing countries

The new growth and trade theories provide key orientations in examining why exports of processed agricultural products from developing countries in Sub-Saharan Africa are limited. In this study, we are focusing on three areas that have been overlooked before: endowment in human capital (for production and for R&D); the structure of the world industry for product that developing countries wish to export; and the level of differentiation of the product in the view of consumer. Scherer (1999) summarizes the rationale behind these arguments in the following:

> ...International trade has several important additional effects in this context. For one, when markets are open internationally, firms locked in relatively small nations need not be constrained by the limited opportunities within their home markets. If they can plausibly view the world as their market, and if they have sufficient human capital, they can undertake R&D projects of great scope and wide diversity. Second, having to compete with the best offerings from other nations also forces companies to strain for new products of superior quality and reliability—if they are tough enough to withstand the competitive pressures. But competition can cut two ways: those who come up with products that prove to be inferior or too late may be forced to withdraw. Third, competing on a world scale facilitates tapping worldwide knowledge pools, which may encompass more opportunities than local pools... Scherer (1999)

2.3.1 Role of Human Capital

The introduction of human capital as an essential input has become relevant in explaining the growth and competitiveness of the manufacturing export sector in developed countries. Mankiw, Romer and Weil (1992) argue that exclusion of human capital will lead to biased estimates of the parameters of the production function. Keesing (1965, 1968, and 1971) in empirical analyses indicated the direct relationship between the endowments in skills and the manufacturing trade pattern for several countries. Similarly, Cörvers and de Grip (1997) based their explanations for trade in industrialized countries on human capital endowments. In contrast, very few studies have addressed the impacts of human capital on the manufacturing sector of countries in Sub-Saharan Africa. Owens and Wood (1997) concluded that export of processed goods (e.g., roasted coffee) can be expanded to benefit export growth for developing countries but requires labor skill for them to be produced. This study intends to contribute to the literature related to the role of human capital in manufacturing for Sub-Saharan Africa and other developing countries.

Choosing a proxy for human capital in manufacturing is one of the difficult tasks in introducing human capital in empirical studies because unlike labor and physical capital, human capital is unobservable. Moreover, a comparison and interpretation of the results from empirical studies becomes difficult as these results differ depending on the choice of the proxy. Much depends on data availability. There have been several attempts to measure skilled labor and human capital. Jorgenson and Fraumeni (1996) picked the lifetime labor income for an individual as a proxy for the level of human capital in measuring the impact of education on individual human capital. Ochoa (1996) used the share of professional, technical and related workers employed in a country as the proxy for the level of human capital. Likewise, Griliches (1969) constructed an index for human capital based on the share of workforce that attained some years of schooling and reached minimum earnings. In this study, we use as an index to the level of human capital the difference between the wage rate in the sector we are interested in and the average wage in manufacturing or the lowest wage rate in all manufacturing categories, which often was in the textile and apparel industry. Our choice was constrained by data limitations but this representation of human capital is similar to the index constructed by Waeher's (1968), which is based on the discounted value of inter-industry wage differentials.

2.3.2 R&D

The role of R&D in manufacturing has been outlined by many studies for developed countries. Empirical studies, such as the work of Coe and Helpman (1995), Keller (1998) and Lumenga-Neso, Olarreaga, and Schiff (2001), have focused on the

importance of the R&D sector in capturing knowledge spillovers from trade using the Grossman and Helpman (1990 and 1991) model. The model explains how a country engaged in international trade of manufactured products with R&D sector may benefit from some of the technological progress embedded in imported products. In particular, Coe and Helpman (1995) concluded that R&D from knowledge spillovers account for a large part of total factor productivity (TFP) among OECD countries. The latter is function of the import-weighted pool of foreign technological knowledge and the elasticities of the domestic country's R&D productivity with respect to foreign R&D stocks.

In contrast to the vast literature on developed countries' manufacturing sectors, very few studies have analyzed the role of R&D in low-income developing countries, partly because of lack of data on R&D and human capital. The low shares of professional, manager, college graduates and scientists of the total population imply low levels of R&D activity in many countries in Sub-Saharan Africa (McMahon, 1987; Pack 1992; Tybout, 2000). However countries that experience little or no technological progress need to have at least domestic R&D structure in order to benefit from knowledge spillovers from trade (Jovanovic, 2000).

2.3.3 Role of Market Structure

Structural Barriers

Among many arguments that the new growth and trade theories have in common is the central role attributed to increasing return to scale and market structure. In particular, the new trade theory brings particularly an industrial organization approach to

international trade (Richardson, 1992). The difficulty of applying the development of the industrial organization theory to international trade studies stems from the aggregation problem as international trade theory often addresses issues more at the country level, rather than at firms or plant level as it is often employed in the industrial organization literature. With regard to developing countries trade, however, the aggregation problem might be minimal in some cases because firm size in small countries is often far smaller than the size of a single plant or firm in developed countries.

The structure of the industries of processed agricultural commodities in developed countries market like the U.S. reveals the dominance of very few firms in the supply side of the market, especially for products such as roasted coffee, and cocoa products. Moreover, a number of studies showed the evidence of market power reflected by high markup ratios of domestic firms in developed countries. Hall (1988) and Roeger (1995) found high markup ratios for the U.S. manufacturing industries including food and tobacco industries. Caballero and Lyons (1990) estimated the degree of returns to scale for industries in U.S. and several European countries and concluded that food and beverage industries in these countries present internal as well external increasing returns to scale. Martins, Scarpetta, and Pilat (1996), and Beccarello (1996) concluded that the ratios of price to marginal cost were above one, indicating non-competitive pricing for food processing industries and especially beverage industries in the largest seven OECD countries and especially for Japanese and French processors.[12]

There is no unanimous view about whether high profitability and high concentration of domestic industry constitute a barrier to imports. On the one hand,

[12] Connor (1988) offered analysis of the structure and concentration in the U.S. and food processing industries. Schmalensee (1989) reported some results on structure and performance of some U.S. manufacturing industries. More

White (1974) suggested that the domestic market structure affects trade flows in that a more concentrated domestic industry allows more imports because the import products can be priced lower than domestic products. Pugel (1980) showed some evidences of the negative correlation between import competition and profitability of firms in domestic markets. Similarly, the contestable market theory insists that, in general, natural monopoly power that may arise from economies of scale cannot be exercised if there is a potential threat to entry (Baumol, Panzar, and Willig, 1982; Willig and Baumol, 1987).

On the other hand, other studies such as Esposito and Esposito (1971) that are more in line with the new trade theory indicated that more foreign competition (more imports) is inconsistent with concentrated domestic industries as increasing import will shrink the profitability of domestic industry. Andersen and Rynning (1991) empirically showed that high profitability of monopolists is linked to extensive barriers to entry. Similarly, studies such as Yeats (1974), UNCTAD (1981), and Yeats (1991), noted that high industry concentration reflects the level of protection over local industry and constitutes structural barriers for outside firms even if they are supposedly able to produce some type and variety of processed products.

In this study, we want to seek evidence of the links between industry concentration as structural barrier and the expansion of export of processed agricultural commodities from developing countries. The impacts of these structural barriers on the ability of a firm to enter the market have never been measured empirically and are often overlooked when examining the reason why a single country in developing world cannot expand export in processed form the commodity it produces.

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recent information on the U.S. food processing industries are given in Henderson, Handy and Neff (1999). Similarly, Klette (1999) focused on the structure of Norwegian manufacturing.

Bain (1956) identifies four different sources of entry barriers due to market structure: (i) economies of scale, (ii) absolute cost advantage, (iii) product differentiation and (iv) capital requirement.[13] Disentangling one source over the other in empirical studies is, however, difficult. In fact, an absolute cost advantage may originate from firms having access to fixed factors, which in turn imposes specialization and economies of scale in the industry.

Several studies attempt to measure the "heights" of these structural barriers using indexes. These indexes are then used in empirical studies to estimate the correlation between structural barrier and export share.[14] For example, Orr (1974a and1974b) constructed an index of barriers and then ranked industries according to the height of the barriers to entry; the indexes were constructed upon the propensity of capital requirements, advertising intensity, R&D intensity, risk, and high concentration. Similarly, Comanor and Wilson (1967) and Caves, Khalizadeh-Shirazi and Porter (1975) particularly employed the minimum efficient scale as a proxy for scales of economy barrier, defined as the average size of the largest plants accounting for 50 percent of industry output expressed as industry sales.

Oligopsony in the Markets for Raw Materials

Control of inputs, that is some degree of monopsony or oligopsony, is one of the sources of oligopoly or monopoly power of firms as cited in Browning and Browning

[13] Some theories refute some of these definitions of structural barriers. For example, Stigler (1950) opposed the view that economies of scale constitute a barrier and explained that entrance cost is a better definition of entry barrier. Similarly, Schmalensee (1981) concluded that entry barriers from economies of scale measured by capital cost of a firm of minimum efficient scale are often too low and cannot account for shielding even small monopoly profit. More useful discussions and analyses on entry barriers can be found in Jones (1985) and Tirole (1990).

(1992). Feenstra (1979) showed that if monopsony is taken into account, the usual welfare gain from open trade is in serious doubt as the loss incurred by input producers could be large. The possibility of an oligopsony model has been overlooked in studies related to the source of high markup ratio in processing industries using raw materials from developing countries. At the aggregate level, in developed countries, a high concentration ratios for processors are associated with large imports of raw materials for product such as coffee, cocoa, and spices (UNCTAD, 1981). This raises suspicions that importers in these developed countries may be oligopsonists in the raw materials markets.[15] The low price of the raw material resulting from the exercise of oligopsony power has two opposite effects for the country exporting the raw material. While the low price hurts producers and exporters of the raw material it could benefit processors of the raw material, assuming that arbitrage holds. In this study, we take into consideration the structure of the raw material market to better explain the dominance of a few processing industries in the supply side of the market.

2.3.4 Product Differentiation and Export Competition

The implications of product differentiation and monopolistic competition give some hope for firms in small countries that expanding export is possible when their products are distinct from other competing products.[16] The rationale is that a supplier (processor or exporter) of a distinct product in a market with consumers having Dixit-Stiglitz type of preferences becomes a monopolist with regard to that product and earns

[14] Unfortunately, the implications of the results in these studies are often limited because of the lack of theoretical framework supporting the link between the constructed indexes and export volume or share.
[15] Carter and Schmitz, (1976) found evidence of oligopsony power for the world wheat market.

positive profits, at least in the short-run.[17] In other words, any structural barriers by the established firms in the market becomes less relevant to a new entering firm when this new firm earns market power from its own effort to distinguish its products from others. Then, the problem becomes how firms can distinguish their products to consumers and attain some degree of monopoly power. Some of the answers drawn from the literature and the ones pursued in this study are increase in fixed costs and input productivity (Spence, 1976; Sutton, 1991; Röller and Sickles, 2000).[18]

From the monopolistic competition theory, Spence (1976) shows that a firm's fixed costs constitute the source of monopolistic power if the firm is producing differentiated products and sets price above marginal costs to earn positive profit in the short run. Although such an idea is familiar, theoretical model and empirical studies that examine the direct links between fixed cost to the firm's degree of monopoly or the market share are rare.[19] The chapter 5 of this study provides theoretical and empirical analyses on the link between fixed costs and market shares.

Conclusion

This chapter has reviewed recent theoretical developments in theories of growth and international trade and their implications on ways to spur the export of processed

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[16] Bain (1956), however, mentioned that product differentiation could be a disadvantage for new entrants if consumers believe that the manufactured good is definitely different and at lower quality than what is already available and produced by incumbent firms.

[17] In practice, differentiation is not only through product quality, but may include packaging or distribution specific to the brand or the private label. Competitiveness is based on over services such as regularity of delivery, and product presentation, which are very important to the buyers (Connor, 1988; Abbott, Bredahl, 1994).

[18] Abbot and Bredahl (1994) emphasize that factor productivity rather than absolute factor cost is relevant in competitiveness.

[19] One problem stem from the difficulty to fully separate fixed costs from other costs. Proxies to fixed factors that have been used in empirical analysis include spending on advertising and R&D (Spencer and Brander, 1983; Venables, 1987)

agricultural product from developing countries. The theories argue that human capital, market structure, and product differentiation may explain the lack of export expansion in processed agricultural (primary processing) from developing countries in Sub-Saharan Africa. These arguments guide this research to look beyond the traditional arguments such as tariff escalation, to explain the inability of some low-income developing countries to expand exports of processed products. In the next three chapters, more detailed theoretical and empirical models are introduced to conduct empirical studies related to the implications of these theories.

The next chapter, Chapter 3 will investigate the impacts of growth in human capital on value added for several manufacturing industries in three African countries. Chapter 4 will estimate the impacts of industry concentration and level of labor skill on the exports from developing countries in an oligopoly market of homogenous product. Chapter 5 will estimate the impacts of human capital endowments and input costs on exports for differentiated product. In Chapter 4 and 5, we choose the cases of processed agricultural goods for which the raw material is produced and exported from selected countries in Sub-Saharan Africa.

Chapter 3: The Impact of Human Capital on Manufacturing Value-Added

Introduction

Resource endowments determine the composition of manufactured goods produced and therefore determine the export structure according to the Heckscher-Ohlin trade theories. In Table 3.1, summarized data show that exports of food and beverages, and tobacco (ISIC 31) industries and of textiles (ISIC 32) dominate exports of manufactured products of many countries in Sub-Saharan Africa (SSA). Moreover, Table 3.2 shows that for selected SSA countries, the food, beverages, and tobacco industries and the textile industries represent the largest total output value and value-added in manufacturing industries.

These production and export structures of manufactured goods are in sharp contrast with developed countries' manufacturing production and exports, which are dominated by physical- and human capital intensive goods (Katrak, 1973; Bassanini, Scarpetta, and Visco, 2000).[1] The scarcity of human capital and physical capital in Sub-Saharan Africa has been discussed in earlier literature (e.g. McMahon, 1987; and Tybout, 2000). However, the impact of the level and allocation of human capital on the repartition of value-added and total output of different manufacturing categories for individual SSA countries has not been closely analyzed. Moreover, recent case studies (Martins, Scarpetta, and Pilat, 1996; Covers and de Grip, 1997) show that, in general, manufacturing of food processing, beverage and tobacco in developed countries has become physical capital and human capital-intensive.

Table 3.1. Structure of Exports and Manufacturing Exports of Selected African Countries (Value in %)

Sector	Country:	Ethiopia	Kenya	Madagascar	Mauritius
	Year :	1995	1996	1995	1996
Agriculture		79.2	50.0	66.3	1.2
Mining Quarry		0.0	2.6	7.8	1.6
Manufacturing Industries		20.8	47.4	25.9	97.2
Food, beverages, and tobacco		3.7	13.7	6.4	30.5
Textile		13.8	3.2	6.9	59.7
Wood and products		0.0	0.6	1.4	0.1
Paper and products		0.0	2.5	1.2	0.3
Chemicals and plastics		3.2	15.6	6.2	0.8
Pottery and glasses		0.0	3.1	0.0	0.3
Basic metal		0.0	5.1	0.0	0.0
Fabricated metal and machinery		0.1	3.1	1.3	2.7
Other manufacturing		0.0	0.5	2.5	2.8
Total Export Value		100.0	100.0	100.0	100.0

Source: United Nation Conference on Trade and Development Report.

Table 3.2 Wage per Worker and Repartition of Value-Added in Manufacturing in 1996

ISIC Code	Manufacturing Industries	Ethiopia		Kenya		Mauritius	
		Wage	Value added	Wage	Value added	Wage	Value added
		(birrs/year)	%	(K.pounds/year)	%	(rupees/year)	%
31	Food, beverages, and tobacco	5979.4	52.4	3484.4	42.9	91206.2	28.0
32	Textile	4141.5	18.5	3327.6	7.1	52818.8	48.2
33	Wood and products	4642.1	1.6	2966.7	1.9	78833.7	2.6
34	Paper and products	6389.0	5.3	5038.2	5.9	108982.7	4.1
35	Chemical and plastics	5764.9	6.4	6748.2	15.7	97865.9	5.5
36	Pottery and glasses	5222.3	7.6	5585.4	4.0	105646.1	4.2
37	Basic metal	7445.1	3.0	3238.5	0.6	101529.6	0.8
38	Fabricated metal and machinery	6325.4	3.9	5279.5	16.8	72956.5	4.7
39	Other manufacturing	4429.0	1.2	4332.7	5.1	45583.8	1.9
	Total		100.0		100.0		100.0

Source: United Nations Yearbook of Industrial Statistics.

[1] Human capital is defined as the accumulated value of an individual's intellect, knowledge, experience, potential and commitment that contribute to the achievements of an organization's vision and business objectives (Knowledge Workers). Physical capital refers to equipment and machines

The objective of this part of the dissertation is to estimate the role of human capital (labor skill) and stock level of knowledge on manufacturing value-added based on the endogenous growth models developed by Romer (1986, 1990). In this model, value-added per worker is specified as a function of human capital per worker, physical capital per worker and a constant term representing the level of accumulated knowledge. For estimation, this study employs an econometric method and panel data across 9 two-digit level ISIC codes. These panel data were estimated separately for the period 1969-97 for three East African countries: Ethiopia, Kenya, and Mauritius.[2] The two-digit ISIC categories of industries constitute the cross-section units. These countries were selected for two reasons: (i) the data were available and (ii) to compare results later as, Mauritius' manufacturing exports relies more on textile than the two other countries.

The next section will present the theoretical model from endogenous growth theory and the empirical model to be estimated. Then, the data and estimation technique are introduced. The results will be summarized and discussed. The conclusions and implications of the study are presented.

3.1 Theoretical Model

There are many variants of models specifying endogenous growth theory, but this study employs the basic Romer models (Romer 1986, 1990). In many endogenous growth models, each industry has two sectors, the production and the research sectors. The total endowment in human capital H is allocated between these two sectors. That is, $H = H_A + H_Y$, where H_A represents human capital going into the research sector

[2] The years are slightly different for each country, as explained later.

(marketing research, invention), and H_Y represents human capital going into the production sector (experiences in handling machines).

The research sector produces knowledge using human capital while the growth rate of knowledge production is assumed to be proportional to the amount of human capital devoted to research according to the expression,

$$\dot{A} / A = \theta H_A \ , \tag{3.1}$$

where A is the stock level of knowledge, θ is a constant, and the dot notation represents the instantaneous change for the time derivative, ($\dot{A} / A = dA / dt$). The stock level of knowledge, A, is assumed to have a direct relationship with the range of durable inputs produced and invented in the research sector, which makes up the final good. The higher the stock of knowledge, the more types of durable inputs are produced. This assumption also implies that each durable input is only produced by the research sector (there can be many research sectors).

Following Romer (1990), final output at the industry level is a function of human capital used in production, the amount of labor, and a total list of physical capital. The total list of physical capital, n, is partitioned into n_i distinct lists corresponding to each durable input of type i (i =1, 2, 3, …, A). These durable inputs contribute to making up the manufactured final good. The n_i can be thought of as the number of ingredients (or primary inputs) that make up a single durable input. Using the continuous notation, the total list of physical capital is $n = \int_0^A n_i di$, and the production function is written as

$$Y = H_y^{\alpha} L^{\beta} \int_0^A n_i^{1-\alpha-\beta} di \ , \tag{3.2}$$

where Y is final good output, L is the amount of labor. Also, α and β are positive parameters that respectively represent output elasticity with respect to human capital in the production sector and labor. The restriction on the parameters is that $\alpha + \beta < 1$, in order to keep the exponent on the list of durable input positive.

One characteristic of Romer's specification in (3.2) is that the durable inputs are perfect substitutes: an additional dollar of one durable input does not affect the marginal productivity of any other durable input. If each durable input has the same list size $\overline{n}$, (that is, the durable inputs are "symmetric" in Romer's term), and if we take into account the fact that state of knowledge A also represents the number (or the range) of durable inputs produced, the integral term in (3.2) can be written as:

$$\int_0^{\infty} n_i^{1-\alpha-\beta}\, di = A\,\overline{n}^{1-\alpha-\beta}, \qquad (3.3)$$

where $\overline{n}$ is a fixed number of inputs (also can be called intermediate goods) for every durable input. To get an accounting measure of capital, it is assumed that δ units of capital are used to produce one unit of each ingredient of the durable input. Then, the total amount of capital, K, entering the production of final output can be written as[3]

$$K = \delta\ \overline{n}\ A. \qquad (3.4)$$

[3] For example, in the ice cream industry, assume that "durable" inputs are i =milk, sugar, and flavor. In this case, A (the number of durable inputs) = 3. Let's take one of the durable input, say, flavor. If the flavor is made of only two ingredients (say, solvent and pure extract), then $n_{\text{flavor}} = 2$. Also, it is assumed that $\delta = 1$ unit of solvent and $\delta = 1$ unit of pure extract are combined to make up one unit of flavor. Assuming that n_i =2 and $\delta = 1$ for the other durable inputs, the total amount of capital is $K = 1 \times 2 \times 3 = 6$, following equation (3.4).

Solving for $\bar{n}$ in (3.4), substituting into equation (3.3), and then substituting again into equation (3.2), the production function can be rewritten as:

$$Y = H_y^{\alpha} L^{\beta} A(K/\delta A)^{1-\alpha-\beta} . \tag{3.5a}$$

After rearranging terms in (3.5a), the general expression of the industry output becomes

$$Y = A^{\alpha+\beta} \delta^{\alpha+\beta-1} H_y^{\alpha} L^{\beta} K^{1-\alpha-\beta} . \tag{3.5b}$$

The production function derived in (3.5b) exhibits constant return to scale (CRS) in the main inputs, H_y, L, and K. Also, it is important to notice that equation (3.5b) is very much comparable to the growth accounting model (Solow-Swan). In case where A is exogenously determined, equation (3.5b) can be viewed as the neoclassical model, but with human capital and a labor-augmented stock of knowledge, which can be rewritten as

$$Y = \delta^{\alpha+\beta-1} (AH_y)^{\alpha} (AL)^{\beta} K^{1-\alpha-\beta} .$$

3.2 Empirical Model

From equation (3.5b) above, an empirical model is developed to estimate particularly the impact of human capital on output and value-added. First, expressing (3.5b) in terms of output per worker and then taking the logarithm of both sides of the equation, the equivalent formulation in terms of output per worker is,

$$\log y = (\alpha + \beta)\log A + (\alpha + \beta - 1)\log\delta + \alpha \log h_y + (1-\alpha-\beta)\log k , \tag{3.6}$$

where the lower letter case y, h_y and k represent respectively value-added, human capital and physical capital, all per worker.[4]

[4] Using per workers is also useful for saving some degrees of freedom for the estimation purposes.

To econometrically test equation (3.6), the stock of capital (or stock of design in capital or level of knowledge), A, is assumed to be industry- and time-specific. Theoretically, A is the level of knowledge and the growth of A is proportional to the amount of labor going into the research sector according to equation (3.1). In past studies, because A is not directly observable, A has been often proxied as the amount of research and development expenditures for the industry (e.g. OECD countries in Ochoa, 1996) or the number of patents issued. In this study, there is no available proxy that the data can provide for A. In addition, δ, the amount of capital used to produce durable inputs may differ by industry but are assumed to be constant over time for each industry. Taking into considerations the above remarks and adding a stochastic term and the industry i and time t subscripts, the proposed econometric model for estimation and for each individual country is the following:

$$\log y_{it} = \gamma_t + \gamma_{0i} + \gamma_h \log h_{yit} + \gamma_k \log k_{it} + \varepsilon_{it}, \qquad (3.7)$$

In comparing (3.6) to (3.7), the first two terms on the right hand side of (3.6) are split into time trend and industry dummy variable:

$$[(\alpha+\beta) \log A + (\alpha+\beta -1) \log \delta]_{it} = \gamma_t + \gamma_{0i}.$$

On the one hand, the coefficient of the industry dummy variable, γ_{0i}, captures, among other things, the different levels of knowledge across industry and the technology specific to each industry (δ). On the other hand, the time trend γ_t captures the change in the level of knowledge over time and refers to the measure of productivity in growth accounting model.

Moreover, the specification in (3.7) is also viewed as one-way fixed effect model, which is justified by the fact that the cross-section units cover all the countries' industry

categories and are not randomly drawn from a population. Also, data summary in Appendix B already exhibits some differences in value-added per worker across the industries that will be captured by γ_{0i}.

Also, in (3.7) the parameters γ_h and γ_k respectively represent the value added per worker elasticities with respect to human capital and physical capital (or capital stock). We expect that these parameters are positive and their sum is $\gamma_h + \gamma_k < 1$. Moreover, ε_{it} represents the error term.

3.3 Data and Estimation

Time series and cross-sectional data are pooled in a panel data for each of the three African countries to estimate parameters in the equation (3.7). The eight or nine industry categories of two-digit level constitute the cross sectional units. The data for manufacturing output, value-added, capital stock, labor and wages are mainly from the International Yearbooks of Industrial Statistics published by the United Nation Industrial Development Organization and partly from local government publications. The data are available annually, but the time covered slightly varies for each country: 1969-97 for Ethiopia, 1970-97 for Kenya, and 1970-96 for Mauritius. Nine manufacturing industries at the two-digit level (ISIC codes) are considered, except for Ethiopia, which has only eight two-digit level categories. The "other industry" category, (ISIC 39) did not exist for Ethiopia because industries in this category have been incorporated into the first eight remaining categories. This may present difficulties when comparing cross-country results. The monetary values are kept in local currency units.

Appendix B gives an overview of the data collected and show that, the food, beverage and tobacco industries are the major contributor of value-added for the entire manufacturing sector in all three countries.[5] The 9 manufacturing industry categories can be roughly classified into three groups according to the levels of wages paid and the level of value-added per worker. The first group, the food, beverages and tobacco industries appears to yield the highest value-added per worker and also has relatively high wages. In contrast to the first group, a second group that includes textile and woodwork industries shows relatively low value-added and pays relatively low wages per worker. A third group, including the remaining industries such as the paper and plastic industries, is in between the two first groups in terms of the levels of value-added and wage per capita.

As it is proposed in Jorgenson and Fraumeni (1996) industry output can be represented in a two-stage expression. First, value-added is function of physical capital, human capital and labor. In the second stage, output is function of value-added and intermediate goods. Because the interest here is mainly in examining the importance of human capital, this study focuses specifically on the first stage and takes annual value-added per worker by industry as the dependent variable. Following the UNIDO data, value added in this study is the output value subtracted from the values of all purchased materials (raw material including packages).

Because of the data limitation, the wage differentials are the only available proxy that this study could use for human capital. The use of wage differential as the proxy for human capital has been introduced and discussed in various studies (Branson, and Monoyios, 1977; Stern and Maskus, 1981; Bound and Johnson, 1992; Bowen, Hollander,

[5] One explanation of the importance of the first group relatively to the rest of the industries is maybe the access to the sources of input materials, which could be mostly local or easily imported.

and Viaene, 1998; and Jones, 2001). This choice is also justified by the work Bigsten et al. (1998) who found positive correlation between Africa's manufacturing wages and human capital index based on the level of education. For Ethiopia and Kenya, the wage differential was measured as the difference between the wage paid per industry and per capita earnings in the agricultural sector, which includes forestry and fisheries. For Mauritius, the wage differential was measured as the difference between the average wage in each of the nine industry categories and the wage in the "Wearing Apparel" industry (ISIC 322). This latter choice is driven by the fact that in Mauritius, the agricultural wage is higher than the wage rate paid in some industries, such as the textile industry, because of the dominance and the high factor returns of the sugar cane industry. Therefore, the agricultural wage might be a biased reference to the wage of unskilled labor.

Parameters in equation (3.7) are estimated for each of the three countries. One of the industry dummies is dropped to avoid collinearity. Using the PROC ARIMA procedure in SAS during preliminary testing indicated the presence of first order autoregressive error terms, in each cross-sectional unit for all three countries. The presence of contemporaneous correlation of the error terms among the nine categories of industries also was detected (one of the reason is certainly because they draw inputs from the same country and input productivity is maybe country-specific). Moreover, heteroskedasticity problem also was found. One possible explanation is that the size of industry categories is very different implying that error terms are not likely to be heteroskedastic. Given such conditions, the SAS procedure PROC TSCSREG with

Parks' method option is employed to estimate parameters in equation (3.7).[6] Park methods is a two stage GLS which corrects for autocorrelation and heteroskedasticity. Parks showed that the parameter estimates are consistent and asymptotically normally distributed (for details, see Parks, 1967). Dummies for the time periods are also introduced to check for structural change.

3.4 Results

The main results are summarized in Table 3.3. For all three countries, the coefficients on human capital (wage differentials) and physical capital (or intermediate goods) are within the reasonable range ($\gamma_h + \gamma_k < 1$), have positive signs as expected, and are statistically significant. In particular, the results show that growth of value added per worker is positively related to the growth of human capital. However, there are some differences in the results across countries. Value added per worker in Kenya is more responsive to an increase in the level of skill, elasticity of 0.417, than in any of the other countries but less responsive to increase in capital stock. On the contrary, value added per worker in Mauritius responds highly to an increase in physical capital stock but is little impacted by an increase in human capital.

These results are consistent with the difference in the two countries economy. Mauritius, one of Africa's fastest growing country, has better access to capital than Kenya and relies on textile industry using low level of labor skill. On the contrary, Kenya's manufacturing may have limited access to capital and is based on food

[6]The Parks' method corrects for heteroskedasticity and autocorrelation at the same time. It is a two-step GLS procedure where in the first step the variance-covariance of errors is estimated by variable transformation using the first order auto-regression coefficient, and in the second step the estimated variance covariance of errors is used for parameter estimation.

Table 3.3. Input Elasticities of Value Added per Worker

Variables	Coeff.	Ethiopia (1969-97)	Kenya (1970-97)	Mauritius (1970-96)
Dependent variable: log of value added per worker				
Intercept		-5.129**	-8.316**	-1.406**
		(-23.35)	(-24.73)	(-7.02)
Time trend (TFP)[a]	γ_{t1}	0.005	-0.016	0.010**
		(0.98)	(-1.92)	(4.87)
	γ_{t2}	-0.005*	-0.014 **	
		(-1.96)	(-3.21)	
Industry dummy:				
Food, Beverage, and Tobacco	γ_{01}	0.965**	0.635**	-0.716**
		(8.09)	(6.05)	(-5.59)
Textile, Wearing apparel, Footwear	γ_{02}	-	0.079	0.203**
			(1.43)	(0.039)
Wood Product and Non-metallic Fixtures	γ_{03}	-0.074	-	-
		(-0.61)		
Paper and Product, Printing and Printing	γ_{04}	0.277*	0.407**	0.165
		(2.18)	(4.70)	(1.69)
Chemicals, Oil refining, Rubber, Plastics,...	γ_{05}	0.704**	0.646**	-0.311**
		(4.02)	(5.98)	(-3.02)
Pottery, China, Non-metallic minerals	γ_{06}	0.096	0.551**	-0.098
		(0.64)	(4.23)	(-0.92)
Basic metallic (Iron, Steel,...)	γ_{07}	0.924**	-0.698	-0.267
		(6.93)	(-1.78)	(-1.40)
Fabricated Metal, Non-electrical and electrical machinery, Transport equipment,...	γ_{08}	0.246	0.242**	-0.156
		(1.66)	(2.74)	(-1.38)
Other Manufacturing	γ_{09}	no data	0.501	-0.411**
			(2.62)	(-3.22)
Log of human capital per worker	γ_h	0.138**	0.417**	0.038*
		(6.36)	(11.77)	(2.37)
Log of capital stock per worker	γ_k	0.099**	0.091**	0.818**
		(6.46)	(2.97)	(37.38)
R-Square		0.74	0.90	0.93
Total number of observations:		232	252	243

Notes. () are t-values and ** and * are significance at the 1% and 5% levels, respectively.
a: $\gamma_{t1}$and γ_{t2} represent the trend for two different periods: before 1987 vs. 1987 and after for Ethiopia; before 1983 vs. 1983 and after for Kenya. There is no break in Mauritius' time trend.

processing and oil refinery (serving most of East Africa), which use relatively high level of labor skill.

The industry dummies are often statistically significant, which confirms that the levels of value added per categories of industry are different. Also from the model derivation, statistically significant industry dummies could mean either that there is a higher level of growth of knowledge relative to other industries or different technology (as expected) or both. It is important to note that the signs and the value of the coefficients of the industry dummies are relative to the dropped industry dummy. For Ethiopia and Kenya, food, beverage and tobacco category represents higher levels of valued added per workers and eventually accumulates higher level of knowledge than the other category of industry. This result reflects the facts that "food, beverage and tobacco" industry for these countries (i) largely contributes to the total value-added of the manufacturing industry, (ii) yields high value-added per worker, and (iii) often pays relatively high wage to workers.

A key information is also provided by the value and significance of the time trend, commonly called the residual in growth accounting model, which in this study can be interpreted as the changes in growth of knowledge going into the research sector over the years. The negative signs on the estimated coefficients for the trend indicate that accumulation of knowledge or manufacturing productivity declined by 0.5% per year in Ethiopia and 1.4% a year in Kenya, respectively for the periods 1987-97 and 1983-97. Indeed, these periods coincide with drought period in Ethiopia and economic downturn in Kenya in the mid-1980's, which may have provoked the difference in productivity between these periods for the two countries. However, accumulation of knowledge in

manufacturing industry in Mauritius has increased by 1% a year between 1970-96 despite the fact that manufacturing in Mauritius is dominated by textile industry. Further research is needed to investigate which category of industry has benefited this increase in the accumulation of knowledge in Mauritius.

Conclusion and Implications

This study uses a model derived from endogenous growth theory to estimate the role of human capital and the level of knowledge for various two-digit manufacturing industries in three East African countries. The empirical model specifies value-added per worker as a function of human capital per worker, physical capital per worker and a constant term representing the level of accumulated knowledge. Choosing and finding available proxies for human capital constitutes a serious obstacle to researchers in testing the endogenous growth model for developing countries.[7] To overcome such difficulties, this study particularly employs the differences between the wage in the manufacturing industry on one hand, and wages in the agricultural sector (Ethiopia and Kenya) or the wage in the 'wearing apparel industry' (Mauritius) on the other hand, to represent the levels of human capital per worker.

The results of the estimation indicate that the endogenous growth model predicts well in that the growth in value added per worker is found to be positively correlated to the growth in human capital (level of skill) employed in manufacturing industry. Also, the values of the coefficients are all within the reasonable range and provide explanation of the sources of growth in value added per worker in manufacturing industries. In

[7] In, Braconier and Sjöholm (1998), the variable representing the growth of human capital is replaced by the level of R&D expenditures.

particular, food, beverage and tobacco industry category, particularly in Ethiopia and Kenya employ relatively high level of skill, which contributes to higher growth of value-added per worker. Also, Kenya's manufacturing value added is relatively more responsive to increase in human capital than the other two countries while Mauritius's manufacturing value added is highly responsive to increase in physical capital. The results also show that growth of knowledge going to the research sector in manufacturing has increased for Mauritius from 1970 to 1995, but has decreased for Ethiopia and Kenya since the mid-80's.

These results imply that increasing the level of skill employed in manufacturing will in general increase value added per worker (labor productivity). Therefore, labor training and general education of the workforce is a way to increase productivity in manufacturing. Because the composition and structure of manufacturing exports are very similar to the composition and structure of output of domestic manufacturing for these countries, increase in value added due to high level of human capital the manufacturing sector will eventually increase the value added from export of processed goods. It is, however, difficult to conclude that an increase in the level of human capital alone will guarantee the expansion of export of products such as roasted coffee, chocolate, wine and spices. Market structure in the destination market could constitute one of the barriers for these products. The next chapter of this dissertation closely investigates the impacts of the barriers due to market structure in the export of some individual processed foods.

Chapter 4: The Roles of Structural Barriers and Human Capital in the Exports of Homogenous Products

Introduction

Over the years, the gap between world prices of primary commodities and prices of processed goods has widened (Morrisset, 1997). This hurts developing countries that export raw material, especially those which rely heavily on raw material exports to earn foreign currency. The widening gap between the prices of the raw material and processed goods, however, shows the gain of value-added that could have been captured if these developing countries could process the raw material and export the processed product into the world market. So far, many developing countries find it difficult to expand exports of processed agricultural products to the world market. One of the issues faced by developing countries is how they can expand their export earnings from processed products to capture some of the value-added in the international market.

In a context where developed countries are large importers of raw materials and also constitute the largest market for processed agricultural products, trade barriers (such as tariff escalation) applied by these developed countries are often cited as the major impediment to the export of processed products from developing countries. Specifically, for products like coffee and cocoa, Yeats (1974) and Tangerman (1989) have concluded that tariff escalation has been the major impediment to increasing export of processed goods.

This chapter attempts to go beyond the common argument of tariff escalation and trade barriers to find an explanation about how processors in developing countries have not been able to expand their market share in the world market. There are two reasons

why this study considers other explanations. The first reason is that these tariffs and other trade policies generally have been the center of the discussion in earlier trade rounds for developing countries, but these negotiations have not changed the status of many developing countries exports of processed products, especially in Sub-Saharan Africa. The second reason is that the issue of trade barriers has become less relevant for some specific manufactured products such as textile, roasted coffee, and processed cocoa. In fact, new opportunities have emerged, such as the recent African Growth and Opportunity Act (AGOA), which set tariffs to zero to a number of Sub-Saharan African countries.

This chapter investigates the role of the structure of international markets on developing countries exports. The focus is on the facts that in developed countries, processing of some agricultural goods exhibits high mark-up ratios that may indicate non-competitive pricing and is highly concentrated by a few firms. Martins, Scarpetta, and Pilat (1996) concluded that food processing industries in OECD countries are marked with high levels of non-competitive pricing and high levels of market power for local processors. Table 4.1 presents the results of their estimation and shows that the ratios of price to marginal cost in food and beverage industry are mostly above one (price above marginal cost). Moreover, developed countries' industries that uses raw materials from developed countries as inputs are often very concentrated. Table 4.2 shows the high level of four-firm concentration ratio (CR4) and the Herfindahl-Hirschmann index for the U.S. sugar cane refining, chocolate manufacturing, coffee roasting and flavoring extract industries.

Table 4.1 Markup Ratios in Developed Countries Industries

Country	Food Industry	Beverage Industry
France	1.11	1.68
Germany	1.12	1.33
Japan	1.32	1.26
United Kingdom	1.20	1.54
United States	1.05	n.a.

Source: Martins, Scarpetta, and Pilat (1996)
Note: markup is the ratio of price to marginal cost

Table 4.2 Firm Concentration in Selected U.S. Industries

SIC Code	Industries	Four-firm Concentration (%)*	Herfindahl-Hirschmann Index**
2033	Canned Fruits and Vegetables	27	301
2043	Cereal Breakfast	85	2253
2062	Cane Sugar Refining	85	2125
2066	Chocolate and Cocoa Products	75	2188
2084	Wines, Brandy, Brandy Spirits	65	1530
2087	Flavoring Extracts	69	2085
2091	Canned and Cured Seafood	29	406
2095	Roasted Coffee	75	1501
2111	Cigarettes	93	n.a.

Source: US Department of Commerce
Note: * Percent of value of the shipments, and percent of value-added for SIC 2084 (Wines, Brandy, Brandy Spirits), accounted for by 4 largest companies.
** The sum of the square of the individual companies percent of value of shipments for 50 largest companies.

Stigler (1964), Saving (1970) and Encaoua and Jacquemin (1980) showed that high level of concentration is indeed indicative of high degree of oligopoly power.[1] Whether this high concentration is the result of regulations that limit the number of firms or the result of economies of scales, or both, is not really clear. The concern in this study is whether this high concentration affects exports of processed agricultural goods from developing countries.[2] In this regard, the new developments in trade theories, indeed, emphasize the role of market structure in determining the direction, volume, and composition of trade (Helpman and Krugman, 1985; Krugman, 1986).

Views have been divided on the impact of high concentration of local firm on import from abroad. On the one hand, White (1974) argued that the monopoly or oligopoly power exercised by the few firms in the export market, may actually induce imports from other firms willing to set prices lower than the monopoly or oligopoly price. Indeed, the contestable market theory (Willig and Baumol, 1987) implies that concentration and monopoly or oligopoly power do not constitute a barrier because the threat of entry will prevent the few firms concentrated in an industry from exercising their market power.[3]

On the other hand, Shepherd (1972) showed that for the U.S. manufacturing, profitability of a small individual firm is only slightly but negatively affected by concentration of leading firms. Yeats (1974) also reported that in many cases, the largest markets for some processed agricultural products (U.S. and E.U.) involve very

[1] However, Jacquemin, de Ghellinck, and Huveneers (1980) argued that "concentration is not the whole story of monopoly power".
[2] If concentration was the results of trade protection, concentration should have been declining after protection is reduced or eliminated. Data, however, show that the concentration did not decline.
[3] Yamawaki (1986) found positive relationship between prices and level of concentration in U.S. manufacturing on the one hand, and the profitability of Japanese firms exporting to the U.S. on the other hand.

concentrated local processors, which make it hard for outside firms to access these markets. Similarly, Andersen and Rynning (1991) showed that high profitability of monopolists is linked to extensive barriers to entry.

The primary objective of this chapter is to estimate the impacts of the concentration of firms in the destination market on the market shares of the outside firms. The model developed allows us also to reach another objective, which is to estimate the impacts of the level of labor skill on developing country's share of the market of processed agricultural goods. In fact, it is puzzling that despite barriers in developed countries' market, firms in some exporting countries (both producers and non-producers of the raw materials) have managed to have larger export shares than other firms.[4] This chapter will test if the level of skill employed could be part of the explanation of the difference in market shares among the exporters.[5] The focus is on the cases of U.S. markets for cocoa paste and cocoa butter. The U.S. cocoa industries are among the most concentrated industries, according to table 4.2. Also, in 1999, 95 percent of the total demand of cocoa paste is covered by U.S. firms, and the rest is imported from various countries including Brazil, Canada, Côte d'Ivoire, Indonesia, and Malaysia (USDA). For cocoa butter, 69 percent of the U.S. demand is produced domestically and the rest is imported from countries such as Brazil, Côte d'Ivoire, Ecuador, Malaysia, and Indonesia (USDA). In this chapter, it is assumed that these processed products are homogeneous, regardless of origin or variety.

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[4] For example, in the U.S. import market of cocoa products, The Netherlands and Brazil have relatively large shares of the import market compared to other countries such as Côte d'Ivoire or Ghana. Grossman (1982) found that, for the U.S. market of some selected manufactured goods, imports from developing countries are often in sharper competition with products by U.S. firms than by other exporting countries. The study has not however covered any agricultural goods except *bovine leather*.

[5] Pack and Paxson (1999) concluded that Africa's manufacturing is indeed skilled-constrained.

The next section introduces a framework that attempts to measure the impacts of industry concentration and skilled labor endowments on the ability of a single developing country (or a firm) to expand exports of processed goods in the context of an imperfectly competitive market.

4.1. Theoretical Model

4.1.1. Model Determining Market Structure and Conduct

The problem can be portrayed as that of a relatively small individual firm willing to expand its share and competing with some other firms, including a few that are dominant. Because the price or output decision of one firm affects the decisions of all other firms and vice versa, solving the firm's problem suggests the use of conjectural variation models, which were developed in early work of Kaldor (1934), Frisch (1951), Bishop (1952), and Sato and Nagatani (1967).[6] Conjectural variation models include parameters that take into account each firm's belief of the impacts of its decision on other firms. In the industrial organization literature, there are common steps to derive conjectural variation models. First, the profit function for each individual firm is stated and in the case of a homogenous product, the model employs a single market price (since firms face a single market demand); total demand is equal to the sum of all firms' outputs.

Second, the first order condition is derived from the profit function, taking into account conjectural variations. Third, the first order conditions are then aggregated over all firms to get an expression of the industry margin as a function of the factors involving

input prices and parameters indicating market power. In many studies, when aggregating over the firms, assumptions have to be made such as constant and identical marginal costs among firms.

In many cases, the use of conjectural variation models in empirical studies leads to estimates of the level of market power and degree of competition in the industry, and conjectural parameters that represent market conduct. Early models focused mainly on industries in a single country and often assumed symmetry among firms.[7] Iwata (1974) empirically estimated conjectural variation parameters and the degree of collusion among firms. Moreover, in Applebaum (1982) and later Azzam (1997), the conjectural variation models were employed to estimate the relation between the firm's inputs costs and market concentration and their impact on the spread between price of raw material and price of output in an industry. Similarly, Azzam and Pagoulatos (1990) used these models to measure the degree of market power of the firms in the industry.

In this chapter, the focus, however, is on estimating the impacts of market structure on the market share of an individual firm. Therefore, a number of changes to these early conjectural models have been brought in order to reflect the reality of international market and to focus on a particular foreign firm j's inability to expand output. One adjustment is that firms are divided into the groups of domestic and foreign firms. The domestic firms are the dominant group while the foreign firms are fringe firms to which the firm j belongs. Each fringe firm is treated individually since the focus

[6] It is the assumptions on the conjectural parameters that lead to different models such as Cournot, Bertrand, and Stackelberg models. Shubik and Levitan (1980) presented useful and detailed theoretical models related to market structure and conduct.

[7] Symmetric firms are identical firms having the same market shares.

is on an individual firm *j*. This rules out the usual assumption of symmetry among all firms in the industry.

Another adjustment is to treat marginal costs as different among firms because firms face different factor markets. In fact, firms are located in many different countries, which have different labor and capital markets (because of differences in factor endowments and the immobility of resources across countries). This is a major difference from previous studies, which were limited to the case of industries inside a country and assumed that firms in the industry generally bid for the same inputs (labor, energy, and capital). Previous studies' assumptions, such as same marginal cost among firms in equilibrium and the same factor markets for all firms, are not realistic in international markets. Such assumptions may not hold because access to inputs, in general, and wages in particular, may not be uniform across different areas or regions within a country. It is assumed, however, that the market for raw material is the only common factor market for all firms; all firms are assumed to buy the raw material at the same price, which is the world price.

The model also features the hypothesis that the group of dominant firms has oligopsony power in the raw material market. It is often the case in international markets that dominant processing firms are also the largest importers of the raw material. The exercise of monopsnony or oligopsony power may have an effect on the industry margins in general, and on the output of firm *j* in particular, as the price of raw material is brought down below its marginal value product. Oligopsony power of the leading firms has been put into the model by some studies (Azzam and Pagoulatos, 1990; Stiegert, Azzam, and

Brorsen, 1993; and Azzam, 1996). This chapter employs an analogous framework, but puts it in the context of international trade.

Another important feature of the model employed in this study is the introduction of labor skill into the technology of the firms. Though such a practice is not new, it is not frequently applied in the conjectural variation models and in international trade. The new developments in growth theory, which takes into account the role of human capital as an input, have prompted the inclusion of different proxies of human capital in the production function. Following Branson and and Monoyios (1976), Stern and Maskus (1981), Bound and Johnson (1992) this study uses the ratio of the industry wage to the wage of unskilled worker or minimum wage to represent the level of skilled employed in production. This measurement captures the effect of the level of the labor skill on a firm's access to the market of processed good.

4.1.2 Specification of the Theoretical Model

The goal in this section is to present a model for estimating the impact of human capital endowments and the structure of processing industry on the volume market share of a firm. We consider a market of a processed, homogenous product Y in a country $\mathcal{M}$. Two different groups of firms M and N supply the product Y to $\mathcal{M}$. The first group, M consists of $i = 1, 2, 3, \ldots m$ symmetric home firms, that are located in the country $\mathcal{M}$. The second group, N, consists of $j = 1, 2, 3, \ldots n$ different firms, that are located outside the country $\mathcal{M}$, but export to country $\mathcal{M}$. All firms i in M and all firms j in N produce only a single variety of Y; the total $m+n$ processing firms produce a homogenous good.

(The homogenous good assumption implies that the price of the product is the same regardless of origin and variety.)

In the model outlined below, the following notations will apply:

y_M: total output produced of product Y by group M, $y_M = \sum y_i$ (i=1, 2, 3, …, m)

y_N: total export from group N, $y_N = \sum y_j$ (j = 1, 2, 3, …,n)

y: total market supply $y = \sum y_i + \sum y_j, = y_M + y_N$

p: price of processed good

x: quantity of raw material used to produce Y

ϖ : price of the raw material

w_H: wage rate of skilled labor

w_L: wage rate of unskilled labor

c: processing cost.

Demand for the Processed Good

We express the market demand function in $\mathcal{M}$ as

$$y = f(p, p', I), \tag{4.1a}$$

where p' is price of a related good, and I is the consumer's expenditure and the remaining variable are defined as above.[8] A constant elasticity form of (4.1a) can be written as:

$$y = p^{(\eta)} I^{(\mu)} p'^{(\kappa)}, \tag{4.1b}$$

[8] This is not a general equilibrium study, so we are not concerned with demand in countries where firms in N are located. In other words, we assume that firms in N produce only for export market to $\mathcal{M}$.

where η, μ, and κ are parameters, which represent respectively the price elasticity of demand, income elasticity and cross-price elasticity with respect to a related good. The advantage of the constant elasticity form resides in the ease of estimation and the interpretation of the parameters.

Supply of the Processed Good

The main assumption is that the group *M* is enjoying double market power. That is, it is assumed that the market for raw material is segmented so that the *m*-firms in group *M* have oligopsonistic power in purchasing the unprocessed good in the world market. In addition, firms in group *M* are oligopolists in the processed good market. Moreover, it is assumed that *k* units of raw material are needed to get one unit of processed good so that the cost of raw material is $k\varpi y_i$. On the other hand, we also assume that the processing activity employs skilled (x_H) and unskilled (x_L) workers, and capital (x_K). Using the specification by Schroeter and Azzam (1991) and Stiegert, Azzam, and Brorsen, (1993), which separates the cost function into processing cost and cost of raw material, the profit function for a single processing firm *i* in the destination market can be written as follows:

$$\pi_i = [p(y) - k\varpi]y_i - c_i(y_i, w_H, w_L), \tag{4.2}$$

where c_i, the cost of processing, is a function of the firm's output, the unit costs of skilled labor, w_H, and the unit cost of unskilled labor w_L. The term $p(y) - k\varpi$ measures the dollar margin of processing per unit of processed good since $k\varpi y_i$ is by definition the cost of raw material.

To take into account the oligopsony hypothesis in the raw material market into the model, it is common to specify the inverse supply function facing each firm in M as $\varpi = \psi(ky_i)^{\lambda}$. The parameter λ, which is nonnegative, is the inverse of supply elasticity and measures the degree of market power in the raw material market ($\lambda = 0$ under perfect competition). The parameter ψ is a constant representing a supply shifter.

After substituting the expression of ϖ into the profit function, the first and second order conditions for a profit maximization problem for a single firm i in group M are

$$[p(y) - k\varpi] - \lambda k\varpi + \frac{dp}{dy} y_i[1 + v_i^{'} + v_i] = c_i^{'}(y_i, w_H, w_L), \qquad \text{f.o.c} \qquad (4.3a)$$

and

$$2\frac{dp}{dy}[1 + v_i^{'} + v_i] + \frac{d^2p}{dy^2} y_i[1 + v_i^{'} + v_i]^2 + \frac{dp}{dy} y_i[\frac{d(v_i^{'} + v_i)}{dy_i}] - \lambda(1+\lambda)k\frac{\varpi}{y_i} - c_i^{''} < 0 \text{ s.o.c}$$

(4.3b)

where the v's are conjectural variation parameters.[9] More specifically, the term $v_i^{'} = \sum_{i'=1}^{m} \frac{dy_{i'}}{dy_i}, (i \neq i')$ indicates firm i's beliefs of the output decision from the rest of the firms in group M in reaction to a change in firm i's output level.[10] Similarly, $v_i = \sum_{j=1}^{n} \frac{dy_j}{dy_i}$ indicates firm i's beliefs of the output decisions from firms in the group N in reaction to a change of firm i's output level.[11]

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[9] Solving equation (4.3a) for y_j gives the reaction function for j, $y_j = f(\Sigma yi, p, p', c_d)$ whose derivative with respect to y_i is the conjectural variation of i about j which can be written as $v_{ij} = df(.)/dyi$.

[10] In a Cournot model, amongst M's firms, which is not very likely, $v' = 0$.

[11] In a Stackelberg or quantity leadership model, v may take on different values determining various types of market structure; v is zero in a Cournot duopoly case.

Assuming that all exporting firms in group N respond (by reducing their outputs) in the same way to any of the M's firm output decision (for example, the case where the reaction function is linear in $y_M = \Sigma y_i$), then $v_i = v$ = constant (negative).

Multiplying both sides of the equation (4.3a) by $s_i = y_i/\Sigma y_i$, which is the volume share of output of firm i to total output of group M, and summing over all i yields the following expression:

$$\frac{p-k\varpi}{p} - \lambda k\frac{\varpi}{p} + \frac{1}{\eta}[(1+v)\mathrm{H}_M + \theta]s_M = \frac{1}{p}c'_M, \tag{4.4}$$

where s_M is the share of group M's output to total output y, η is the price elasticity of total market demand, $\mathbf{H_M}$ is the Herfindahl-Hirschmann index ($H_M = \Sigma_i s_i^2$), and θ is a parameter, $\theta = \Sigma_i s_i^2 v_i'$. In (4.4), $c'_M = \Sigma_i s_i c_i'$ is group M's marginal costs, which is assumed to be the sum of the weighted marginal costs of all firms in M (the shares are the weights), following the approach of Goldberg and Knetter (1999).

For firms in group N, the expression of the profit function for a single firm j is analogous to expression in equation (4.2). It is assumed, however, that group N's firms are price takers in the market for raw material. In this case, the first (necessary) and second (sufficient) order conditions for a profit maximization problem for a firm j are

$$\frac{p-k\varpi}{p} + \frac{1}{\eta}[1+\tau_j+\tau_j']s_j = \frac{1}{p}c_j' \qquad \text{(f.o.c)} \tag{4.5a}$$

and

$$2\frac{dp}{dy}[1+\tau_j+\tau_j'] + \frac{d^2p}{dy^2}y_j[1+\tau_j+\tau_j']^2 + y_j\frac{dp}{dy}[\frac{d(\tau_j+\tau_j')}{dy_j}] < 0, \quad \text{(s.o.c)} \tag{4.5b}$$

where s_j is the output share of firm j to total output y and the remaining variables and parameters are as defined earlier. The terms $\tau_j = \sum_{i=1}^{m} \frac{dy_i}{dy_j}$, and $\tau_j' = \sum_{j'=1, j \neq j'}^{n} \frac{dy_{j'}}{dy_j}$ respectively represent the reactions of all firms in M and the remaining n-1 firms in N to the change in output of the single exporter j.

At this stage, equations (4.1) and (4.4), the system of equations in (4.5), and the identity that $y \equiv \Sigma y_i + \Sigma y_j$ constitute a system of $n+3$ equations. Correspondingly, there are also $n+3$ unknowns: the n individual firms output in N and, total output in group M (y_M), total supply (Y), and the market price (p). Therefore, there could be a solution to the problem from which the market shares can be written as:

$$s_j = s_j (\mathbf{H_M}, w_{Hj}, w_{Lj}, w_{Kj} w_{HM}, w_{LM}, w_{KM}, \varpi, p', I; \eta, \lambda, \tau, \tau', \nu, \nu', \theta). \quad (4.5b)$$

Using the above share equation, the main interests in this study lie in measuring the impacts on the market shares of market concentration represented by the Herfindahl-Hirschmann index ($\mathbf{H_M}$), on the one hand, and the impacts of the level of factor endowments (including human capital), represented by the relative input costs, on the other hand. However, a functional form of the above equation is needed in order to estimate these effects.

Functional Forms of the Share Equations

Choosing a functional form of the above market shares relies on the assumptions on the specification of the marginal cost of processing and the demand for processed good equation. To derive the expression of marginal cost, this study chose a linear approximation of cost function derived from a generalized Leontief production function,

which has been used often in conjectural models and empirical studies of industrial organization (Diewert 1973; Applebaum, 1982). Under such an approximation, cost and marginal cost are linear functions of the input prices and the square roots of the product of all pairs of input prices. This linear approximation will ease parameter estimation. The general expression of the short-run cost function for all home and foreign firms is:

$$c = y\left(\alpha_H w_H + \alpha_L w_L + \alpha_K w_K + 2\alpha_{HL}\sqrt{w_H w_L} + 2\alpha_{HK}\sqrt{w_H w_K} + 2\alpha_{KL}\sqrt{w_K w_L}\right), \qquad (4.6)$$

where the w's are the input prices, the α's are non-negative parameters (α_H, α_K, $\alpha_L > 0$ and α_{HL}, α_{HK}, $\alpha_{KL} \geq 0$). The subscripts H, K, and L respectively refer to the three inputs employed in the processing: skilled labor, unskilled labor, and physical capital. Here, the subscripts i and j are dropped, assuming that all firms have similar cost structure but different parameters. The corresponding expression of the marginal cost is:

$$c' = \alpha_H w_H + \alpha_L w_L + \alpha_K w_K + 2\alpha_{HL}\sqrt{w_H w_L} + 2\alpha_{HK}\sqrt{w_H w_K} + 2\alpha_{KL}\sqrt{w_K w_L} \qquad (4.7)$$

After substituting the expression of marginal cost in equation (4.7) into each individual equation in (4.4) and (4.5), and multiplying both sides of the equations by the quantity, p/w_L, the following expressions are obtained:

for each firm j in N

$$\frac{p}{w_{Lj}} s_j = D_j\alpha_{Lj} + (-D_j)\left(\frac{p - k\varpi}{w_{Lj}}\right) + D_j\alpha_{Hj}\left(\frac{w_{Hj}}{w_{Lj}}\right) + D_j\alpha_K\left(\frac{w_{Kj}}{w_{Lj}}\right) + 2D_j\alpha_{HLj}\left(\frac{w_{Hj}}{w_{Lj}}\right)^{1/2} + 2D_j\alpha_{KLj}\left(\frac{w_{Kj}}{w_{Lj}}\right)^{1/2} + 2D_j\alpha_{HKj}\left(\frac{w_{Hj}}{w_{Lj}}\frac{w_{Kj}}{w_{Lj}}\right)^{1/2}, \qquad (4.8)$$

for the group of firms M,

$$\frac{p}{w_{LM}}s_M = B\alpha_{LM} + (-B)\left(\frac{p}{w_{LM}}\right) + B(1+\lambda)\left(\frac{k\varpi}{w_{LM}}\right) + B\alpha_{HM}\left(\frac{w_{HM}}{w_{LM}}\right) + B\alpha_{KM}\left(\frac{w_{KM}}{w_{LM}}\right) + 2B\alpha_{HLM}\left(\frac{w_{HM}}{w_{LM}}\right)^{1/2}$$
$$+ 2B\alpha_{KLM}\left(\frac{w_K}{w_L}\right)^{1/2} + 2B\alpha_{HKM}\left(\frac{w_{HM}}{w_{LM}}\frac{w_{KM}}{w_{LM}}\right)^{1/2},$$
(4.9)

$$\text{where } B = \frac{\eta}{[(1+\nu)\mathrm{H}_m + \theta]}, \text{ and } D_j = \frac{\eta}{[1+\tau_j + \tau_j']} \text{ for } j = 1, 2, 3, \ldots, n. \quad (4.10)$$

The multiplication of both sides of the equation by p/w_L makes the input costs relative to the wage rate for unskilled labor appear on the right hand side of the share equation in (4.8) and (4.9). These relative input costs, especially for the ratio w_H/w_L, will be important for estimation purposes as they reflect the level of skill (human capital) employed. On the other hand, the expressions on the left-hand side of the eq. (4.8) and eq. (4.9) can be viewed as the individual firm's output value relative to the total output valued at labor cost. The expressions also can be viewed as the weighted market share, using the ratio output price to labor cost, p/w_L, as the weight.[12]

Recall the following identity, which is necessary for finding solutions:

$$s_M + \Sigma_j s_j \equiv 1. \quad (4.11)$$

Taking the logarithm of both side of equation (4.1b), the demand for the processed good can be written as:

$$\log y_t = a + \eta \log p_t + \kappa \log p_t' + \mu \log I_t. \quad (4.12)$$

[12] This has some meanings in the estimation in that it reduces heteroskedasticity problem in the system of equations. In fact, the weight is smaller for countries with high labor cost and large market share like the U.S. than for other countries with small share and low labor costs.

Theoretically, the share equations (4.8) and (4.9), the identity equation (4.11) and the demand equation (4.12) form a system of $n+3$ simultaneous equations. Since there are $n+3$ unknowns, which are the $n+1$ shares, the price p, and the output y, a set of solutions for the system can be found.

Comparative Statics

From the total differentiation of eq. (4.8), the derivative of the share s_j with respect to the ratio w_H / w_L determines the impacts on market share of the level of labor skill, proxied by the relative wage of skilled labor w_H / w_L and written as:

$$\frac{ds_j}{d\left(w_{Hj}/w_{Lj}\right)} = D_j \frac{w_{Lj}}{p}\left(\alpha_{Hj} + \alpha_{HLj}\left[\frac{w_{Hj}}{w_{Lj}}\right]^{-1/2}\right). \tag{4.13}$$

The sign of the derivative in (4.13) depends on the value of the estimates of B, and D_j (the α_H's have to be nonnegative) in each case,Solving for s_j in (4.8) and for s_M in (4.9) and taking the ratio of the two shares leads to the expression of s_j / s_M, (which is the same as y_j / y_M), which represents the output share of j relative to M. The derivative of the relative share with respect to λ measures the impact of the degree of oligopsony in the raw material market on the relative shares.

$$\frac{d(s_j / s_M)}{d\lambda} = \frac{D_j}{B}\frac{(p - k\varpi - c_j')}{(p - k\varpi - c_M' - \lambda k\varpi)^2} k\varpi . \tag{4.14}$$

Similarly, the derivative of the relative share s_j/s_M with respect to $\mathbf{H}_M$ measures the impact of industry concentration in the processed good market on j' s relative shares.

$$\frac{d(s_j / s_M)}{d\mathrm{H}_M} = \frac{D_j(1+v)}{\eta}\frac{(p - k\varpi - c_j')}{(p - k\varpi - c_M' - \lambda k\varpi)}. \tag{4.15}$$

The signs of these derivatives also depend on the values of the estimated parameters and mostly on the conjectural variation parameters, B and D_j.

Signs of the Conjectural Variation Parameters

The expressions (4.12) through (4.15) particularly show that the reactions of competitors of a firm subsequent to the firm's output decision theoretically play an important role in determining the direction and the extent of the impacts of market structure and level of skill on market shares. The sign of parameter B is difficult to assess in advance; hence, the signs of the expression in (4.12) and (4.14) become difficult to predict. However, the signs of the parameters D_j and$v(=v_i)$ related to equations (4.13) and (4.15), which are the aims of this chapter, can be discussed.

Given that the price elasticity of demand η is negative, the sign of D_j, as defined in (4.10), depends on τ_j and τ_j'. The second order condition in (4.5b) tells little about the signs of these two terms. However, it is not unrealistic to assume that they are negative as firm j believes that when it reduces its output, its competitors will all increase their outputs. It is likely that if there are many firms in the industry, the combined increase in output from the competitors will be more than the decrease in the small firm j's output so that the sum $\tau_j + \tau_{j'}$ may exceed one in absolute value. Also, firm j must be an important firm (e.g. larger than other firm in N but not necessarily larger than firm in M) to induce such a response from its competitors. If this is the case, D_j is going to be positive, otherwise, D_j is negative. A positive D_j means, according to equation (4.13), that an increase in the level of skill will increase the relative market share of j.

Besides, after making the series of assumptions in industrial organization literature that (i) d^2p/dy^2 is positive (convex demand curve or constant elasticity), (ii) the marginal costs and the conjectural variation parameters are constant and does not depend on the level of output, a sufficient (not a necessary) condition for the second order condition in (4.3b) to hold is that $vi + v_i' > -1$. Also, it is not unrealistic to assume that both v_i and v_i' are negative as a decrease in firm i's output will entice its competitors to increase their outputs, especially if i is a large firm. Under these assumptions, the absolute values of the conjectural variations, v_i and v_i', should not exceed *1*. The rationale is that if firm i is a large firm, it believes its competitors will not have the capacity to match the amount of output it may take away from the market. This implies that $1+v$ $(=1+v_i)$ would be positive.

Given that the price elasticity of demand η is negative, the case where both D_j and $1+v$ are positive would indicate that the level of concentration among M firms will reduce the relative market share of firm j, according to equation (4.15) . In other words, for a firm j, the high capacity of the concentrated firms in M $(1+v > 0)$ compared to other firms in N and the more than proportionate response to j's change in output from its competitors can explain why j's market shares decline as the firms in M become more concentrated.

4.2 Implementation of the Model on Trade

From this part onward, each individual firm in group N is considered as a single country exporting the processed good to developed country's market where group M is located. Such consideration of a firm in N to represent a country is not an unrealistic

assumption because in many industries the output value of a single firm in developed country is often far larger than total export revenue from a given product of firms in one of the developing countries. Also, exports of processed agricultural goods from developing countries are often operated by very few and concentrated firms (Bigsten et al., 2000).

The system of equation (4.8), (4.9), the identity (4.10) and the demand equation (4.18) form a system of $n+3$ equations that can be solved simultaneously using econometrics method and taking into account error terms in each equation. The parameters of interest are η, κ, μ, B's, and D's. These parameters are directly estimated using the above system of equations. Values of parameters θ, λ, ν, and the τ's are determined using the values of the estimates of B's and D's. The main restrictions on the parameters are that $\alpha_H, \alpha_K, \alpha_L > 0$ and α_{HL}, α_{HK}, and $\alpha_{KL} \geq 0$.

It is not, however, within the reach of this study to include all n exporters of a product in the model. Therefore, the shares do not add to one as information from some countries is missing so only the largest ones are included. The parameters of the system of equation are estimated using seemingly unrelated regression (SUR) method.

To reduce measurement errors that may be included in the spread between input and output prices, geography is taken into account, with transportation cost. Transportation cost is defined as the cost of transport per unit of distance and per unit of volume, tr, times the distance between the exporting country's border and the country $\mathcal{M}$'s border, d_j, times the volume of processed good exported y_j. The marginal transportation cost becomes $d_j * tr$. Assuming that tr, the unit transportation cost is the

same for all countries (but may vary per period), the relevant variable that enters the model is d_j, the exporting country's distance with respect to the border of country $\mathcal{M}$.

Taking into account these assumptions and remarks, and adding time period subscript in each variable and an error term u in each of the equations, the equations to be estimated include the following:

for each exporting country j in group N:

$$WSHARE_{jt} = \gamma_{0j} + \delta_{jt} DIST_{jt} + \gamma_{1j} SPREAD_{jt} + \gamma_{2j} SKILL_{jt} + \gamma_{3j} CAPITAL_{jt} + \gamma_{4jt} (SKILL_{jt})^{1/2} + \gamma_{5jt}(CAPITAL_{jt})^{1/2} + \gamma_{6j} (SKILL_{jt}*CAPITAL_{jt})^{1/2} + u_{jt}; \quad (4.8a)$$

for firms in group M:

$$WSHARE_{Mt} = \gamma_{0M} + \gamma_{1M} (POUT)_{Mt} + \gamma'_{1M} (RAWCOST) + \gamma_{2M} SKILL_{Mt} + \gamma_{3M} CAPITAL_{Mt} + \gamma_{4M} (SKILL_{Mt})^{1/2} + \gamma_{5M} (CAPITAL_{Mt})^{1/2} + \gamma_{6M} (SKILL_{Mt}*CAPITAL_{Mt})^{1/2} + u_{Mt}; \quad (4.9a)$$

and the demand equation in country $\mathcal{M}$:

$$LY = a + \eta\, LPOUT + \kappa\, LPOTH + \mu\, LINCOME + u_{yt} \quad (4.11a)$$

The variables of the empirical model are described in tables 4.3.

By comparing (4.8) to (4.8a), and (4.9) to (4.9a), we have the following relationships for the parameters that this study is interested in:

$$D_j = -\gamma_{1j};\ B = -\gamma_{1M};\ \text{and } B(1+\lambda) = \gamma'_{1M}\ , \text{ or } \lambda = -((\gamma'_{1M}/\gamma_{1M}) + 1). \quad (4.16)$$

Table 4.3 Description of the Variables in the Model

Name	Description
WSHARE	Weighted market shares, $s(p/w_L)$
DIST	Distance between the borders of the exporting country and the importing country $\mathcal{M}$
SPREAD	Spread between the unit price of processed good and the cost of raw material to make one unit of processed good, all relative to wage for unskilled labor, $(p-k\varpi)/w_L$
SKILL	Ratio of industry wage relative to the wage for unskilled labor, w_H/w_L
CAPITAL	Ratio of rental price of capital relative to the wage for unskilled labor, w_R/w_L
RAWCOST	Ratio of the cost of raw material to make a unit of processed good to the wage of unskilled labor ϖ/w_L
LY	Log of total market demand
LPOUT	Log of output price
LPOTH	Log of the price of other related goods
LINCOME	Log of income

4.3. Data and Estimation

Because of data availability, the U.S. is chosen to represent the country $\mathcal{M}$, the destination market where the group of firms M is located. The group of countries in N includes the main sources of the U.S. import.[13] These countries include developing countries producers of the raw material. Other remaining supplying countries are not included because they have only very small market shares or that data are not available for certain years. The data are quarterly and cover the period 1989: I-1999: IV.

Products and the Exporting Countries

This chapter covers two processed cocoa products both included in SIC 2066: (i) non-defatted cocoa paste (or cocoa liquor) non-defatted; and (ii) cocoa butter. For cocoa paste, exporting countries with their respective shares of the U.S. import market in 1999

[13] The study includes some of the top 7 or 8 exporters largest exporters of the processed good including those who do not produce the raw material. These countries cover more than 80 percent U.S. imports for these products.

include Canada (31 percent), Côte d'Ivoire (31 percent), Ecuador (8 percent), Brazil (5 percent), and The Netherlands (4 percent).

For cocoa butter, exporting countries with their respective shares of the U.S. import in 1999 include Malaysia (25 percent), Indonesia, (24 percent), Ecuador (8 percent), Brazil (6 percent), Cote d'Ivoire (6 percent), Columbia (3 percent), Mexico (3 percent) and The Netherlands (less than one percent). The transformation coefficients for cocoa paste (non-defatted) and cocoa butter are respectively $k = 1.25$ and $k = 2.67$ according to the International Cocoa Organization (ICCO).

Prices and Wages Data

Prices of the processed products generally are the U.S. wholesale prices of the manufactured product (chocolates and cocoa products). Labor prices were collected from the United Nations Yearbook of Industrial Statistics for the exporting countries and from the U.S. Bureau of Census for the United States. However, for some exporting countries, wage rate data for the processing sector under consideration were available (e.g. roasting coffee for Sweden). For other countries, such as Brazil, Kenya, and Indonesia, wage rates had to be based on the average wage in the food and beverage (two-digit ISIC codes) industry. For all countries, the cocoa industry wage and wage in the wearing apparel industry (in the textile industry), respectively, are taken as the proxy for the wage of skilled and unskilled labor.[14]

[14] Use of nominal wage may lead to misinterpretation since two workers who have the same qualifications but work in two different countries may have very different wage rates converted into the same currency since labor is not mobile across countries.

The rental price of capital is taken as the real interest rate, which is calculated using the nominal market interest rate published in the *International Financial Statistics* published by the International Monetary Found (IMF).

Market Shares

The volume market shares are calculated as the ratio of the individual firm's supply to the total U.S. production and imports for a given product. The total U.S. production of roasted coffee, cocoa paste and cocoa butter are proxied as the equivalent amount in processed form of the U.S. import of raw material (green coffee and cocoa beans, respectively), taking into account inventories. The data on U.S. imports of the processed good and the raw material data by country of origin are mainly drawn from the USDA/FAS and from publications of exporting country governments.

Herfindahl Index

The U.S Manufacturing Census publications have only concentration ratios and Herfindahl indexes for census years 1987 and 1992. A few manufacturing industries have the indexes available for 1982. The concentration ratios and Herfindahl indexes appeared to have not changed much during those years.

Procedures and Estimation

The estimation employs EVIEWS econometric software program and is conducted separately for cocoa paste and cocoa butter. The theoretical specification was checked using joint and individual mean tests. Each equation was first estimated individually using ordinary least squares (OLS) method, but the results show mostly no

statistically significant coefficients and wrong signs for the few remaining significant coefficients. Some contemporaneous correlation among the error terms implied by events such as weather conditions or financial crisis, mostly, among developing countries exporters may exist. Moreover, we believe that these equations are part of the system of market shares equation. Therefore, we employ SUR method on EVIEW, which is an iterative process in two steps. OLS estimation is conducted and the residuals are saved to construct an estimated variance co-variance matrix, which is used to get EGLS estimates of the parameters and predicted values. OLS estimation using these predicted values of the dependent variable is again conducted and the residual are saved to construct another estimated variance-covariance to obtain new estimates. These steps are conducted repetitively until the parameter values are stable. The SUR estimation improves the fit and estimates were generally more significant and within expected range and sign compared to OLS estimates.

Also, in some equations, the time trend has to be included in the regression to improve the fit. Dummy variables are also employed to represent the variable *DIST,* which accounts for geography. *DIST* takes the value of "1" for countries sharing border with the U.S., "2" for other countries in Latin America, "3" for countries in Europe and "4" for countries in Africa. Moreover, the variable *LPOTH* for the cocoa paste and cocoa butter models is represented respectively by the log of the prices of cocoa butter and of cocoa powder.

4.4 Results and Interpretation

Cocoa Paste

The results for cocoa paste are summarized in Tables 4.4, which generally shows that most of the coefficients generally have the expected signs and within the expected magnitudes including the parameters of the demand equation.

The coefficients on *SPREAD* are all negative and significant for Canada, Côte d'Ivoire and Ecuador, which happened also to be the largest U.S. import sources. This indicates that as the gap between the prices of cocoa paste and cocoa beans relative to the wage of unskilled worker widens, these three countries would lose part of their weighted market shares. In other words, a relative increase in the cocoa industry margin would not benefit foreign exporters. Moreover, the negative and statistically significant values of the coefficient on *SPREAD* mean that the parameter D_j is positive, which implies that the higher the level of concentration of U.S. cocoa industry, the smaller the expansion of market share of these three countries export to the U.S. according to equation (4.15).

In theory, these negative and significant impacts of the level of concentration on weighted market shares and on relative market shares (associated with D_j being positive) of Canada, Côte d'Ivoire and Ecuador can be explained by the definition of the parameter D_j, in (4.10). The parameter D_j is positive for these three countries because the sum $\tau_j + \tau_j'$ is negative with an absolute value exceeding one, which means that the increase (decrease) in output of firms from each one of these three countries is matched by a more than proportionate reduction (increase) in output from all competitors. This may indicate that Canada, Côte d'Ivoire, and Ecuador constitute major competitors to all other supplying firms in the market. Therefore, any output decision by one of these three

Table 4.4 Cocoa Paste: SUR Estimates of the Weighted Market Shares and Demand Parameters

Variables		Brazil	Canada	Côte d'Ivoire	Ecuador	U.S.
Dep. Var.: WSHARE						
Intercept		88.098**	-0.012**	1.666	0.306	-1.026
		(2.144)	(-2.312)	(0.496)	(0.292)	(-0.344)
Time Trend		-0.001***	0.001***	0.003***	-0.002***	0.0005**
		(-3.499)	(5.601)	(3.174)	(-2.65)	(3.261)
SPREAD		-0.012	-0.017**	-0.044**	-0.036**	
		(0.624)	(-2.243)	(-2.416)	(-1.961)	
POUT						0.967**
						(14.140)
RAWCOST						-0.98*
						(-1.890)
SKILL		60.762**	-0.0002	-1.235	0.473	0.188
		(2.143)	(-0.038)	(-0.584)	(0.808)	(0.155)
CAPITAL		-0.000	-0.006	0.028*	0.0008	-0.065
		(-1.445)	(-1.330)	(1.949)	(0.609)	(-0.937)
$(SKILL)^{1/2}$		-146.289**		0.57	-0.693	0.404
		(-2.143)		(0.114)	(-0.473)	(0.107)
$(CAPITAL)^{1/2}$		-0.00002		-0.948	0.094	1.407
		(-0.002)		(-1.642)	(1.116)	(1.416)
$(SKILL*CAPITAL)^{1/2}$		0.0004	0.015*	0.582	-0.083	-0.896
		0.04	(1.848)	(1.380)	(-1.351)	(-1.182)
Dep. Var.: LY						
LPOUT	-0.805**					
	(-2.924)					
LPOTH	-0.362**					
	(-3.393)					
LINCOME	0.527					
	(1.032)					
Nb. Observations:		44	44	44	44	44
Syst. R-Square: 0.94						

Note: *, **, and *** are levels of significance at 0.1, 0.05, and 0.01 respectively.

Explanation of the variables for the market shares are: *WSHARE* is ps/w_L, the weighted market shares; *SPREAD* is the quantity $(p-k\varpi)/w_L$, the spread between the unit price of cocoa paste and the cost of cocoa beans to make one unit of cocoa paste, all relative to wage for unskilled labor; *SKILL* is the ratio w_H/w_L, industry wage relative to the wage for unskilled labor; *CAPITAL* is the ratio w_R/w_L, rental price of capital relative to the wage for unskilled labor; *POUT* is the ratio p/w_L, price of output relative to the wage for unskilled labor; and *RAWCOST* is the quantity $k\varpi/w_L$, ratio of the price of raw material to wage of unskilled labor. Moreover, for the demand equations *LY, LPOUT, LPOTH* and *LINCOME* represent respectively, the logarithms of total demand, output price, price of other related products and income.

countries is not left unnoticed and provokes strong response from the rest of the other firms. It is not unreasonable to suggest that such a response reflects the behavior of large firms including U.S. firms, with large capacity given their size (and level of concentration) and some degree of control of the market.

A practical explanation of the negative relationship between the level of domestic concentration and market shares of exporting firms is that the degree of market power associated to the high levels of concentration enables U.S. firms to control the market price and quantity. So, as the industry margin is growing because of, say, a decrease in the prices of cocoa beans (which increases gap between the price of raw cocoa beans and prices of cocoa butter), the large concentrated firms with some degree of market power can expand their market shares, using strategy such as lowering price below the monopoly price to increase sale and market share, at the expense of the foreign exporters, without losing much of the industry profit. This strategy is often called limit pricing when the dominant firms can further lower the prices to deter entry of other firms in the market.

Also, because the coefficient on *POUT* is positive, the parameter B is negative, which means according to equation (4.14) that if the U.S. firms have oligopsony in the cocoa beans market, that will further reduce the relative market shares of Canada, Côte d'Ivoire, and Ecuador. Indeed, there is evidence, though weak, of oligopsony power. Using the relations in (4.16), a calculated value of λ, which is the elasiticity of the inverse supply curve facing U.S. importers of the raw cocoa beans, is 0.0134.

According to eq. (4.13) the negative signs of the coefficient on *SPREAD* (D_j is positive) also mean that as the level of skill (or labor productivity or human capital)

employed in cocoa industries in Canada, Côte d'Ivoire, and Ecuador increases, the market shares of the three countries relative to the U.S. firms market share would also increase. One reason why high labor skill may have an impact on the export shares for developing countries is that employing skilled labor could be cost-effective for the industries. Therefore, profits may increase and so does their ability to make their own strategy to attract consumers and increase market share for example, by lowering their price below the market price. However, as explained above, this effort may be hampered by the concentrated firms strategy.

The coefficients for the variables *DIST* (not reported), $(SKILL)^{1/2}$, $(CAPITAL)^{1/2}$, and $(SKILL*CAPITAL)^{1/2}$ generally are not statistically significant.

Cocoa Butter

Table 4.5 summarizes the results for cocoa butter. The coefficients on variable *SPREAD* are negative for most of the exporting countries and are statistically different from zero for relatively large exporter such as Indonesia, and also for The Netherlands. This implies that the increase in the gap between cocoa beans and cocoa butter prices relative to the wage of unskilled labor will reduce the weighted market shares of Indonesia, and The Netherlands. Also, these negative *SPREAD* coefficients imply that parameter D_j is positive for these two countries. As in the case of cocoa paste and using the definition in (4.10), positive D_j indicate that a decrease (increase) in output for relatively large U.S. import sources of cocoa butter like Indonesia will be matched by a more than proportionate increase (decrease) in output from all of its competitors (including the large and concentrated U.S. firms) combined.

Table 4.5. Cocoa Butter: SUR Estimates of the Weighted Market Shares and Demand Parameters

Variable	Brazil	Colombia	Côte d'Ivoire	Ecuador	Indonesia	Malaysia	Mexico	Netherlands	U.S.
Dep. Var: WSHARE									
Intercept	277.449	0.041	-15.492***	2.771	18.967	1.358	-7.183	-0.72	-10.152
	(1.320)	(3.110)	(-3.077)	(0.606)	(1.008)	(0.493)	(-1.137)	(-1.292)	(-0.863)
SPREAD	0.055	-0.008	0.033**	-0.02	-0.154***	-0.044	-0.026	-0.023***	
	(0.936)	(-1.312)	(1.937)	(-0.832)	(-3.701)	(-0.966)	(-1.509)	(-3.243)	
POUT									0.732***
									(6.224)
RAWCOST									0.003
									(0.038)
SKILL	187.364	0.083**	-4.09	3.361**	15.008	0.66	-4.703	-0.452	-10.484***
	(1.289)	(2.966)	(-1.264)	(1.962)	(0.996)	(0.467)	(-1.065)	(-1.226)	(-2.128)
CAPITAL	-0.001	0.006***	-0.068***	0.001	0.003	0.004	-0.0004	0.005	-0.458
	(-1.339)	(4.253)	(-3.213)	(0.241)	(0.797)	0.04	(-0.188)	(0.636)	(-1.686)
$(SKILL)^{1/2}$	-455.843		16.557***	-6.547	-34.433	-1.973	11.63	1.149	21.677
	(-1.304)		(2.188)	(-1.217)	(-1.026)	(-0.522)	(1.102)	(1.263)	(0.154)
$(CAPITAL)^{1/2}$	-0.008		2.738***	0.471	-0.092	-0.179	0.182	0.015	-9.527**
	(-0.156)		(3.205)	(1.767)	(-0.237)	(-0.273)	(1.667)	(0.190)	(-2.820)
$(SKILL*CAPITAL)^{1/2}$	0.008	-0.046***	-1.698***	-0.341**	0.117	0.213	-0.139	-0.021	7.371**
	(0.197)	(-3.601)	(-2.737)	(-1.958)	(0.319)	(0.257)	(-1.634)	(-0.381)	(2.845)
Dependent variable: LY									
LPOUT	-0.354***								
	(-2.352)								
LPOTH	-1.029***								
	(-4.861)								
LINCOME	1.084								
	(0.977)								

Note: *, **, and *** next to figures are the levels of significance at 0.1, 0.05, and 0.01 respectively. Figures in parentheses are *t*-values. Variable names are explained in Table 4..3.

Moreover, positive D_j, according to equation (4.15), suggests that the more concentrated the U.S. industry is, the smaller the market shares of countries such as Indonesia and the Netherlands are. As before, one explanation is that a high degree of market power associated with high levels of concentration enables U.S. firms to control the market price and quantity. In this case, strategy such as limit pricing, which consists of lowering price to keep and to increase market share without losing much of the profit, can lead to the expansion of concentrated firms market shares at the expense of competitors' market share. The results also show that the coefficient on *POUT,* for the U.S. is positive and statistically significant. This again suggests the dominance of concentrated U.S. firms because as the price of cocoa butter relative to the wage of unskilled labor increases, the weighted market shares of U.S. firms will increase. The negative coefficient on *SPREAD* (thus, positive D_j), also implies that as the levels of skill employed in cocoa processing in Indonesia and The Netherlands increase, so do their market shares according to equation (4.13). As before, a possible explanation of the effects of the use of high labor skill on the export shares for developing countries is that the use of skilled labor may cut marginal cost and increase per unit profits. This will allow firms to attract consumers and increase market share for example, by slightly lowering their price below the dominant firm's price or by investing in advertising.

The coefficient on *SPREAD* for Côte d'Ivoire is positive and significant at the 10 percent level, implying that the weighted market share of Côte d'Ivoire will likely increase with the gap between the prices of cocoa butter and the price of cocoa beans increases. This result is puzzling given that Côte d'Ivoire, although a large cocoa bean exporter to the U.S., is not a large cocoa butter exporter. However, the level of

significance is not as pronounced as for the other countries. Besides, the coefficient for the variables *DIST* (not reported) was not significant.

Conclusion and Implications

This chapter has estimated the impacts on individual exporting countries market shares of the level of concentration represented by the Herfindahl index, and the level of labor skill employed, which is indexed by the ratio of industry wage rates to the wage of unskilled labor in manufacturing. The model in this chapter is developed upon basic conjectural variation theories applied to international trade. The cases of the U.S. import market of cocoa paste and cocoa butter are examined. The model employed generally predicts well and can explain the role of market concentration and level of labor skill on the exporters market shares based on conjectural variation parameters.

The results indicated that the high level of U.S. firms concentration does limit the expansion of exports from foreign firms form developing countries to the United States. The reason is that concentration implies large capacity and some degree of market power. In general, concentration may arise from economies of scales, or from regulation or merger among the few large firms, or trade barriers. Because of the link between concentration and market power, the few concentrated firms have the ability to choose prices and quantity and earn profits, regardless of what may have caused concentration. In fact, in the markets of cocoa butter and cocoa paste where a high percentage of total supply is controlled by very few domestic and established firms, it is reasonable to believe that these firms have some degree of market power.

The channel through which concentration affects the market shares can be explained by the idea that few concentrated firms can impose capacity barrier by using part of the profit to improve distribution system, and services to attract more buyers at the expense of foreign firms. Moreover they can also do limit pricing which is to lower the price enough below monopoly price and close to competitive price to keep away consumers from the fringe firms.

Also, in many exporting countries, the level of skill employed is positively related to export shares. These impacts on market shares of the level of concentration and level of skill affect mainly the main sources of U.S. imports (and main competitors to U.S. firms) such as Canada, Côte d'Ivoire and Ecuador for cocoa paste and Indonesia for cocoa butter.

As an implication, claims that taxes and tariffs escalation are the only major impediments to export promotion often overshadow the role of market structure and the lack of use of skilled labor in manufacturing for small open countries. Despite trade policies to facilitate market access, such as the African Growth and Opportunity Acts (AGOA) for Sub-Saharan African countries or the projected Free Trade Agreement of the Americas (FTAA) to countries in Latin America, there are cases where exports still could be very limited because of the market structure and lack of skill and low labor productivity in these countries. Also, if the large food processors in developed countries increase their cooperation (e.g. information sharing) or merge, the export shares of the firms from developing countries will further decline.

Moreover, because outside firms often have little or no influence to affect the structure of the local industries in developed countries, increasing the level of skill in the

industry's labor force could be one of the few alternatives for developing countries to improve their market shares. The use of high labor skill in developing countries industries could be cost-effective and could lead to increased profits. This will allow these firms to slightly lower their price below the dominant firm's price and to attract consumers and increase export shares.

The study to this point has assumed that processed products are homogenous, which is rarely the case in food processing. This is one of the limitations of the model. In fact, products differentiated by firms and by country of origin are common in food processing. Product differentiation offers more opportunities and challenges for potential entrants in an industry in terms of investment other than labor training. Moreover, market structure still plays an important role, but is defined by an individual firm's effort to distinguish its product from other competitors and to expand its market share. The next chapter will address this issue.

Chapter 5: Export of Differentiated Products and the Roles of Factor Prices, and Fixed Costs

Introduction

For a small country producer and exporter of raw agricultural products, expanding the share of processed exports is an important step for capturing more value-added and offsetting the losses from the declining prices of the raw agricultural products in the world market. Developed countries are major producers and consumers of processed agricultural commodities, but access to these markets is very limited. Moreover, processing of raw agricultural commodities in developed countries is often concentrated in only a few firms. The previous chapter of this study showed that low input quality (low labor skill) and the level of concentration of local firms limits the ability of producers of raw materials to export processed commodities to the market. This conclusion, however, was drawn based on the assumption that processed products of the same type are homogenous and have a single price (i.e., different brands and packaging have no effect on price).

In reality, however, processed products are far from homogenous because of the quality of inputs, packaging, marketing services, and so on. In fact, the unit values of the processed products under the same classification (SIC 4-6 digit level) can vary significantly across importing country sources. For example, the U.S. unit import values of cocoa butter and cocoa powder from the Netherlands are higher than that of the same products from Côte d'Ivoire. Again, in the case of cocoa cake and cocoa butter in the U.S. market, The Netherlands and Canada have higher market shares than Indonesia or

Cote d'Ivoire. So the basic questions are: (i) Why do prices differ among sources? and (ii) Why do import shares differ? Answers to these questions from the literature include transportation costs, preferential trade agreements, and sanitary problems.[1] This chapter, however, focuses on the role of competitors input costs, and structural barriers linked to fixed costs to explain the difference in prices for differentiated processed products. As in the previous chapter, the context is the same, where many exporters are competing for an export market (the U.S. market) that is already dominated by local U.S. firms.

The objective of this chapter is to estimate the residual demand elasticity, indicative of the level of differentiation and market power, and the effects of competitors' input costs and fixed costs on the residual demand and market shares for developing countries exporting differentiated processed agricultural goods. This chapter focuses on the U.S. import markets for cocoa powder and roasted coffee for which, the U.S. market supplies are highly concentrated in U.S. firms, leaving only small shares of the market to exporting countries' firms. The U.S. import prices and market shares for cocoa powder and roasted coffee among sources are different and this research will investigate what causes these differences. This study will help determine some of the factors that impede the ability of developing countries like Brazil, Colombia, Côte d'Ivoire, Ecuador, Indonesia, and Malaysia to export more cocoa powder and roasted coffee to the United States.

[1] One problem comes from the difference in product contents that are not taken into account in commodity classification. For example, products under SIC 2066 (all cocoa products) imported by the U.S. from Switzerland have higher unit values than from other countries because Swiss products contain more chocolate (high value added) and less cocoa paste (lower value added) than others.

5.1 Overview of Theory and Model

Overview of the Theory

Under product differentiation, the two prominent theories that provide insight to how an individual firm can penetrate a market and expand its sales are the theory of monopolistic competition (Chamberlin, 1934) and "love for variety" (Dixit and Stiglitz, 1977). These theories basically suggest that if a firm produces a distinct product (i.e., differentiated from other products of the same type) and if consumers are better off with more varieties in the market, then such a firm will have market power. Rosenberg (1976) and Scherer (1980) indicated that firms with low market power have a strong incentive to innovate and invest in R&D in order to expand their market shares.

Many theoretical and empirical studies have examined the factors that make a firm's product distinct so that the firm can survive and expand its market. These factors include the firm's own variable and fixed costs, and input costs of its competitors (Spence, 1976 and 1979; Spencer and Brander, 1983; Baker and Bresnahan, 1988; Knetter and Goldberg, 1999). Kravis and Lipsey (1992) demonstrated the positive links between U.S. firms export shares and the levels of human capital and R&D. In particular, Sutton (1991) and Röller and Sickles (2000) have explained and empirically tested the theory that market structure can determined endogenously by new entering firms.

The monopolistic competition model (Chamberlin, 1934) is considered as the model between the monopoly and the perfect competition models. The main thrust of the theory is that firms within an industry produce different varieties of the same type of product, such as different brands of roasted coffee or bars of chocolates. There is an

aggregate market demand facing the industry, but each firm may face a different and a steeper demand curve (the "*dd*" demand in Chamberlin's words) than industry demand as its product is distinct from other products of the same type. In this case, each firm becomes a "little" monopolist and earns positive profits. As a result, the industry has a positive profit in aggregate. The positive industry profit, however, attracts new firms that continue to enter until a last (or the marginal) firm breaks even. As a result, the profit for all firms and for the industry is zero in equilibrium.

Spence (1976) emphasized that fixed costs play an important role in defining market structure, especially in the case of the monopolistic competition model. The reason is simply that the zero-profit condition in equilibrium under the monopolistic competition model requires that price be equal to average cost. In the case where the firm has fixed costs, price has to be above marginal costs (and therefore above the competitive price) in order for the firm to produce any output. In other words, the monopolistic power of a firm selling its distinct variety of product at a price above the competitive price comes from the firm having fixed costs. This implies that fixed costs contribute to non-competitive pricing and induce firms to set prices above marginal costs. Similarly, fixed costs limit the number of varieties of product in an industry: only firms that can cover all variable and fixed cost can stay in the industry and produce their varieties of products.

On the demand side, Dixit and Sitglitz (1977) introduced different forms of consumer utility functions formalizing the idea that consumers prefer more, rather than less, variety of a particular product. In order to study welfare under product differentiation and monopolistic competition model, (The Dixit and Stiglitz model has

been dubbed the "love for variety" approach). Simultaneously, the monopolistic competition and the "love for variety" theories imply that even when there are structural barriers in a market (e.g. high concentration of incumbent firms), an individual firm (new entrant) may always have a chance to penetrate the market as long as its product is distinct from other products of the same type. Such an important implication, however, has not been explored much in international trade literature related to export promotion in developing countries. Furthermore, theoretical studies related to product differentiation in the field of industrial organization indicate that the demand (or residual demand) facing a firm and the firm's market shares depend also on the input costs of the firm's competitors as these costs affect the total industry supply (Caves and Porter, 1978; Baker and Bresnahan, 1988).

Outline of the Model

The model involves a market for a number of varieties of product Y in a country where consumers have the Dixit-Stiglitz type of preference. Two different groups of firms, M and N, supply the product y to the market. The group M consists of m symmetric (identical) home firms located in the country, while the group N consists of n different firms exporting to the country. Each of the $m+n$ firms produces a single variety of Y, and each variety of Y is produced by only a single firm. Therefore, there are $m+n$ differentiated products in the model. The focus is on a single exporting firm j in group N. Three different steps are considered.

(i) First, the "residual demand" function for the exporting firm *j* is specified, following the work of Baker and Bresnahan (1988). The term "residual market demand" is commonly defined in the literature as the demand perceived (or faced) by an individual firm in an industry. The residual demand for *j* is the total market demand subtracted by the total output of all suppliers other than *j*. Therefore, the residual demand facing *j* is a function of many variables, including the export prices and the factor input costs of all of *j*'s competitors. Estimation of the residual demand parameters will lead to the measurement of the price elasticity of the residual demand and the measurement of elasticities of residual demand with respect to the factor costs in all of *j*'s competitors. On the one hand, the price elasticity of the residual demand is indicative of *j*'s level of market power: the more distinct *j*'s product is, the less elastic is the demand it faces.[2] The residual demand elasticity of *j* is a function of the price elasticity of total market demand, the market shares of all firms, and the supply elasticity of *j*'s competitors. Under perfect competition, the residual demand is flat and the inverse of residual demand elasticity is zero, indicating that the firm has no market power. On the other hand, the elasticity of the (inverse) residual demand with respect to the factor costs of *j*'s competitors measures the impacts of *j*'s competitors input cost on *j*'s exports. An increase in input costs for *j*'s competitors is expected to depress their supply curves and therefore will shift *j*'s residual demand upward.

[2] Andersen and Rynning (1991) reported that high market shares or concentration levels do not always mean high degree of market power. A similar comment was made by Roberts (1984) for the U.S. coffee roasting industry.

(ii) Second, under the assumption that products are differentiated by source, the first order condition of j's profit maximization problem is specified. The parameters of this first-order condition, which is also called the supply relation, capture the interaction among all firms or conjectural variations. In equilibrium, a zero-profit condition is imposed. This will relate the market share of j to the levels of the fixed costs of j and of its competitor.

(iii) Third, the residual demand, the supply relations, and the export share of the exporter j are combined to form a system of equations and estimate the parameters using econometric methods. The theoretical and empirical models in this part of the dissertation are shown in detail in the following sections, 5.2 and 5.3.

5.2. Model Specification

A market for a number of varieties of a product y is considered in a country $\mathcal{M}$ where consumers have Dixit-Stiglitz type of preferences. Two different groups of firms in M and N supply the product y to the market. The group M consists of $i = 1,2,3, \ldots m$ symmetric home firms located in the country $\mathcal{M}$, while the group N consists of $j = 1,2,3, \ldots n$ different firms exporting to the country $\mathcal{M}$. Each firm i in M ($i = 1, 2, 3, \ldots, m$) or firm j in N ($j = 1, 2, 3, \ldots, n$) produces only a single variety of y, and each variety is produced by only a single firm. Therefore, there are $m+n$ differentiated products (or varieties of product) in the model. The objective of this section is to present a model that allows estimation of the elasticity of the residual demand facing an individual exporter j

and estimation of the impacts of own and cross-factor prices and fixed costs on the demand and revenue of an individual firm j.

Demand for Differentiated Products

The utility of a representative consumer in $\mathcal{M}$ is assumed to be a function of the amount consumed on different varieties of good y from $m+n$ sources and the amount consumed on all other goods, q_0. Using the constant elasticity of substitution specification (Spence, 1976; Dixit and Stiglitz, 1977), the consumer utility function is

$$U = U\left(q_0, \left\{ \sum_i^m y_i^\rho + \sum_j^n y_j^\rho \right\}^{1/\rho} \right)$$

where y is the amount of good (from now on, we refer to y as the quantity of good y) and the subcript on y indicates the variety. The parameter ρ measures the degree of substitution between each pair of variety of products; ρ is assumed to belong to the interval $0 < \rho < 1$. A value of ρ close to one means that each variety is almost a perfect substitute to another variety.[3]

The representative consumer is spending total income I, where $I = q_0 + \Sigma p_i y_i + \Sigma p_j y_j$, in a two-stage budgeting process. First, income is allocated between all goods y and good q_0, then the amount spent on good y is split among the $n+1$ different varieties (details of the derivation are shown in Appendix C). After rearranging terms of the first order conditions of the utility maximization problem subject to the budget constraint, the demand for a single variety of product j is:

[3] In some studies, the coefficient also is also indicative of the degree of competition of the market: a value close to one indicates near-perfect competition when producers face flat market demand.

$$y_j = I_y \frac{p_j^{1/(\rho-1)}}{\sum_{i=1}^{m} p_i^{\rho/(\rho-1)} + \sum_{j=1}^{n} p_j^{\rho/(\rho-1)}}, \quad \text{for } j = 1, 2, 3, \ldots, n, \tag{5.1a}$$

where $I_y = \Sigma p_i y_i + \Sigma p_j y_j$ is the income spent on good y. Equation (5.1a) shows that demand for y_j is a function of all prices and income and is homogenous of degree zero in all prices. The absolute value of the price elasticity of demand facing each firm (details provided in the Appendix C) can also be written as

$$\eta_{jj} = \frac{1}{\rho - 1}\left(1 - \rho \frac{p_j^{(\rho/\rho-1)}}{\sum_{i}^{m} p_i^{(\rho/\rho-1)} + \sum_{j=1}^{n} p_j^{(\rho/\rho-1)}}\right).$$

When the number of variety of products is large, the denominator of the last term inside the parentheses gets far larger than the corresponding numerator; the terms inside the parenthesis approach one and the price elasticity of demand facing an individual firm tends toward $1/(\rho-1)$ (Dixit and Stiglitz 1977; Helpman and Krugman, 1985).

Assuming that the expenditure on good y can be written as $I_y = Q^*P$, where Q and P are quantity and price indexes, a more familiar expression of (5.1a) is

$$y_j = Q\left(\frac{P}{p_j}\right)^{1/(1-\rho)} \tag{5.1b}$$

where $Q = \left(\sum_j y_j^{\rho}\right)^{1/\rho}$ and $P = \left(\sum_j p_j^{-\rho/(1-\rho)}\right)^{-(1-\rho)/\rho}$ (see the proof in Appendix C).

For what is needed in the next sections, equation (5.1a) can also be rewritten to express p_l as a function of firm l's own output, output prices for all the other firms, and l's expenditure:

$$p_l = D_l\,(y_l,\ p_1,\ p_2,\ p_3,\ \ \ldots\ p_{m+n-1},\ I_y), \tag{5.1c}$$

where $D_j(\cdot)$ is the inverse demand function.[4]

Supply of Differentiated Products

Specification of the profit function and derivation of the supply relations require a set of assumptions.[5] This study assumes that the cost function for any individual firm in M or N can be separated into cost of the raw material and cost of the processing activity. Moreover, the cost of processing is a function of output and the prices of labor and capital. The profit function for any firm l in group M or N is written as:

$$\pi_l = (p_l - \varpi k)y_l - c_l$$

where k is the amount of raw material to produce one unit of the processed good y, ϖ is the price of the raw material, and c is the cost function for the processing operation. (At this stage we are not yet concerned about separating the cost into fixed and variable cost). The price p_l in (5.1c) represents the inverse demand function facing an individual firm l.

As in Chapter 4 of the dissertation it is assumed that in the raw material market, firms in group M (the home firms) are oligopsonists and firms in group N are price takers. As in Stiegert, Azzam and Brorsen (1993), the supply of raw material facing a firm i in M can be specified as $\varpi = \psi\,(ky_i)^{\lambda}$, where the parameter λ (nonnegative) is the inverse of the price elasticity of supply, an indicator of the oligopsony power ($\lambda = 0$ under perfect competition). The parameter ψ is a constant (supply shifter). After substituting the expression of the inverse demand function in (5.1c) and that of the supply of raw material

[4] This follows the notation used by Bresnahan (1989).
[5] Hadar (1966) presented one of the pioneering models of product differentiation under oligopoly.

into the profit equation, the first order condition for profit maximization for a firm i in M is written as:

$$p_i - (1+\lambda)k\varpi + \left(\eta_{ii} + \sum_{i' \neq i}^{m} \eta_{ii'}\varepsilon_{i'i} + \sum_{j=1}^{n} \eta_{ij}\varepsilon_{ji}\right) p_i = c_i'(\omega^i), \text{ for } i = 1, 2, 3, \ldots, m, \qquad (5.2)$$

where ω is the vector of input prices in the processing activity, $\eta_{il} = \partial \ln D_l(\cdot) / \partial \ln y_i$ is the change in price for firm l in response to a change in firm i's output (η_{il} can also be called the inverse elasticity of demand of firm i with respect to output price of firm l) and $\varepsilon_{li} = \partial \ln p_i / \partial \ln D_l(\cdot)$ is the inverse of the firm l's change in output price in response to a change in i's output price.

The expression of the first order condition for profit maximization for a firm j in group N is analogous to equation (5.2) except that all n firms in N are assumed to be price takers when purchasing the raw material. The supply relations can then be written as:

$$p_j - k\varpi + \left(\eta_{ji} + \sum_{i=1}^{m} \eta_{ji}\varepsilon_{ij} + \sum_{j' \neq j}^{n} \eta_{ij'}\varepsilon_{j'j}\right) p_j = c_j'(\omega^j), \text{ for } j = 1, 2, 3, \ldots, n, \qquad (5.3)$$

where the parameters and variables are as explained above.

The expressions inside the large parentheses in (5.2) and in (5.3) are commonly called the inverse of the residual demand elasticities (hereafter denoted as η_i^R in (5.2) and η_j^R in (5.3)). In many studies, the inverse of the residual demand elasticity reflects the level of market power of a firm. Baker and Bresnahan (1988) and Goldberg and Knetter (1999) indicated that in the case of product differentiation, the (inverse of the) residual

demand elasticity of individual firm is directly related to price markup, an indicator of market power.[6]

Expression of the Residual Demand Equation for an Individual Firm

As one of the interests in this chapter is to estimate the price elasticity of the residual demand in order to infer the level of market power and the impact of factor prices on residual demand of an individual firm, an expression of the residual demand is needed. Using equations (5.1c), (5.2) and (5.3), this study follows the steps taken by Baker and Bresnahan (1988) to determine the equation of residual demand facing an individual firm j.

First, we consider a firm l, one of j's competitors, and a member of the group M or N. From (5.1c), the inverse demand for firm l can also be written as $p_l = D_l(y_l, p_j, \mathbf{p}^{l'}, Iy)$ where $\mathbf{p}^{l'}$ is a vector of prices for all firms other than firm l and j ($l' \neq l$ and $l' \neq$ j). Similarly, from (5.3) the (inverse) supply schedule for firm l can be written as $p_l = D_l(y_l, p_j, \mathbf{p}^{l'}, \omega^l, \varpi)$. Therefore, the equilibrium price for firm l can be written as:

$$p_l = D_l^*(p_j, \mathbf{p}^{l'}, Iy, \omega^l, \varpi), \text{ for all } l' \neq j \text{ and } l' \neq l. \tag{5.4a}$$

In (5.4a), the symbol (*) indicate the equilibrium value.

Second, we solve for the equilibrium prices and quantities for all l' firms (where $l' \neq l$ and $l' \neq j$) and replace $\mathbf{p}^{l'}$ in (5.4a) by its equilibrium prices vector. After substitution, the equilibrium price in (5.4a) for firm l can be rewritten as:

$$p_l^* = D_l^*(p_j, Iy, \omega^l, \omega^{l'}, \varpi)\ l=1,2,3...m+n, \text{ and } l' \neq l. \tag{5.4b}$$

[6] Baker and Bresnahan (1988) also argued that if a product is distinct from any other products of the same type, substitutability between the products are small; hence the reaction functions and conjectural variations are the same.

Note that all variables on the right hand side of (5.4b) are exogenous variables the price of j's output, consumer's expenditure on y, and the vectors of input prices from all other firms and price of raw material). Equation (5.4b) is also the general expression of the equilibrium price for all remaining firms, the l's.

Third, we replace all prices in the right hand side of (5.1b) by all equilibrium prices as expressed in (5.4b). The expression of the inverse demand equation for firm j becomes

$$p_j = p_j\ (y_j\ ,\ Iy,\ \omega^l,\ \omega^{l'},\varpi). \tag{5.5}$$

Equation (5.5) represents the inverse demand function of the residual demand and is the basis of the empirical estimation of the (inverse) of the residual demand elasticity facing an individual firm j. In particular, equation (5.5) shows that the residual demand is not a function of j's own firm input costs -- ω^j does not appear in (5.5) -- but rather a function of the input costs of all other firms, and of course, of the cost of the raw material.

Free Entry and Zero-profit Condition

Under product differentiation, the residual demand in (5.5) and the supply relation in (5.3) simultaneously determine the equilibrium price and quantity for firm j. So far, the equilibrium condition is independent of fixed costs. Spence (1976), however, indicated that theories of differentiated products and imperfect competition are associated with firm's fixed costs.[7]

[7] The impacts of fixed costs on the equilibrium output in conjectural variation models cannot be captured because fixed costs vanish after the derivation of the first order condition. Moreover, a firm's fixed costs are in reality unobservable and hard to define. As a result, the contribution of fixed costs to non-competitive pricing is more commonly cited in theoretical studies, such as Spence (1976) and Panzar (1989) but rarely included in empirical studies.

In an attempt to include fixed costs to explain why the shares and prices for differentiated products are different by sources, it is assumed that each firm, which are individual monopolists in selling their product, is forced to bring its profit to zero and operates just to cover its fixed costs. This may be somehow a strong assumption but nevertheless it is consistent with relevant theories related to imperfect market, such as the theory of monopolistic competition and the contestable market theory. The theory of monopolistic competition maintains that positive industry profits will actually encourage new entry until profits are zero. The contestable market theory argues that the mere threat of entry discourages monopolists or oligopolists from exercising their market power and eventually forces them to earn zero profits. In both cases, the zero profit condition is not an unrealistic assumption for firms producing differentiated products.[8]

A new firm willing to enter the market faces two choices: to produce the same variety as the existing ones or to create a new variety. We assume that the threat of a new competitor duplicating the variety already produced by an incumbent firm will force the incumbent firm to earn zero profits (unless the incumbent firm may be forced to seek to improve the quality of its product, leading to a new variety). In this case, duplicating the variety will not serve the interest of the potential entrant. Instead, the potential entrant firm is forced to produce a different variety than existing ones, and in turn, will keep its profit to zero in order not to attract a second potential entrant willing to duplicate its variety. As a result, independent of the number of firms, profits for each individual firm and the industry are zero in equilibrium. Such an explanation is also part of the vast

[8] Perry (1984) showed that for an industry with economies of scale, regulation that encourages competition by allowing entry until the industry profit is close to zero -- the so-called 'structural policy' - - could eventually be one of the options to reach social optimum.

number of theoretical and empirical studies of the monopolistic competition model, and the role of fixed costs in multi-stage games for entry (Shaked and Sutton, 1982; Sutton, 1991).

The zero-profit condition for any firm l in M or N is written as $(p_l - k\varpi)\, y_l - c_l = 0$. In addition, it is assumed that processing costs for l consist of fixed and variable costs and that the variable cost function is linearly homogenous in output: $c_l = (c'_l)y_l + \bar{c}_l$, where the bar on the c indicates the fixed processing cost.[9] Therefore, the zero-profit condition for a firm j can be expressed as:

$$p_l - k\varpi = c'_l + (\bar{c}_l / y_l), \tag{5.6}$$

Applying (5.6) to a firm i in M, substituting the processing margin $(p_i\text{-}k\varpi)$ of equation (5.2) to equation (5.6), and rearranging terms, the revenue for a firm i in group M is:

$$p_i y_i = -(1/\eta_i^R)\bar{c}_i + (\lambda_i / \eta_i^R)k\varpi y_i . \tag{5.7a}$$

Recall that η_i^R is the inverse of the residual demand elasticity for firm i. Equation (5.7a) shows that, assuming the inverse demand elasticity is negative, the revenue for an individual firm is positively related to fixed costs. Assuming that the m firms in M are symmetric (identical), the elasticity term in (5.7a) no longer depends on i. Summing both sides of equation (5.7a) over all i, the aggregate revenue for M can be expressed as:

$$\sum_i^m p_i y_i = -(1/\eta_M^R)\bar{c}_M + (\lambda / \eta_M^R)k\varpi y_M , \tag{5.7b}$$

where, $y_M = \Sigma_i y_i$ is the total output and $\bar{c}_M$ is the total fixed cost for the group M.

[9] Baumol, Panzar, and Willig (1982) emphasize on the distinction between fixed and sunk costs. They argued that fixed costs, unlike sunk costs, may still exist in the long run. With such an argument, we avoid the debate on long-run vs. short-run cost functions.

Analogously, applying (5.6) to a firm j in N, substituting the processing margin (p_j-$k\varpi$) of (5.3) to equation (5.6), and rearranging terms, leads to the following expression of the revenue of the firm j in N:

$$p_j y_j = -(1/\eta_j^R)\bar{c}_j, \; for\, j = 1, 2, 3, \ldots, n. \tag{5.8}$$

In (5.8), η_j^R is the inverse of the residual demand elasticity for firm j. Equation (5.8) shows that if the inverse of the elasticity of residual demand is negative then the revenue share for firm j (j's export revenue) is directly related to its fixed costs. It is important to note that from equation (5.6) onward, all prices and levels of output correspond to their equilibrium values. However, the same notation has been kept to avoid burdening the expressions.

Market Share of Individual Firm and Fixed Costs

One of the main interests in this chapter is to examine the impact of fixed costs on the revenue of a particular firm j relative to the share of the competing group of firms M. After dividing (5.8) by (5.7b), the ratio of firm j's revenue to group M's revenue can be written as

$$s_{j,M} = \frac{p_j y_j}{\sum_{i=1}^{m} p_i y_i} = \frac{-(1/\eta_j^R)\bar{c}_j}{-(1/\eta_M^R)\bar{c}_M + (\lambda/\eta_M^R)k\varpi y_M}. \tag{5.9a}$$

Equation (5.9a) shows that (provided demand elasticities are negative) the size of the revenue for an individual firm j relative to the group M's revenue increases with firm j's own fixed costs, but decreases with group M's fixed costs. Furthermore, dividing the denominator and the denominator of (5.9a) by $\bar{c}_M$, the revenue share becomes:

$$s_{j,M} = \frac{-(1/\eta_j^R)(\bar{c}_j / \bar{c}_M)}{-(1/\eta_M^R) + (\lambda/\eta_M^R)(k\varpi y_M / \bar{c}_M)}. \quad (5.9b)$$

Equation (5.9b) shows that the relative size of the revenue share of an individual firm j increases with its fixed cost relative to the competitor firm in M fixed cost. In addition, note that the term $k\varpi y_M$ corresponds to the value of raw material purchased by the group M. Therefore, equation (5.9b) indicates that the relative share of revenue of a firm j decreases as group M's ratio of fixed cost to the value of the raw material increases when its competitor has some market power in the market for raw material (λ is nonzero). This derivation is more straightforward than the approaches taken by Shaked and Sutton (1982) or Röller and Sickles (2000), which employs multi-stage games to determine the outcomes of the capacity (fixed costs) competition among firms.

5.3 Empirical Specification and Econometric Model

For any individual firm j in N, the estimation of the parameters, including the residual demand elasticity, employs the system of equations in (5.3), (5.5), and (5.9b). A double log form for the residual demand in (5.5) as chosen for it allows the coefficient on quantity to be interpreted as the elasticity. In addition, we introduce a linear Diewert cost function (derived from the generalized Leontief profit function) of the form

$c_j = y_j \sum_f \sum_{f'} b_{ff'} \sqrt{\omega_f \omega_{f'}}$, where f and f' ($f = f' = 1, 2, 3$) are inputs, in order to derive the marginal cost for the supply equation in (5.3). The Diewert cost function presents an important advantage in that it is already linear in the parameters and eases econometric estimation without any prior transformations. After adding the stochastic term u in each equation (assuming that there are some errors when individual firms and consumers make

their decisions), the following equations form the system of equation to be estimated econometrically for a firm j:

$$\log p_{jt} = \alpha_{j0} + \eta_j^R \log y_{jt} + \sum_{j' \neq j}^{n} \sum_{f}^{3} \delta_{jj'f} \log \omega_{ft}^{j'} + \mu_j \log I_{yt} + u_{jt}, \quad \text{(residual demand)} \quad (5.10)$$

$$p_{jt} = \beta_{j0} + \beta_{j1}(k\varpi) + \sum_{f=1}^{3} \sum_{f'=1}^{3} \beta_{jff'} \sqrt{\omega_{ft}^{j} \omega_{f't}^{j}} + u_{jt}^{'}. \quad \text{(supply relation)} \quad (5.11)$$

$$\log s_{j,Mt} = \gamma_{j0} + \gamma_{j1} \log(\bar{c}_{jt} / \bar{c}_{Mt}) + \gamma_{j2} \log(\bar{c}_{Mt} / k\varpi y_M) + u_{jt}^{''} \quad \text{(relative share)} \quad (5.12)$$

In the above equations, the ω's are firms' factor prices. The parameters to be estimated are η (expected to be negative), the δ's, the μ's (expected to be positive), the β's and the γ 's (γ_{j1} must be positive as the theory predicts -- because it is of the opposite sign of the elasticity, according to (5.9b) -- and γ_{j2} is expected to be zero or negative). The subscripts and superscripts are described as follows:

R stands for residual in the parameter of demand elasticity η;

j and j' corresponds to supply sources (exporters), $j = 1, 2, 3, \ldots, n$;

f and f' are inputs (labor, skilled labor, and capital);

t is the time period;

and M is the group of home firms;

The theoretical models presented earlier predict the signs and the relationships among parameters in the above econometric specifications. The following relationships are noted:

(i) $\beta_{j1} = 1/(1+\eta_j^R)$

(ii) $\beta_{jff'} = \beta_{jf'f}$ (because of imposed symmetry in the Diewert cost function).

Empirical Implementation

One problem in implementing the above model is the lack of choice of variables representing fixed costs. Data on firms' costs are scarce, even for the U.S. manufacturing. But even if all costs data are available, it is still difficult to separate fixed costs from variable costs. Advertising expenditures -- the only meaningful, continuous, and accessible data -- are employed as a proxy for the fixed cost for the U.S.[10] Advertising expenditure fits the role of fixed costs in the analysis as it was cited as capacity input in Sutton (1991) and Röller and Sickles (2000), and a source of product differentiation or sunk costs in Comanor and Wilson (1969), Shepherd (1972). Thorough analyses of the role of advertising on competition and as barriers to entry are found in Comanor and Wilson (1967, 1971, and 1979), Dixit and Norman (1978), Ayanian (1983), Matraves (1999), and Morton (2000).

Yet, the actual levels of advertising by firms in group N (as we refer them to firms from developing countries) are often unknown; equation (5.12) requires further adjustment. Suppose that in period t each exporter j spends an unknown fraction α_{jt} of their export revenue in advertising in the M market so that j's level of advertising can be written as:

$$\bar{c}_{jt} = \alpha_{jt}(p_{jt} y_{jt}) \tag{5.13}$$

Substituting (5.13) into (5.12) yields the following:

$$\log s_{jMt} = \gamma_{j0} + \gamma_{j1}\left(\log \alpha_{jt} + \log s_{jMt} - \log(\bar{c}_{Mt} / p_{Mt} y_{Mt})\right) + \gamma_{jt} \log(\bar{c}_{Mt} / k\varpi y_{Mt}) + u_t'' \tag{5.14}$$

[10] The U.S. Manufacturing Census data do not provide a detailed list of all fixed costs each year. Also, separating fixed cost from variable costs was not feasible even for the years where the Census released relatively more detailed data.

where the $\log(\bar{c}_{Mt}/p_{Mt}y_{Mt})$ term is exactly the log of the well- known "advertising-sale" ratio. After rearranging terms in (5.14), the equation, that is part of the system, to be estimated is the following:

$$\log s_{jMt} = \frac{\gamma_{j0}}{(1-\gamma_{j1})} + \frac{\gamma_{j0}}{(1-\gamma_{j1})}\log\alpha_{jt} - \frac{\gamma_{j1}}{(1-\gamma_{j1})}\log(\bar{c}_{Mt}/p_{Mt}y_{Mt}) + \frac{\gamma_{j2}}{(1-\gamma_{j1})}\log(\bar{c}_{Mt}/k\varpi y_{Mt}) + u_t'' \tag{5.15}$$

Based on equation (5.9b) and (5.12), the fact that γ_{j1} is always nonnegative (we assume it is different than one, for convenience) does not contradict our earlier findings that the market share of firm j relative to market share of the group M increase with its expenditure in fixed cost (advertising) relative to M's fixed cost. However, whether γ_{j1} is greater or less than one will determine the sign of coefficient on the log of the advertising to sale ratio in (5.15). In the case where γ_{j1} is less than one, (5.15) indicates that the increase in the level of advertising-sale ratio for the group M will reduce the market share of firm j relative to firm M.

5.4 Data and Estimation

This study examines the U.S. import markets of two products; (i) cocoa powder and cocoa cake (part of SIC 2066); and (ii) roasted coffee (SIC 2095), for which the raw materials (cocoa beans and green coffee) are largely produced and exported from developing countries, mostly in Africa and Latin America. In addition, these developing countries, along with some developed countries, also process the raw material and export the processed product to the U.S. market. The U.S. firms in these industries are taken as group M (home firms). The exporting countries are treated as the foreign firms in group N because data at firm levels are not available, especially for the small exporting

countries. The size of the exports from developing countries also justifies the approximation. In fact, the export revenue from processed products of a country in Sub-Saharan Africa or Latin America is very small compared to the value of a shipment of a single U.S. firm.

Cocoa Powder (or Cocoa Cake)

Cocoa powder (or cocoa cake) is a product separated from cocoa liquor or paste, which comes from cocoa beans (the raw material). The cocoa processing industry (SIC 2066) has one of the highest concentration ratios in the U.S. food industries (4 firms produced 75 percent of the industry value of shipments in 1992). For cocoa powder, the sources of U.S. imports during 1999 that are included in the analysis with their respective volume shares are: The Netherlands (67 percent of total import value), Brazil (4 percent), Canada (3 percent), and Côte d'Ivoire (3 percent). Import of cocoa powder represents 30 percent of the total U.S. demand; the rest (70 percent) is produced locally.

Table 5.1 shows quarterly average of export prices (custom values) and shares of countries exporting to the Unite States between the period 1995-99, and indicates the difference in price and market shares among exporting countries. The Netherlands is particularly the major import source for the United States with the highest prices.

Table 5.1. Exports of Cocoa Powder to the U.S. (1995:I-1999:IV)

Exporting Country	Share (%)	Unit Value ($/kilogram)
Brazil	**4.44**	**0.78**
	(1.74)	(0.05)
Canada	**1.75**	**1.19**
	(1.61)	(0.21)
Côte d'Ivoire	**2.67**	**0.56**
	(1.68)	(0.14)
The Netherlands	**71.91**	**1.27**
	(4.56)	(0.11)
Other	**19.23**	

Source: USDA
Note: Figures in parentheses are standard deviations

Roasted Coffee

The U.S. coffee roasting industry also is a concentrated manufacturing industry (the top 4 firms produced 66 percent of the industry value of shipments in 1992). Roasted coffee imports are very limited and represent only 7 percent of the U.S. total demand. In 1999, the major sources of U.S. imports of roasted coffee include Canada (36 percent of import), Brazil (15 percent), Mexico (8 percent), Sweden (7 percent), The Netherlands (6 percent), and Colombia (5 percent).

Table 5.2 shows that Canada and Brazil are the leading exporters of roasted coffee to the U.S. during the period 1995-1999 but the prices of roasted coffee from The Netherlands is the highest.

Table 5.2. Exports of Roasted Coffee to the U.S. (1995:I-1999:IV)

Exporting Country	Share (%)	Unit Value ($/kilogram)
Brazil	**17.12**	**6.12**
	(7.17)	(1.32)
Canada	**27.50**	**6.62**
	(8.98)	(1.44)
Colombia	**6.30**	**6.83**
	(3.03)	(1.04)
Mexico	**9.72**	**6.66**
	(2.52)	(0.84)
The Netherlands	**6.57**	**9.27**
	(0.81)	(1.05)
Sweden	**11.35**	**6.11**
	(5.64)	(0.83)
Other	**21.44**	

Source: USDA
Note: Figures in parentheses are standard deviations

Data Sources

For the U.S., the volume, value, and unit price of the domestic production of processed products are from the Census Bureau and the Bureau of Labor Statistics. U.S. imports by source were prepared by the United States Department of Agriculture/ Economic Research Services Data Access Retrieval and Tabling System (DARTS). Prices of the manufactured product from abroad are the c.i.f unit value (custom value?). Prices of the raw material are taken from the commodity prices published by the IMF.

For the other countries, the average fixed investment cost is proxied as their import market share value multiplied by the average U.S advertising-sale ratio. In other words, it is assumed that the share of expenditure on advertising relative to sales is the same for all firms and only the level of advertising expenditures differ. The advertising data come from the IMF and the USDA/ERS. Interest rates are real interest rates calculated from nominal market interest rate from IMF publication.

Econometric methods are employed to estimate equations (5.10), (5.11) and (5.15). In general, theory offers no specific indication of the choice of variable factor costs (the ω's on the right hand side of (5.10)) to be included in the estimation of the parameters of the residual demand equation. Goldberg and Knetter (1999) used bilateral exchange rates as one of the important cost shifter variables. In this study, we profit from the homogeneity of the residual demand to divide all prices and incomes by the wage rate in the manufacturing firm of interest. The use of these ratios, especially the ratio of manufacturing wages between two countries, has an important implication as they indicate how factors (mainly, endowments of skilled labor) affect the firm's residual demand.

For each country, equations (5.10), (5.11), and (5.15) are estimated by simple OLS and by the SUR procedure and the results are compared. SUR estimates are often superior to OLS as they are consistent while the simple OLS estimates could be unbiased but inefficient when the error terms among the equations are contemporaneously are correlated.[11] However, for the Netherlands, OLS presents a better fit than SUR method.

5.5 Results and Interpretation

Cocoa Powder

Table 5-3 summarizes the results for all countries. The elasticity of the (inverse) residual demand for every exporting country is negative and significant, except for Côte d'Ivoire indicating that cocoa powder exports from these countries are distinct. The highest estimate of the elasticity, indicating high degree of distinction and market power

[11] Strickland and Weiss (1976) indicated the usefulness of considering the kind of equations in this model which involve level of advertising as part of a system of equation, and if data permit, as simultaneous equations.

compared to the other sources, is – 0.526 for the Netherlands. This is consistent with the relatively high unit prices and high market shares of Dutch firms exporting cocoa powder to the United States. On the other hand, Brazil and Canada appear to enjoy only a limited market power, as the elasticities estimate are low. On the other hand, Côte d'Ivoire face competitive demand curves and have no market power in setting prices. These results are consistent with the relatively low import share for Côte d'Ivoire in the U.S. market.

The results also show that the residual demand facing the Netherlands increases as the industry wage in Canada and level of interest rate in the U.S. raise. Input prices from other sources do not affect the residual demand of Netherland indicating that Canadian and U.S. firms are its largest competitors in the U.S. cocoa powder market. Similarly, the residual demand for Brazil is increased (an upward shift of demand) when there is a hike in labor price or interest rate in Canada. Geography and trade closeness of Brazil and Canada to the United States are perhaps part of the explanation.

Besides, an increase in the U.S. per capita income affects only the demand for cocoa powder from the Netherlands. In addition, there seems to be no statistically significant effects of the U.S. advertising-sale ratio on the export shares of the countries involved. Most of the coefficients in the supply relation are not significant, except for Canada where output price increases with the price of raw material.

Table 5.3 Parameter Estimates of the Residual Demand and the Impact of Advertising on Market Share for Differentiated Cocoa Powder Exported to the U.S.

Equation	Brazil	Canada	Côte d'Ivoire	The Netherlands
Residual demand				
(dep. Var : lnP)				
LnY	-0.068**	-0.095**	-0.005	-0.526***
	(-2.670)	(-2.620)	(-0.210)	(-3.050)
lnWH_bra		1.388	-1.579	
		(0.780)	(-1.190)	
lnWH_can	1.117			1.015***
	(1.890)			(2.940)
lnWH_cot				
lnWH_net		0.429		
		(0.680)		
lnWH_us			0.753	-0.289
			(1.110)	(-1.06)
lnWK_bra			-0.077	
			(-1.030)	
lnWK_can	0.187		0.326	
	(1.98)		(1.750)	
lnWK_net				
lnWK_us	-0.154	1.164	-0.437	0.783**
	(-0.510)	(1.310)	-0.580	(2.770)
lnINCOME	0.070	0.003	-0.064	0.593**
	(1.010)	(0.010)	(-0.440)	(2.720)
Supply				
(dep.var.:P)				
RAWCOST	-0.003	0.107*	-0.019	-0.030
	(-0.100)	(2.150)	(-0.520)	(-0.460)
WH	0.046	0.381	1.669	0.037
	(0.110)	(1.370)	(0.600)	(0.780)
WK	0.004	-0.0267	0.240	0.207
	(0.490)	(-0.090)	(0.880)	(0.810)
$(WH*WK)^{1/2}$	-0.308	1.514	-11.480	-1.568
	(-0.480)	(0.340)	(-0.670)	(-0.690)
Share				
(dep var.:lnSHARE)				
lnADTSALE	-0.250	0.250	1.421	0.098
	(-0.420)	(0.250)	(0.740)	(0.200)
lnADTRAW	1.505*	0.587	-1.800	1.092*
	(2.450)	(0.590)	(-0.900)	(2.100)
Estimation Method	SUR	SUR	SUR	OLS

Note: The prefix " *ln*" represents natural log, P is the export price, Y is the export volume, WH is the wage in cocoa industry, WK is the country's interest rate, INCOME is GDP (U.S.), RAWCOST is cost of cocoa beans to make one unit of cocoa powder , SHARE is the ratio of the export value to U.S. firms value of shipments; ADTSALE is the U.S. advertising-sale ratio; ADTRAW is the ratio of U.S. advertising expenditure to cost of cocoa beans going into processing. The country denominations are bra=Brazil, can=Canada, cot=Côte d'Ivoire, net= The Netherlands, and us=United States. The *, **, and *** are significance levels at 0.1, 0.05. and 0.01 respectively.

Roasted Coffee

The results for roasted coffee are summarized in table 5.4. All the exporting countries except Colombia have statistically significant residual demand elasticities, which is indicative of market power. Moreover, the elasticities are higher for the Netherlands and Sweden than for any other countries indicating that coffee roasters from these countries have higher degree of market power than other exporters as their products are distinct. This is consistent with the relatively high market shares of these countries in the U.S. import of roasted coffee.

The results also show that the residual demands for all the exporters except Canada increase (upward shift) in response to any increase in consumer's income in the U.S. The shift is relatively high for Brazil and Sweden. Moreover, more significant cross-input cost effects among competitors than in the case of cocoa powder. In fact, residual demand facing Brazilian coffee roasters increase as the average industry wage in Mexico and the interest rate in Sweden increases. Similarly, the raise in wage in coffee roasting industry in the U.S. and the increase in interest rates in Brazil and Colombia shift the residual demand for roasted coffee exported from The Netherlands and Sweden.

Table 5.4 Parameter Estimates of the Residual Demand and the Impact of Advertising on Market Share for Differentiated Roasted Coffee Exported to the U.S.

Equation	Brazil	Canada	Colombia	Mexico	The Netherlands	Sweden
Residual demand						
(dep. Var : lnP)						
lnY	-0.167***	-0.171***	-0.009	-0.187*	-0.204**	-0.212***
	(-5.390)	(-3.510)	(-0.190)	(-2.100)	(-2.410)	(-3.440)
lnWH_can	-3.729**				0.739	1.708
	(-3.010)				(1.260)	(1.700)
lnWH_col	-0.065	0.089			-0.222*	
	(-0.390)	(0.850)			(-1.920)	
lnWH_mex	0.763**					
	(3.080)					
lnWH_net	-0.476**	-0.135	0.170**	-0.086		
	(-3.700)	(-1.30)	(2.360)	(-1.090)		
lnWH_swe			-0.845**	-0.851**	-0.634*	
			(-2.590)	(-2.740)	(-2.080)	
lnWH_us	-0.886*				1.197***	2.193**
	(-1.980)				(3.410)	(2.650)
lnWK_bra					0.089*	0.236*
					(1.970)	(2.810)
lnWK_can	-0.309		-0.285***	-0.577*		
	(-1.300)		(-3.080)	(-2.190)		
lnWK_col					0.222**	0.733***
					(2.450)	(4.280)
lnWK_swe	1.254***			2.006***		
	(4.320)			(5.330)		
lnWK_us				-2.589***		
				(-4.680)		
lnINCOME	17.654***	-0.709	0.644***	4.355***	6.701**	17.683***
	(4.790)	(-1.200)	(4.620)	(5.510)	(2.300)	(3.730)
Supply						
(dep.var.:P)						
RAWCOST	-2.410	0.582	-0.285	-1.567	-8.012***	-6.773***
	(-1.030)	(0.370)	(-0.180)	(-0.590)	(-3.620)	(-6.010)
WH	7.560	0.302	-0.443	0.358	-0.307	-2.381
	(1.820)	(0.200)	(-0.110)	(0.160)	(-1.250)	(-2.280)
WK	0.116	-0.145		0.099	-1.436	-2.864
	(1.280)	(-0.080)		(0.90)	(-1.320)	(-2.400)
$(WH*WK)^{1/2}$	-7.969	4.606	6.076	-7.518	12.856	43.032
	0.302	(0.170)	(0.310)	(-0.600)	(1.120)	(2.400)
Share						
(dep var.: SHARE)						
lnADTSALE	-2.191**	0.550	1.721*	1.368**	0.939***	1.072***
	(-2.820)	(1.030)	(2.050)	(2.440)	(3.080)	(2.950)
lnADTRAW	1.628***	-0.102	-1.336**	-0.676*	-0.525**	-0.531*
	(3.090)	(-0.270)	(-2.270)	(-1.780)	(-2.530)	(-2.160)
Estimation Method	SUR	SUR	SUR	OLS	SUR	OLS

Note: The prefix " ln" represents natural log, P is the export price, Y is the export volume, WH is the wage in roasting coffee industry, WK is the country's interest rate, INCOME is GDP in U.S., RAWCOST is the cost of green coffee to make one unit of roasted coffee, SHARE is the ratio of the export value to U.S. firms value of shipments; ADTSALE is the U.S. advertising -sale ratio; ADTRAW is the ratio of U.S.advertising expenditure to cost of the green coffee going into processing. The country denominations are bra=Brazil, can=Canada, col=Columbia, mex=Mexico, net= The Netherlands, swe=Sweden,and us=U.S. The *, **, and *** are significance levels at 0.1, 0.05. and 0.01 respectively.

The impacts of U.S. advertising-sale ratio, the coefficients on (*lnADTSALE*), are statistically significant for all the exporting countries except for Canada. As it is described in equation (5.15), any significant coefficient on the advertising-sale ratio, regardless of the sign, indicate that for every exporters, except Canada, γ_{j1} is significant (and positive as equation (5.9b) has implied). This means that increasing the levels of advertising relative to the level of the U.S. advertising induces an increase in the relative share of all the exporters of roasted coffee, except Canada. This is an important finding, for developing countries in that investing in advertising could increase their market share.

The sign of the coefficient on *lnADTSALE*, however differs across exporters. In fact, the increase in the U.S. advertising-sale ratio augments the relative share of countries such as Canada, Colombia and Mexico, while reducing the relative share of Brazil. A possible explanation is that Brazil is the largest coffee producer and exporter in the world and its variety, called Brazilian Arabica, is classified by the International Coffee Organization as different from the "milds" Arabica varieties produced and roasted in countries such as Colombia or Mexico, or from variety Robusta produced and roasted in part of Africa and South East Asia. Moreover, a large part of green coffee imported by U.S. and Canadian roasters is from Colombia, Guatemala, and Mexico (USDA/FAS). Therefore, an increase in the intensity of advertising by U.S firms may also benefit the exporters from Colombia and Mexico as firms in these countries roast the same variety widely roasted in the U.S. Indeed the positive effects on relative market shares of other firms are consistent with the theories that advertising has a positive externality on other

firms that do not pay for it. However, such an increase in U.S. advertising-sale ratio constitutes a barrier to the expansion of Brazil's export of roasted coffee to the U.S.

Conclusion

This chapter attempts to explain the difference in prices and market shares among exporters of selected processed products to the U.S, despite the fact that access to the market is already very limited. These exporters include developing countries that produce the raw materials used in the processing activities and are seeking to expand their export revenue by processing these raw materials. One specific objective was to find evidence of product distinction among exporting countries by estimating the degree of market power of each exporting countries and determining impact of input variables costs of competitors. Another objective was to estimate the impacts on market shares of a country's own fixed cost as a source of product distinction as a barrier to competitors. Our methods particularly rely on the estimation of the parameters of residual demand, the conjectural supply relation, and export shares in a product differentiation framework.

The results show that despite the fact that the export to the U.S. is very limited for roasted coffee and especially cocoa powder, exporters from countries such as The Netherlands (for cocoa powder) and Brazil, Canada, The Netherlands and Sweden (for roasted coffee) have some degree of market power, as their products are individually distinct from any other sources. Product distinction and market power are indicated by the statistically significant residual demand elasticity for these countries. This market power allows the exporters to raise their prices above marginal costs, at least in the short

run. Also, this degree of market power from product distinction, particularly, explains the high price and high market share for cocoa processors from the Netherlands and coffee roasters from Canada and Sweden.

In contrast, firms exporting cocoa powder and roasted coffee from some large producers of raw material such as Côte d'Ivoire (for cocoa), and Colombia (for coffee), lack market power in the U.S. import market. This may explain in part why import price and market shares are relatively low for these countries. In addition, the results also show that for an exporting country factor prices affect other competing exporters residual demand. The implication of this result is that in international markets, countries that already have easy access to skilled labor and capital for investment may not only increase their chance to distinguish their products, but also depress other competitors' residual demand and market shares.

The results show that increasing the level of advertising relative to U.S. advertising will increase the exporters' market shares relative to the U.S. market share especially for roasted coffee. The implication is that export revenue for small exporting countries like Colombia, and Côte d'Ivoire can be expanded if firms in these countries invest more in advertising. But these results also imply that the higher is the level of expenditures in advertising and other fixed costs by U.S. coffee roasters compared to advertising and fixed costs from exporters, the smaller is the market share of these exporters. Therefore, higher level of advertising by the U.S. coffee roasting industry constitutes a market barrier for countries exporting roasted coffee to the U.S. Similarly, advertising-sale ratio, indicator of the intensity of advertising, reduces the relative market share of Brazil, which is one of the world largest coffee producers and coffee roasters.

This chapter of the dissertation has empirically tested the hypothesis that fixed costs constitute the source of non-competitive pricing and a barrier to entry. In past studies, the lack of data, especially on firm's variable and fixed costs (which are not observable) often limits the authors to pursue empirical studies. This study used available information in advertising expenditures, which may not be the perfect proxy for fixed costs. However, the use of advertising as a proxy gives some insights on how fixed costs of large firms affect market share expansion of their competitors in a market for differentiated product.

Chapter 6: Conclusions

Determining the factors that affect the ability of small open economies to export semi-processed and processed agricultural goods has been the main issues addressed in this dissertation. However, unlike previous studies, the analysis mainly focuses on the role of human capital and market structure using the arguments of new trade and growth theories. The assumptions departed from familiar ideas (such as lack of technology, trade barriers, especially tariff escalation, and high transportation costs), and predict that the low level of skill in the workforce and the structure of the international market contribute to limiting the expansion of exports from a small open economy. This chapter summarizes the findings of the analysis from three previous chapters and discusses the implications of the results on export policy, especially for developing countries willing to expand their export markets. Some limitations of the models and the methods employed are discussed along with suggestions for future research.

6.1 Summary of the Findings

The findings in this dissertation are different from familiar results from other studies that focused on trade barriers in searching for the reason why developing countries have been unable to improve their export earnings of processed agricultural goods. This dissertation does not intend to exclude the importance of results from previous research. The results of this dissertation, however, show that market concentration, consumer views, and the level of fixed costs are important. More importantly, among other factors, the endowment in skilled labor for the production and for the research sectors matters.

Positive Impact of Human Capital on Manufacturing Value Added

The investigation presented in Chapter 3 showed that the food and beverage industries and the textile industries yield the largest share of value-added manufacturing in three selected Sub-Saharan African countries, Ethiopia, Kenya, and Mauritius. Moreover, processed food and beverages and textiles also represent the largest share of manufacturing exports for these countries. The analysis concluded that the repartition of value-added in the manufacturing industry is influenced by the allocation of human capital. The food and beverage industries particularly dominate the structure of manufacturing by representing the largest part of value-added because these industries have greater access to the country's relative skilled labor than other categories of manufacturing. This is also explains why food, beverage and textile represents the largest share of export values for these countries.

Results in Chapter 3 also indicate that the level of human capital has a positive and significant impact on value added per worker for manufacturing but the estimates of the impacts vary across country. The elasticity of value added with respect to human capital is higher in Kenya than in Ethiopia and Mauritius because manufacturing Kenya includes some industries employing relatively high skilled labor. However, the results also show that while value added per worker of the manufacturing sector has increased in Mauritius, it has declined in Ethiopia, and Kenya.

Level of Labor Skill and Structural Barriers to Export

The analysis in Chapter 4 focusing on the U.S. markets of cocoa paste and cocoa butter and concluded that market shares of developing countries exporting to large market such as the U.S. are constrained by the low quality of the labor force in these developing countries and the structural barriers represented by the high concentration of U.S. industries. The higher the level of skill in the labor force employed in the industry, the more likely the market shares of the countries will grow. But a high level of industry concentration of local industries in developed countries limits the expansion of exports of processed agricultural products from developing countries.

Product Distinction and Barriers due to Fixed Costs

In Chapter 5, the study examines the case of export of differentiated products such as cocoa powder and roasted coffee. The results showed that some developed countries exporting to the U.S. have distinct products that allow them to have market power and extend their export levels. However, some developing countries, large producer of the raw materials, such as Côte d'Ivoire and Colombia have little or no market power as their products lack distinction. Moreover, high fixed costs, represented by the level of advertising for products from U.S. firms, reduce the market shares of some exporting countries.

6.2 Implications on Export Promotion for Developing Countries

Education

One of the direct implications of the results in this dissertation is that the quality of the labor force and, generally, the endowments in human capital are important for manufacturing sectors. Countries with low levels of human capital and uneducated populations have little chance to succeed in the export market of processed goods.[1] Only better educated labor force would provide skilled labor that produces high quality product, skilled managers who help organize production and marketing activities, and especially researchers (such as scientists searching for new technology and innovated product and economists analyzing market data to improve future sale.

In the light of recent developments in the literature, the level of human capital also constitutes an index of the returns to investment. In fact, Söderbom and Teal (2000) reported that the low level of human capital in many countries in Sub-Saharan Africa is one of the main reasons that discourage investors to flow capital into these countries.[2] On-the-job-training for workers is possible but it would be more profitable for firms to train educated rather than uneducated workers.

Investment

The need for investment for manufacturers from developing countries is important to lessen the impact of entry barriers from fixed costs imposed by large, established firms in the international market. The literature related to solving entry problems using game

[1] Preferential trade agreement that allows many least developed countries to export semi-processed products does not lead automatically to increasing export revenue.

[2] This is not new since the quality of labor force constitutes one of the factor choices of investors.

theory explains that the outcome of increased fixed costs by potential or new entrants will, at least, alter the strategy of incumbent firms of keeping all competitors out of the market. Therefore, this will increase the chance of the new entrant to penetrate the market and increase their shares.

In this study, fixed cost barriers take only the form of advertising expenditures but fixed costs could include investments embedded in firms' costs such as R&D and improvement of distribution system. If consumers view products as source differentiated and have a preference for variety, any investment that helps generate product distinction is important in order to increase developing country firms' market power in the export market.

Market Structure

The two previous implications – the need for education, and for investment -- represent some hope for potential exporters from developing countries that by educating their workforce and by bringing distinction to the products through investment, they can improve their access to an export market. The results in this study, however, imply that much also depends on the structure of the market and firm conduct.

The structure of the market is often determined by the product-specific economies of scale that makes only few but large firms supplying almost the entire world market. In this case, it is difficult for any other firms to penetrate the market and expand their share even if they have high level of skill, large investment, and low trade barriers. As a result, the processing of some types of agricultural goods for exports may not be profitable. Information about the structure of the market has not been often taken into account in

policy making. Moreover, the level of protection in developed countries often overshadows structural barriers based on product-specific economies of scale.

6.3 Limitations of the Study

Limited Data

Many other commodities and many other countries could have been included in this study if the data were available. Moreover, it is still difficult to find and to choose proxies for variables such as human capital, level of skill, and fixed costs, even for developed countries. Concentration ratios and Herfindahl indexes are unavailable on annual basis.

The lack of firm data, in particular, led to treating individual exporting countries as single firms. However, making such an assumption can also be justified by the low level of output value of developing countries compared to value of shipment of single firms from developed countries. Moreover, the processing in developing countries is often concentrated in a few firms, which makes the aggregation over firms a realistic assumption.

Model Limitation

Because of the lack of data, the empirical models that determine market shares could not be solved simultaneously and had to be determined using SUR methods. Moreover, discontinuity of the data on Herfindahl index and concentration ratio for the U.S. industries did not allow the direct estimation of the impacts of these variables on

market shares. Instead, this study has employed equations from comparative static to measure the impacts of firm concentration on market share.

6.4 Orientation for Further Researches

In general, further studies for the same objectives and using the same models and methods can be conducted with more data, which will include additional agricultural products to support the findings. Similarly, the study can be replicated to the European Union import markets involving countries in Sub-Saharan Africa. Moreover, accurate information on the allocation of skilled labor among and within industries and on country or firm's expenses in R&D and advertising over a relatively longer period may help further test the hypotheses in this dissertation.

Another important area of research could be also the determination of the causes that lead to product distinction. In particular, if the residual demand elasticity is an index of the level of product differentiation, then it is worth pursuing an economic model that links the residual demand elasticity to the sources of product differentiation such as quality of the product and advertising. Chapter 5 in this dissertation and probably some other researches have started to explore the way but further studies are needed.

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APPENDIX – A. Gain from Processing the Raw Materials

Côte d'Ivoire in 1999:

Export of cocoa beans: 1,081,562 Metric Tons

Unit value of export (f.o.b) of cocoa beans: 1608$ / Metric Tons

Unit value of export of cocoa paste (f.o.b.) 2098$ / Metric Tons

1 kg of cocoa beans yields 0.8 kg of cocoa paste (ICCO)

Value added that could have been captured if Côte d'Ivoire exported cocoa paste instead of cocoa bean is:

(2098*0.8 – 1608) * 1081562 = $76,141,965

Kenya in 1999

Export of green coffee: 69,742 Metric Tons

Unit value of export (f.o.b) of green coffee: 2400$ / Metric Tons

Unit value of export of roasted coffee (f.o.b.) 5250 $ / Metric Tons

1 kg of green coffee yields 0.84 kg of roasted coffee (ICO)

Value added that could have been captured if Kenya exported roasted coffee instead of green coffee is:

(5250*0.84 – 2400) * 69742 = $140,304,494

Note: The calculations are based on figures from the United Nations (FAO).

APPENDIX- B. Basic Information on Manufacturing in Kenya, Mauritius and Ethiopia

Country:	Kenya (Kenyan pounds)	Size (employees/establish.)		Wage per Worker (local currency)		Value added (%)		Value added per worker (local currency)		Share of Labor Cost to Ouput value	
ISIC Codes	Industries	Year 1990	Year 1995	Year 1990	Year 1995	Year 1990	Year 1995	Year 1990	Year 1995	Year 1990	Year 1995
31	Food, Beverages and Tobacco	123.25	86.95	1562.31	3484.39	37.00	47.90	6862.75	15795.01	0.02	0.02
32	Textile, Wearing apparel, Footwear	102.26	51.75	1335.37	2720.58	9.60	7.00	2821.86	4423.06	0.10	0.15
33	Wood products, and non-metal furnituresl	53.16	25.65	1188.69	2412.74	3.00	2.40	2550.61	4163.51	0.11	0.14
34	Paper, Paper Products, Printing and Publishing	67.35	33.56	2306.36	4214.64	7.50	6.00	6014.92	9697.22	0.11	0.10
35	Chemical, plastics	81.10	66.02	2820.28	5576.25	16.40	15.00	9584.13	16333.51	0.02	0.03
36	Pottery, Glass,	128.10	149.81	2709.92	4789.20	5.20	4.10	7803.63	12066.75	0.09	0.12
37	Metallic, basic metal, non-ferrus metal	184.03	137.48	1685.29	2980.34	0.30	0.20	562.11	n.a.	0.08	n.a.
38	Fabricated Metal, Machinery	97.25	58.84	2216.87	4442.64	18.80	15.70	5975.49	10692.31	0.07	0.03
39	Other manufacturing	38.21	13.56	1692.60	3399.22	2.20	1.70	6403.12	11455.71	0.06	n.a.
	Total					100.00	100.00				
Country:	Mauritius (Rupees)										
ISIC Codes	Industries	Year 1987	Year 1992	Year 1987	Year 1992	Year 1987	Year 1992	Year 1987	Year 1992	Year 1987	Year 1992
31	Food, Beverages and Tobacco	64.94	113.30	30231.35	68538.69	26.80	32.30	91423.05	243725.53	0.06	0.08
32	Textile, Wearing Apparel, Footwear	191.70	205.07	14938.31	36446.35	51.90	45.40	29906.71	59304.48	0.17	0.22
33	Wood Products, and Non-Metal Furnitures	43.40	40.71	21922.32	55789.47	1.40	1.90	43449.64	105112.78	0.17	0.23
34	Paper, Paper Products, Printing and Publishing	50.95	36.42	27075.99	75137.29	2.70	3.40	61902.37	179580.63	0.17	0.20
35	Chemical, Plastics	36.69	31.59	29404.99	59588.20	5.50	5.70	97888.68	184234.79	0.09	0.11
36	Pottery, Glass,	30.93	79.33	32814.37	62867.65	1.50	3.60	80239.52	200630.25	0.13	0.14
37	Metallic, Basic metal, Non-ferrus Metal	60.25	62.80	36929.46	75955.41	1.30	0.80	124481.33	134235.67	0.06	0.13
38	Fabricated Metal, Machinery	44.28	44.68	51268.47	53798.15	6.40	4.60	81962.64	104583.60	0.22	0.15
39	Other Manufacturing	69.59	45.10	17104.80	38281.49	2.50	2.30	41009.46	73483.22	0.13	0.15
	Total					100.00	100.00				
Country:	Ethiopia (birrs)										
ISIC Codes	Industries	Year 1982	Year 1987	Year 1982	Year 1987	Year 1982	Year 1987	Year 1982	Year 1987	Year 1982	Year 1987
31	Food, Beverages and Tobacco	152.31	171.70	2302.17	2946.64	50.16	44.82	20433.16	25542.61	0.06	0.07
32	Textile, Wearing apparel, Footwear	430.18	501.10	2034.38	2528.88	24.72	19.09	6496.02	6669.77	0.14	0.16
33	Wood products, and non-metal furnitures	69.68	84.52	2607.63	3288.17	2.12	1.48	7045.01	8893.13	0.21	0.21
34	Paper, Paper Products, Printing and Publishing	117.10	164.00	2890.75	3565.33	4.02	4.07	12043.58	13980.84	0.12	0.14
35	Chemical, plastics	174.91	230.90	3839.92	4890.13	12.37	23.91	21812.20	51147.63	0.03	0.04
36	Pottery, Glass,	121.04	130.79	2556.41	2974.05	2.89	2.16	8376.07	7900.83	0.15	0.15
37	Metallic, basic metal, non-ferrus metal	236.33	285.67	3702.40	4249.71	1.69	1.25	24259.52	22987.16	0.04	0.05
38	Fabricated Metal, Machinery	61.85	74.30	3231.74	4712.60	2.03	3.22	12335.33	20110.85	0.11	0.09
	Total					100.00	100.00				

Source: United Nation Industrial Development Organization

APPENDIX - C. The Dixit-Stiglitz Model

Consumers or representative consumers in the Dixit-Stiglitz model maximize the utility functions $U(\cdot)$ of the forms:

$$U = U\left(q_0, \left\{ \sum_i^m y_i^{\rho} \right\}^{1/\rho} \right)$$

subject to the budget constraint:

$$I = p_0 q_0 + \Sigma_i \; p_i y_i \,,$$

where q_0 is the quantity of all other goods with price p_0 (assumed to be one, for convenience) and y_i is the amount of the i-th differentiated good with price p_i.

The model assumes a two-stage-budgeting process so that in what is relevant for this study, consumers spend the amount $I_y = \Sigma_i \; p_i y_{i,}$, on good y and maximize the subutility function.

$$u_i(\cdot) = \left(\sum_i^m y_i^{\rho} \right)^{1/\rho} \tag{C.1}$$

The Lagrangian function to be optimized is

$$L = \left(\sum_i^m y_i^{\rho} \right)^{1/\rho} + \lambda (I_y - \sum_i p_i y_i) \,,$$

where λ is the Lagrangian multiplier.

The derivatives of L with respect to y_i is of the form:

$$y_i^{\rho-1} (u_i(.))^{-1} = \lambda p_i \,. \tag{C.2}$$

Besides, the derivative of L with respect to λ is simply the budget constraint

$$I_y = \Sigma_i \; p_i y_i \,. \tag{C.3}$$

The parameter λ can be eliminated taking the ratio of two equations of the form in (C.2) for two products i and i', so that one can write:

$$\frac{p_i}{p_{i'}} = \left(\frac{y_i}{y_{i'}} \right)^{\rho-1} \,. \tag{C.4}$$

Staying in the context where we consider that there are only two products i and i', the quantity $y_{i'}$ can be solved from (C.4) and substituted into (C.3). After the substitution, y_i can be solved from (C.3), which leads to the expression:

$$y_i = I_y \frac{p_i^{1/(1-\rho)}}{p_i^{\rho/(\rho-1)} + p_{i'}^{\rho/(\rho-1)}} \,. \tag{C.5a}$$

A general expression of (C.5a), considering more than two products, is

$$y_i = I_y \frac{p_i^{1/(1-\rho)}}{\sum_i^m p_i^{\rho/(\rho-1)}}. \qquad \text{(C.5b)}$$

Raising both sides of (C.5b) into the ρ-th power, summing over all i and solving for Iy, leads to another expression of the budget constraint:

$$I_y = \left(\sum_i^m y_i^\rho\right)^{1/\rho} \left(\sum_i^m p_i^{-\rho/(1-\rho)}\right)^{-(1-\rho)/\rho}. \qquad \text{(C.6)}$$

In light of equation (C.6), Dixit and Stiglitz defined the quantity index Q as the first term of (C.6) and the price index P as the second term of (C.6) so that $I_y = QP$.

Using the definition of the price index P, (C.5b) can be rewritten as:

$$y_i = I_y \left(\frac{P^\rho}{p_i^\rho}\right)^{1/(1-\rho)}. \qquad \text{(C.5c)}$$

Similarly, replacing I_y by the product PQ, as it was earlier defined, (C.5c) can be written as:

$$y_i = Q\left(\frac{P}{p_i}\right)^{1/(1-\rho)}. \qquad \text{(C.5d)}$$

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