The Illicit Coca-Cocaine Economy and the Potential Impact of Free Trade on the Licit Economy of Alternative Crops in Bolivia

Abstract

The factors proportion model of production and trade with ten inputs is use to analyze the potential impact of the Free Trade Agreement of the Americas (FTAA) on the coca substitution program in Bolivia. With five legal crops, the model produces comparative static elasticities of changing prices on factor prices and output. Results show that the coca substitution plan with free trade will result in large income redistribution in the coca-producing region as a result of increased competition from larger and more efficient economies. The success of the coca substitution program under FTAA will require increased subsidies, as well as institutional changes in the long run.

1. Introduction

Bolivia, a small developing country and one of the poorest in Latin America, is a country of 8.5 million people with $1,000 in GDP per capita in 2002 and poverty indexes similar to sub-Saharan Africa. The Bolivian economy has suffered from a considerable slowdown in growth that averaged 1.4% from 1999 to 2001 mainly due to the overall sluggish performance of other regional economies, which affected Bolivian exports. However, the programs of coca eradication and crop substitution have also been major factors affecting the level of economic activity in the country. In 2002, the economy grew by 2.8% led by the construction of a new gas pipeline to Brazil and transportation projects, but other components of domestic demand have remained weak. With an approximate 50% of the labor force underemployed, 9% unemployment and two-thirds of the population living in poverty, it is imperative for the country to jump start the economy to avoid social problems now constantly threatening the stability of government.[1]

[1] A social revolt sacked President Sanchez de Lozada from office in October 2003.

The coca eradication program promoted by the United States is highly controversial in the country and viewed as a foreign interference on domestic matters. In 1999 the government of Bolivia and the US initiated the consolidation of a project intended to replace the illicit coca plantations with a diversified agricultural-based economy. The program known as the Consolidation of Alternative Development Efforts Project (CONCADE) is currently underway in the tropical region called *Chapare* in the department of Cochabamba working simultaneously towards the reduction and elimination of coca cultivation and substituting it with different crops mainly banana, black pepper, heart of palm, passion fruit, and pineapple.

Pressured by the US, president Banzer introduced *El Plan Dignidad* or Dignity Plan in 1997. The plan designed to free Bolivia from the coca-cocaine industry has had some success but the social costs have been huge. To put things in perspective, before the introduction of the Dignity Plan, coca growers in the *Chapare* region were selling the production of one hectare of coca leaf for about $10,000 on the illegal cocaine market. At the time, the coca eradication program provided $2,000 per hectare. This was a one time payment designed to rid the peasants from their illicit activity. The income difference was simply too large for the peasant to give up coca production. In 1999 the CONCADE program began in order to provide the peasants with alternative incomes from legal economic activities. In total, there were 33,800 hectares of illegal coca leaf plantations in 1997 and by 2002 there were only 7,900 hectares, a net reduction of 25,900 hectares. The country's potential coca leaf production was reduced from 77,000 to 18,000 metric tons while potential cocaine production was reduced from 240 to 70 metric tons on a per year basis. In 1997, the illicit coca activity generated annual income of around $500 million (6.25% of GDP) while by 2002 this fell to $183 million (2.29% of GDP). Over the same period, the price of coca skyrocketed by 50% increasing the level of production in neighboring Peru.

The CONCADE program provides technical assistance to the United States Agency for International Development (USAID) and other government and private agencies in Bolivia to support the program of alternatives to coca cultivation in *Chapare*. The $112 million program is intended to offset the lost incomes to coca growers resulting from the virtual elimination of the coca production in the region as set for by the Dignity Plan. As of 2002, CONCADE provided technical support and training to about 10,000 families out of 35,000 living in the area, and despite some success, the overall social costs of coca substitution have been significant and is to blame for social conflicts in the country. For decades, coca represented an important fuel for the engine of growth in the country, the illicit activity created so many legal sectors and vested interests that ranged from drug rehabilitation centers to transportation, manufacturing, and agriculture. By removing the coca production under the Dignity Plan with a weak alternative program and with basically no institutional reforms in the country, the plan destroyed the Bolivian economy almost overnight. The failure of the plan is reflected by the constant social revolts on the part of the peasant coca growers. These social revolts has two sources; peasants simply refuse to give up their income from illegal coca production, and the lack of markets for the new crops makes their commercialization difficult and incomes are reduced. My research in field show that in the summer of 2003, 10 pineapples were sold for $0.13, an unviable economic alternative to coca. Although the families receiving support from the CONCADE program have managed to increase their incomes almost three-fold to $1,287 per year relative to those not under program support with annual incomes of $500 per year, the numbers are still quite different from the $10,000 received from the illegal cocaine industry.

The result is a region constantly under siege. Violence between the peasants and the Bolivian arm forces in charge of the eradication plan are permanent. Several peasants, as well as army officials have been killed and the army has been accused on numerous occasions of human rights violations. The US Senate Leahy amendment calls for the immediate suspension of funds from the US funded “War on Drugs” if evidence of human rights abuses associated with the coca eradication plan are found. So far, either government has taken no action.

The U.S. and the Bolivian governments continue dealing with the coca-cocaine issue by focusing on the supply-side of the problem. Most of the crops use in the coca substitution program is intended for the export market. Exports from the *Chapare* region have grown from 45% of total output in 1996 to 76% of total output in 2002. This large dependency on the export market plays an important role in the survival of the program and makes the Free Trade Agreement of The Americas (FTAA) a critical component in the analysis to determine whether the legal crop program in *Chapare* is likely to succeed. The FTAA could open markets for the new crops in the *Chapare* area but at the same time, it could threaten the survival of the program by increasing foreign competition from more efficient economies in the production of the same crops, especially Brazil and Chile.

This paper uses the factors proportion or the Heckscher-Ohlin-Lerner-Samuelson (HOLS) model of production and trade to analyze potential output adjustments and income redistribution within the *Chapare* region as a result of the FTAA. The model considered to be an important building block of international trade theory is based on the idea that differences in endowments of productive factors across countries explain patterns of production and trade with countries exporting products that use their abundant factors intensively.

The HOLS model is applied to a sector in Bolivia where the coca-eradication, coca-substitution program is taking place. This is a tropical area known as *Chapar*e. The model assumes competitive factor markets where all factors of production within the area can compete with each other for different crops. Factors of production can move freely within the *Chapare*, but cannot migrate seeking higher returns to other agricultural areas of the country. In other words, the *Chapare* region is closed to the rest of the economy in the factor market but not in the output market. The idea is to analyze how income is redistributed and how output adjusts as the *Chapare* region moves along its production possibilities frontier (PPF) to adjust to foreign competition. On the other hand, the output market is open to both domestic and foreign markets. Legal crops leaving the *Chapare* region are intended for both the Bolivian domestic market as well as the foreign market.

There are at least two reasons why the model assumes a closed *Chapare* region. First, agricultural factors of production are basically sector specific. In other words, they generally do not migrate into other sectors like services or manufacturing. Second, agriculture in Bolivia is expected to lose under free trade (Thompson and Toledo, 2001) and movement of agricultural factors of production from the *Chapare* region to other agricultural regions in Bolivia is unlikely to occur. FTAA is expected to become effective by 2005 and the potential impact on the crop substitution program in Bolivia can be examined in general equilibrium models of production and trade. The basic method is to simulate the effects of changing prices on factor prices, the traditional Stolper-Samuelson elasticities and changing prices on outputs, or the surface of production possibilities elasticities. Results are then use to offer preliminary policy recommendations.

The present simulations are based on factor shares and industry shares across six major crops grown in the *Chapare* region. Factor shares and industry shares are derived from data gathered through interviews and surveys over the summer of 2003. Skilled and unskilled labor are shared inputs, as is energy and capital (including arable land). Seeds are assumed to be sector specific. Assumptions of the model include full employment, perfect labor mobility within industries (within crops), and competitive pricing making cost equal to price[2]. Production is based on constant elasticity production functions with constant returns to scale. The model generates general equilibrium elasticities of factor prices with respect to prices of the six major outputs, banana, black pepper, heart of palm, passion fruit, pineapple, and coca[3].

Vectors of projected price changes are used to find net effects across labor groups, energy, seed prices and capital, and some sensitivity analysis is performed. Estimates are then used as a proxy for estimating the level of additional subsidies that will be required for the coca substitution program to survive the FTAA and provide additional insights into institutional changes that should be considered in order to achieve a self-sufficient agricultural based economy in the *Chapare* region over the long run.

2. Previous Research

Most studies on the illegal drugs issue tend to overlook the supply-side of the problem and the unintended consequences of bringing the war on drugs to producing countries. Although in theory the proposals for drug legalization can be applied to both sides of the market, they lack the realism in terms of the social costs involved in dealing with the problem facing producing countries. Friedman (1972, 1980, 1984, and 1989), Becker (1987, 2001) and Schultz (1989) have been long advocates of alternative policies to interdiction programs such as drug legalization and decriminalization of drugs as a way to reduce the increasing levels of drug related violent crimes and corruption at some levels of government. Other studies have focused on consumer behavior and their responses to price. Becker and Murphy (1988) develops the B-M

[2] Thompson (2000) shows that Stolper-Samuelson elasticities hold even when assumptions such as perfect competition, perfect factor mobility and competitive prices are relaxed.
[3] Coca is the only illegal crop in the model.

model of rational addiction and show that addictive drugs are responsive to price, a result that contradicts conventional wisdom that the demand for addictive substances is highly inelastic. Becker (1991) shows further evidence to support the B-M model. Chaloupka (1998) analyzes the demand for cocaine and marijuana by youth in the US and finds that youth cocaine demand is highly responsive to price and that legal sanctions have a statistically significant negative effect on youth cocaine and marijuana use. Other demand-side studies examining the market for illegal drugs have focused on the impact of drug consumption on workers performance, substitution and complementarity among various illegal substances, as well as consumer spending on drug use. The demand-side of the market is as important as the supply-side. For countries like the US, taking the war on drugs to the supply-side maybe less expensive, after all, it is better to create chaos in other countries rather than domestically by combating aggressively drug sales and consumption. This obviously would create domestic problems like, for example, an increase the criminal population resulting in overcrowded prisons. However, the refusal to deal with the demand side of the problem has in part lead to the failure of the war on drugs. The drug problem is not any better than 20 years ago, it has become a losing battle despite huge amounts of resources use over the years to fight it. Any serious intention to eradicate drugs should include not just the eradication of coca leaf but also the consumption of cocaine. So far, the war on drugs continues its failing trail of attacking the supply side of the market while keeping the status quo on the demand side.

Studies on coca producing countries are only a handful. Gibson and Godoy (1993) analyze alternatives to coca production in Bolivia using a CGE model of the national economy and conclude that a 50% reduction in coca leaf production could devastate the Bolivian economy. This result is consistent with our observation of the Bolivian economy after the implementation of the Dignity Plan in 1997. Riley (1993) evaluates the impact of eradication and economic development in Bolivia, Colombia, and Peru using a dynamic model of the cocaine industry and concludes that interdiction policies have a short-term effect on production. Moreno-Sanchez (2003) analyzes the coca eradication program in Colombia and finds evidence of an ineffective supply control mechanism. By contrast, she finds evidence that a crop substitution program is more viable than simple eradication. The Bolivian coca substitution program is viewed as a viable alternative to coca eradication, but an analysis on how the program will be affected under free trade has yet to be looked into in the three coca producing South American countries; Bolivia, Colombia, and Peru.

3. Factor Shares and Industry Shares in *Chapare*

Table 1 presents the total payment matrix for the ten factors of production in the model. Capital is derived as a residual from the income of all other factors.

Skilled Labor (S)
Unskilled Labor (U)
Energy (E)
Banana Seeds[4] (S_1)
Hear of Palm Seeds (S_2)
Pineapple Seeds (S_3)
Black Pepper Seeds (S_4)
Passion Fruit Seeds (S_5)
Coca Seeds (S_6)
Capital (K)

* Table 1 *

One of the most important pieces of information in the data is the total payment to each productive factor in each of the six sectors. Treating the wage of each of the two labor groups and income from all other factors as averages in the six industries separates payment among

[4] Seed is used as a generic term. It does not mean, for example, that bananas use seeds.

them. Capital payments are derived as residuals of sector value added after labor and other factors payments. The foundation of the model is the total payment matrix to each productive factor in each of the six sectors.

In the HOLS model, all labor types are assumed to be freely mobile between industries in the *Chapare* region. Seeds are specific to each sector and completely immobile. Table 2 presents the derived factor shares of each productive factor in the revenue of each sector. Summing down a column in Table 1 gives total sector revenue. For instance, total revenue in the banana industry in Table 1 is $64,152, and the capital share is 17,963/64,152 = 0.28 = 28%. The capital share is a residual and implicitly includes arable land. Capital is the largest factor share in two of the six industries. The largest skilled labor share goes to the heart of palm industry, while the banana industry has the largest unskilled labor share.

* Table 2 *

To derive industry shares in Table 3, start with the row totals of total factor incomes in Table 1. Assuming perfect labor mobility, the wage of each type of labor is the same across sectors. The share of each factor employed in each sector, the industry shares, can then be derived. For instance, the total income of skilled labor is $11,875 and 7,057/11,875 = 0.599 = 59.9% of skilled labor works in the banana industry. A very large share of skilled labor works in the banana industry while a large share of capital is in the coca industry.

* Table 3 *

4. HOLS Model of Production for *Chapare*

Substitution elasticities describe the adjustment in cost minimizing inputs to factor price changes as developed by Jones (1965) and Takayama (1982). Following Allen (1938), the cross price elasticity between the input of factor *i* and the payment to factor *k* in industry *j* can be written

$$E_{ij}^{k} = \hat{a}_{ij}/\hat{w}_{k} = \theta_{kj} S_{ij}^{k} \quad (1)$$

where ^ represents and percentage change in a variable and S_{ij}^{k} is the Allen partial elasticity of substitution. Assuming Cobb-Douglas production, it follows that $S_{ij}^{k} = 1$. Homogeneity implies $\sum_{k} E_{ij}^{k} = 0$ and the own price elasticity E_{ij}^{i} is the negative of the sum of cross price elasticities. The cross price elasticity is a weighted Allen elasticity and with Cobb-Douglas production it equals the factor share[5]. Aggregate substitution elasticities for the economy are the weighted average of the cross price elasticities for each sector. Elasticities are summed across industries to arrive at aggregate substitution elasticities as described by Thompson (1994):

$$\sigma_{ik} \equiv \hat{a}_{i}/\hat{w}_{k} = \Sigma_{j} \lambda_{ij} E_{ij}^{k} = \Sigma_{j} \lambda_{ij} \theta_{kj} S_{ij}^{k}. \quad (2)$$

Factor shares and industry shares are used to derive the aggregate substitution elasticities in Table 4. Constant elasticity of substitution (CES) production would scale these elasticities. With CES of 0.5, for instance, elasticities would be half as large while with CES of 2, elasticities would be twice as large. The largest own substitution elasticity is for seeds in the passion fruit industry while unskilled labor is the smallest. All are inelastic except seeds in the passion fruit industry, which is unit elastic. There is less substitution for capital than for skilled labor but more for unskilled labor.

* Table 4 *

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[5] Balistreri (2002) finds the Cobb-Douglas production function as a reasonable starting point.

The main behavioral assumptions are competitive pricing $\Sigma_i a_{im} w_i = p_m$ and full employment $\Sigma_j a_{kj} x_j = v_k$, where x_j is the output of good j, v_k is the endowment of factor k, w_i is the price of factor i, and p_m is the price of good m. Fully differentiate to find

$$\Sigma_i \sigma_{ki} \hat{w}_i + \lambda_{kj} \hat{x}_j = \hat{v}_k, \tag{3}$$

$$\Sigma_i \theta_{im} \hat{w}_i = \hat{p}_m, \tag{4}$$

where ^ represents percentage change as developed by Chang (1979) and Takayama (1982). The 16 equations in (3) and (4) are put into matrix format as

$$\begin{bmatrix} \sigma & \lambda \\ \theta' & 0 \end{bmatrix} \begin{bmatrix} \hat{w} \\ \hat{x} \end{bmatrix} = \begin{bmatrix} \hat{v} \\ \hat{p} \end{bmatrix} \tag{5}$$

where σ is the 10x10 matrix of substitution elasticities, λ is the 10x6 matrix of industry shares, and θ' is 6x10 matrix of factor shares. The system matrix in (5) relates exogenous changes in factor endowments v and prices p to endogenous changes in factor prices w and outputs x assuming full employment and competitive pricing in the comparative statics of the general equilibrium model.

The present focus is on price changes due to FTAA. Comparative static elasticities $\hat{w}/\hat{p}$ and $\hat{x}/\hat{p}$ are found by inverting (5) and is given by (6). The $\hat{w}/\hat{p}$ matrix describes how prices affect factor prices, the traditional Stolper-Samuelson result. The $\hat{x}/\hat{p}$ matrix describes the local surface of production possibilities in which each output should be positively related to its own price while some other output declines given constant endowments. The matrix $\hat{x}/\hat{v}$ describes how changing endowments affect output, the traditional Rybczynski result.

$$\begin{bmatrix} \hat{w} \\ \hat{x} \end{bmatrix} = \begin{bmatrix} M & N \\ Q & R \end{bmatrix} \begin{bmatrix} \hat{v} \\ \hat{p} \end{bmatrix} \tag{6}$$

$$\begin{bmatrix} M & N \\ Q & R \end{bmatrix} = \begin{bmatrix} \hat{w}/\hat{v} & \hat{w}/\hat{p} \\ \hat{x}/\hat{v} & \hat{x}/\hat{p} \end{bmatrix}$$

5. Comparative Static Elasticities in the *Chapare* HOLS Model

Table 5 reports the $\hat{w}/\hat{p}$ elasticity matrix. Every 1% decrease in the price of bananas would lower skilled wages by 1.3%, unskilled wages by 1.5%, while the return to capital in the banana industry falls by 0.4%.

* Table 5 *

Every 1% increase in the price of coca would raise the wages of skilled labor by 7.6% while unskilled wages increase by 5.4%. Return to coca capital rises 1.4%. In the coca industry, seeds and capital returns are closely tied to price. Some factors benefit and others lose with any price change, and the present model predicts the effects will be uneven. Price changes affect returns to shared labor more than shared capital, except for capital in the coca industry.

Thompson and Toledo (2001) show that the comparative static effects of price changes on factor prices are the same for all CES production functions. The degree of substitution, if constant along isoquants, has no effect on the general equilibrium elasticities of factor prices with respect to prices. Comparative static elasticities in Table 5 extend to all CES production functions regardless of the degree of substitution.

Table 6 shows price elasticities of outputs along the production frontier, with a higher price raising output in a sector as it draws labor away from other sectors. The largest own output effect occurs in the heart of palm industry where a 1% price increase raises output by 27.5%. All effects are elastic and the smallest own effect is in coca.

* Table 6 *

6. Projected Adjustments with FTAA

A survey conducted over the summer 2003 reports expected price changes with FTAA for crops in the *Chapare* region. Given the small size of the Bolivian economy, predictions include up to 10% higher prices for pineapples due to increased export demand. Import competition is projected to lower prices in all other industries except coca where the effect of eradication is expected to increase price by as much as 50%. Other industries will lose significantly, price of black pepper is projected to fall by 70% while for passion fruit by 80%. The price of bananas is expected to fall by 15% and by 20% the price of heart of palm. With FTAA only one of the five legal industries in *Chapare* is expected to win, the pineapple industry, mainly because of the expanding Argentinean market. The coca industry will benefit with an expected increase of 50% in price as the eradication program continues while coca remains cultivated. Although legal coca exists in the *Yungas* region of the department of La Paz, any coca in the *Chapare* region is considered illegal. The fact that coca is still cultivated in the *Chapare* region makes it an important component of the simulation model.

Expected movement of labor and capital into the coca industry will have to be discounted by the probability of jail time, these estimations are beyond the scope of this paper. However, the weak legal system in Bolivia, which historically has not penalized peasants for growing coca other than eradicating it by force, makes the assumption of labor and capital mobility into the coca industry valid until legal reforms take place.

Preliminary estimates show that some industries will collapse, that is, output would fall by 100% with smaller price changes than those projected under free trade. Conversely, some other industries will experience a 100% increase in output with higher prices but lower than those projected under FTAA. Consequently, in order to test the effects on factor payments and output with changing prices under free trade, three simulations are run separately. Each simulation involves the multiplication of the matrices in Tables 5 and 6 times a vector of projected price changes. In the first simulation, which assumes failure of the Dignity Plan as coca enters the model, projected price changes are scaled down proportionally by a factor of 10 to find the vector of factor price and output in column (2) and (3) of Table 7. The second simulation also assumes failure of the Dignity Plan and is run using the projected prices in column (1) of Table 8. A careful look into these new projected price changes reveals that they are much smaller than those expected under FTAA. These smaller projected prices are found by simulating a 100% output change in either direction for each industry. For example, expected price changes for pineapple and coca in column (1) of Table 8 will increase output by 100% in the pineapple and coca industries, the two industries expected to enjoy higher prices. Conversely, expected price changes for banana, heart of palm, black pepper, and passion fruit will collapse these industries with output falling by 100%. These are four industries expected to suffer falling prices due to increased import competition under FTAA. The second simulation will show how factor prices and output are affected given that four industries will totally collapse and two will double output. Factor prices are presented in column (2) of Table 8. The third simulation assumes a total success of the Dignity Plan. Success of the dignity plan assumes that coca is totally eradicated from the *Chapare* region. Zero coca implies that the effective price of coca is zero as no coca can be sold legally or illegally. To capture the successes of the Dignity Plan within the model, a simulation was run to determine how much the price of coca should fall in order for the industry to collapse. The result shows that with a price decrease of 50% in the coca industry, output of coca fall to near zero. The new set of projected factor price changes are in column (4) of Table 8.

Table 7

Table 8*

The potential impact of FTAA on factors payment and output in the *Chapare* region are significant. In the first simulation where projected price changes are scaled down by a factor of 10, the passion fruit industry's output falls by 100% while payment to seeds in the same industry falls by 100%. The passion fruit industry collapses with a projected price decline ten times smaller than that projected under FTAA. Another large change occurs in the heart of palm industry where output falls by 45.9% and payment to seeds by 47.9%. Skilled wages fall by 6.8% while unskilled by 4.9%. Return to capital increases by 7.9% given that the price of coca is expected to increase significantly relative to other industries. With the exception of seeds in the pineapple and coca industries, and capital, all other factors of production are expected to lose under free trade. These results are presented in columns (2) and (3) of Table 7.

Results of the second simulation, which takes into account the projected price changes that would either collapse the industry or double its output are shown in columns (2) of Table 8.

The second simulation generates interesting results. Skilled wages increases by 8.9% while unskilled wages by 5.0%. Return to capital is expected to increase by 52.2% due to capital mobility, which allows it to move into both pineapple but more significantly into the coca industry. Capital, which implicitly includes land will go back to coca production as prices for substitute crops fall with free trade. Ignoring the probability of jail time, the model shows preliminary results of intended behavior on the part of the coca growers moving into the pineapple and coca industries as the FTAA is implemented.

The unintended consequences of free trade in the coca substitution program of the war on drugs can be approximated by these results and considered a worst case scenario given that with the probability of jail time, the movement of labor and capital into the coca industry may be less. The magnitude of factors movement into coca will depend on the degree of risk aversion of coca growers and capital owners. Other winners under this simulation includes energy whose payment increases by 7.9%, seeds in the coca industry increases significantly by 148% as demand increases, and payment to pineapple seeds by 48.6%. The increase in skilled and unskilled wages implies that workers will remain unaffected and even benefit a little in terms of wages as long as movement into the pineapple, but most importantly, into the coca industry is possible.

The last simulation assumes success of the Dignity Plan. This is probably the most realistic of the three simulations, as in my view in the long run, coca will be completely eradicated from the *Chapare* region. Foreign aid, financial access, technology transfer, social programs, and other aid programs are becoming more conditioned to the success of the war on drugs. Bolivia will have to eventually rid itself from coca in the *Chapare* in order to take advantage of these benefits. However, the second simulation, where the coca industry is included is probably the most realistic in the short to medium run. Given recent social revolts in the country, it will be impossible to totally eliminate coca within the next few years.

Results of the third simulation, which eliminates the coca industry, are even more staggering and presented in column (4) of Table 8. The success of the Dignity Plan will lower skilled wages by 37.2%, unskilled wages by 24.7%, while return to capital falls by 68.2%. The only real winner is the pineapple industry with an increase in payment to seeds by 213% as output expands by 100% with higher price due to an increase in export demand. Excess supply of skilled and unskilled labor combined with the collapse of the coca industry reduces significantly the payment to these three factors of production. In 2002, the pineapple industry from the *Chapare* region produced around 35,000 metric tons of pineapple and 48% of that production or 16,800 metric tons were for the export market. Doubling output of pineapple as predicted by the third simulation where no coca is included will require the expansion of the foreign market and even if that is achieved, the problem of diversification cannot be ignored. Without coca, the *Chapare* region could become a one-crop region, pineapples in this case, as is the only sector projected to enjoy higher prices with free trade. A one crop *Chapare* sector will become more vulnerable to exogenous shocks like weather and pests, increasing the risk of failure even with projected higher prices with free trade. Another important finding in this exercise shows that skilled labor, thus skilled wages, is highly dependent on bananas and coca, while capital is highly dependent on coca. Once these two sectors collapse, both factors lose significantly.

7. Conclusion and Policy Recommendations

The large changes on factor prices observed when the coca industry collapses will have serious implications for the Bolivian economy already experiencing several years of economic trouble led by a growing fiscal deficit and high levels of unemployment. If labor loses, consumption would fall and more civil unrest as seen in 2003 is possible. As the economy adjusts to FTAA, a continuing recession would seem likely.

The most realistic results of this paper are those obtained by the second and third simulation. The second simulation, which includes the coca industry, is consistent with the fact that the industry will not disappear in the short to medium run. As long as coca is allowed to be cultivated in the *Chapare* region, there will be no loses in wages, and perhaps some gains as workers move into that industry while the others disappear. The question is how to move forward with war on drugs in the long run. One alternative is to subsidize factors of production to avoid more social revolts. The amount of the subsidy per each factor of production can be approximated by the Stolper-Samuelson result. For example, the third simulation, which excludes coca shows a decrease in skilled wages of 37.2%, this would represent a subsidy of around $111 per month per skilled worker, given their average salary of $300 per month. This number is smaller for unskilled workers, although it is possible that its impact on standard of living maybe higher than that to be experienced by skilled workers. Unskilled wages are expected to fall by 24.7% and given the average income of unskilled workers of $89 per month, the amount of the subsidy will be around $21.8 per worker per month. Seeds for bananas, heart of palm, black pepper and passion fruit would have to be subsidized 100%. Without adequate compensation, these large loses in wages could create another social crisis in the country as coca growers will likely continue their road blockades, social revolts, and strikes as means to express their discontent with the ongoing coca substitution program.

Taking coca out of the model meaning a success of the Dignity Plan, as in the third simulation, yield significant loses for skilled and unskilled labor, and capital.

As of 2002, total private investment in *Chapare* was $53 million. Return to capital in *Chapare* is around 35% as given by average factor shares. A decrease of 68.2% on the return to capital means a net decrease of 23.8% leaving the return to capital to roughly 11.2%. Since the model assumes competitive markets, actual levels of investment will require a subsidy of around $16 million per year. Subsidies cannot continue forever, but the eradication and crop substitution program is a long-run project, in general tied to incentives such as additional financial and technical assistance from developed countries, as well as the country's access to credit. Thus with FTAA, survival of the program in the long run will be closely tied to institutional changes in the country

The role of labor retraining and literacy programs in the country must be implemented in the short-run in order to deal with long-run problems, such as the increasing levels of internal migration of the indigenous population that are flooding the urban centers increasing the levels of crime, drug addiction, and contagious diseases. As the war on drugs continues, thousands of families will lose their incomes either directly or indirectly and will move into the urban centers in search for a more prosperous future, this is a problem than can easily be observed today and it is likely to get worse. The coca eradication and crop substitution program do not provide any type of financial assistance that would help deal with the internal migration problem, nor the country is in condition of offering them any help. Retraining programs will allow the indigenous population to become an integral part of society and be productive citizens rather than criminals involved in blockades and social revolts which impoverish the country even further. It is estimated that around 15,000 families have migrated into the urban centers and while it is certain that oil and gas exploration, as well as the lumber industry are potential employers, the people simply lack the skills to become productive laborers.

Other institutional change of importance is related to the transfer of land rights now protected under the law for small land plots of no more than 50 hectares. Most coca growers own small plots of 50 hectares or less than under Bolivian law cannot be appropriated by a creditor if used as a collateral of an unpaid loan (World Bank, 1996). This prevents small-scale farmers from accessing formal credit as banks refuse to accept those assets as collateral. Without access to formal credit, farmers find it difficult to invest in legal crops and continue borrowing from the secondary market or from loan sharks at a very high interest rates. These loans, in general, can be repaid by growing coca or by engaging in other illicit activities. Accessing credit in the secondary market is not difficult for the farmers as the loans are given, in most instances, based on repayment history.

Changing the legislation to provide farmers with transferable property rights may in the long-run help them access to formal credit at competitive interest rates, that eventually will make possible the development of licit activities in sectors where coca is now grown.

Labor reforms will also have to be implemented as the labor force grows in the legal sector. Agricultural workers, in general, do not have any benefits like health insurance, workman compensation, nor exist any regulation on working conditions and overtime payments. Eventually, more reforms will be necessary in order to deal with the redeployment of labor into other industries.

Finally, although the Bolivian and US governments have apposed to alternatives legal use of coca, research and development must continue. A World Health Organization (WHO) study on the benefits of research for the legal use of coca has been withheld from publication, not a good sign and leading in the wrong direction on how to fight illegal drugs.

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Table 1. Factor Payment Matrix, 2003 (thousand of dollars)

	Bananas	Heart of Palm	Pineapple	Black Pepper	Passion Fruit	Coca	Total
Skilled	7,057	459	269	23	27	3,950	11,875
Unskilled	36,567	1,188	1,750	128	106	22,594	62,332
Energy	1,283	41	379	11	16	4,740	6,469
$Seeds_1$	1,283	0	0	0	0	0	1,283
$Seeds_2$	0	89	0	0	0	0	89
$Seeds_3$	0	0	276	0	0	0	276
$Seeds_4$	0	0	0	68	0	0	68
$Seeds_5$	0	0	0	0	20	0	20
$Seeds_6$	0	0	0	0	0	5,846	5,846
K	17,963	923	771	130	95	41,870	61,753
Total	64,152	2,700	3,444	360	264	79,000	

Source: *Author survey developed with the technical assistance of agricultural Professionals and NGOs representatives working in the Chapare region (2003).*

Table 2. Factor Shares, θ_{ij}

	Bananas	Heart of Palm	Pineapple	Black Pepper	Passion Fruit	Coca
Skilled	0.110	0.170	0.078	0.064	0.104	0.050
Unskilled	0.570	0.440	0.508	0.356	0.401	0.286
Energy	0.002	0.015	0.110	0.030	0.060	0.060
$Seeds_1$	0.002	0	0	0	0	0
$Seeds_2$	0	0.033	0	0	0	0
$Seeds_3$	0	0	0.08	0	0	0
$Seeds_4$	0	0	0	0.188	0	0
$Seeds_5$	0	0	0	0	0.075	0
$Seeds_6$	0	0	0	0	0	0.074
K	0.280	0.342	0.224	0.362	0.360	0.530

Table 3. Industry Shares, λ_{ij}

	Bananas	Heart of Palm	Pineapple	Black Pepper	Passion Fruit	Coca
Skilled	0.599	0.039	0.023	0.002	0.002	0.335
Unskilled	0.587	0.019	0.028	0.002	0.002	0.362
Energy	0.198	0.006	0.059	0.002	0.002	0.733
$Seeds_1$	1	0	0	0	0	0
$Seeds_2$	0	1	0	0	0	0
$Seeds_3$	0	0	1	0	0	0
$Seeds_4$	0	0	0	1	0	0
$Seeds_5$	0	0	0	0	1	0
$Seeds_6$	0	0	0	0	0	1
K	0.291	0.015	0.012	0.002	0.002	0.678

Table 4. Cobb-Douglas Substitution Elasticities, σ_{ik}

	$\hat{w}_S$	$\hat{w}_U$	$\hat{w}_E$	$\hat{w}_{S1}$	$\hat{w}_{S2}$	$\hat{w}_{S3}$	$\hat{w}_{S4}$	$\hat{w}_{S5}$	$\hat{w}_{S6}$	$\hat{w}_K$
$\hat{a}_S$	-0.909	0.468	0.035	0.012	0.001	0.002	0.001	0.000	0.025	0.365
$\hat{a}_U$	0.088	-0.538	0.037	0.012	0.001	0.002	0.000	0.000	0.027	0.371
$\hat{a}_E$	0.064	0.357	-0.945	0.004	0.000	0.005	0.000	0.000	0.054	0.461
$\hat{a}_{S1}$	0.110	0.570	0.020	-0.980	0.000	0.000	0.000	0.000	0.000	0.280
$\hat{a}_{S2}$	0.170	0.440	0.150	0.000	-0.967	0.000	0.000	0.000	0.000	0.342
$\hat{a}_{S3}$	0.078	0.508	0.110	0.000	0.000	-0.920	0.000	0.000	0.000	0.224
$\hat{a}_{S4}$	0.064	0.356	0.030	0.000	0.000	0.000	-0.812	0.000	0.000	0.362
$\hat{a}_{S5}$	0.104	0.401	0.060	0.000	0.000	0.000	0.000	-0.999	0.074	0.360
$\hat{a}_{S6}$	0.050	0.286	0.060	0.000	0.000	0.000	0.000	0.000	-0.926	0.530
$\hat{a}_K$	0.070	0.466	0.048	0.006	0.000	0.001	0.000	0.000	0.050	-0.642

Table 5. Price Elasticities of Factor Prices

^	p_B	p_H	p_P	p_R	p_F	p_C
w_S	1.316	0.478	0.025	0.000	0.000	0.768
w_U	1.578	0.066	0.029	0.000	0.000	0.541
w_E	1.467	0.130	0.525	0.001	0.004	2.066
w_{S1}	5.462	-0.966	-0.435	-0.010	-0.032	-3.019
w_{S2}	-22.558	28.520	-0.084	-0.008	-0.023	-5.012
w_{S3}	-8.045	-0.062	11.773	-0.004	-0.011	-2.776
w_{S4}	-2.349	-0.066	-0.022	5.318	-0.005	-1.876
w_{S5}	- 6.961	-0.327	-0.272	-0.005	13.319	-4.755
w_{S6}	- 2.624	-0.145	-0.118	-0.007	-0.021	3.916
r_K	0.443	0.026	0.057	0.001	0.003	1.470

Table 6. Elasticities of Outputs with Respect to Prices

^	p_B	p_H	p_P	p_R	p_F	p_C
x_B	4.462	-0.966	-0.435	-0.010	-0.032	-3.019
x_H	-22.558	27.520	-0.084	-0.008	-0.023	-5.012
x_P	-8.045	-0.062	10.773	-0.004	-0.008	-2.776
x_R	-2.349	-0.066	-0.022	4.318	-0.011	-1.876
x_F	-7.282	-0.341	-0.283	-0.004	13.306	-5.396
x_C	-2.624	-0.145	-0.118	-0.007	-0.021	2.916

Table 7. Trade Liberalization with Projected Price Changes, Simulation 1

(1) Predicted %Δp		(2) Factor prices		(3) Outputs	
$\hat{p}_B$	-1.5%	$\hat{w}_S$	-6.8%	$\hat{x}_B$	-20.0%
$\hat{p}_H$	-2.0%	$\hat{w}_U$	-4.9%	$\hat{x}_H$	-45.9%
$\hat{p}_P$	1.0%	$\hat{w}_E$	13.3%	$\hat{x}_P$	9.0%
$\hat{p}_R$	-7.0%	$\hat{w}_{S1}$	-21.5%	$\hat{x}_R$	-35.9%
$\hat{p}_F$	-8.0%	$\hat{w}_{S2}$	-47.9%	$\hat{x}_F$	-100%
$\hat{p}_C$	5.0%	$\hat{w}_{S3}$	10.0 %	$\hat{x}_C$	18.9%
		$\hat{w}_{S4}$	-42.9%		
		$\hat{w}_{S5}$	-100.0%		
		$\hat{w}_{S6}$	23.9%		
		$\hat{r}_K$	7.9%		

Table 8. Trade Liberalization with Projected Price Changes, Simulation 2 and 3

(1) Predicted %Δp (Simulation 2)		(2) Factor Prices %Δp (Simulation 2)		(3) Predicted %Δp (Simulation 3)		(4) Factor Prices %Δp (Simulation 3)	
$\hat{p}_B$	-4.0%	$\hat{w}_S$	8.9%	$\hat{p}_B$	-4.0%	$\hat{w}_S$	-37.2%
$\hat{p}_H$	-8.9%	$\hat{w}_U$	5.0%	$\hat{p}_H$	-8.9%	$\hat{w}_U$	-24.7%
$\hat{p}_P$	15.0%	$\hat{w}_E$	7.9%	$\hat{p}_P$	15.0%	$\hat{w}_E$	-8.7%
$\hat{p}_R$	-35.2%	$\hat{w}_{S1}$	-100%	$\hat{p}_R$	-35.2%	$\hat{w}_{S1}$	-100%
$\hat{p}_F$	-8.0%	$\hat{w}_{S2}$	-100%	$\hat{p}_F$	-8.0%	$\hat{w}_{S2}$	-100%
$\hat{p}_C$	35.0%	$\hat{w}_{S3}$	48.6%	$\hat{p}_C$	-50.0%	$\hat{w}_{S3}$	213%
		$\hat{w}_{S4}$	-100%			$\hat{w}_{S4}$	-100%
		$\hat{w}_{S5}$	-100%			$\hat{w}_{S5}$	-100%
		$\hat{w}_{S6}$	148%			$\hat{w}_{S6}$	-100%
		$\hat{r}_K$	52.2%			$\hat{r}_K$	-68.2%