Optimum Level and Welfare Effects of Export Taxes for Cocoa Beans in Indonesia: A Partial Equilibrium Approach

Risti Permani – University of Adelaide [1]
David Vanzetti – Australian National University
Nur Rakhman Setyoko – Ministry of Trade Republic of Indonesia

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Abstract

Aiming to support downstream processing, the Indonesian government announced an export tax in May 2010. Using a partial equilibrium approach, this paper therefore attempts to analyse: (i) whether the Indonesian government has imposed optimal taxes on cocoa beans; (ii) the impacts of cocoa export taxes on domestic welfare. In particular, it attempts to develop a two-stage partial equilibrium welfare analysis in which effects of policy for upstream sectors may affect downstream sectors. The study also presents thorough econometric estimates of import demand, export supply, Armington and cross elasticities using the Vector Error Correction Model (VECM) to deal with cointegration and simultaneity issues. A literature search suggests that existing studies not only report mixed results but also use methods, mostly the Ordinary Least Squares (OLS) model, which could not deal with cointegration and simultaneity issues. Three key lessons can be drawn for this study. First, an export tax on Indonesian exports of cocoa beans would indeed divert some of the crop to domestic use. However, this leads to significant losses to cocoa bean producers and does little to develop a processing sector. Second, interdependence between major cocoa exporting countries' policy is evident. Third, due to limited readily available data, better econometric techniques do not necessarily lead to improved robustness of estimates of elasticities. This could significantly affect estimates of optimal export taxes and, therefore, analysis of welfare effects.

Keywords: cocoa, Indonesia, export taxes, partial equilibrium analysis, welfare effects, vector error correcting method.

JEL codes: F17

[1] Corresponding author: risti.permani@adelaide.edu.au

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1. Introduction

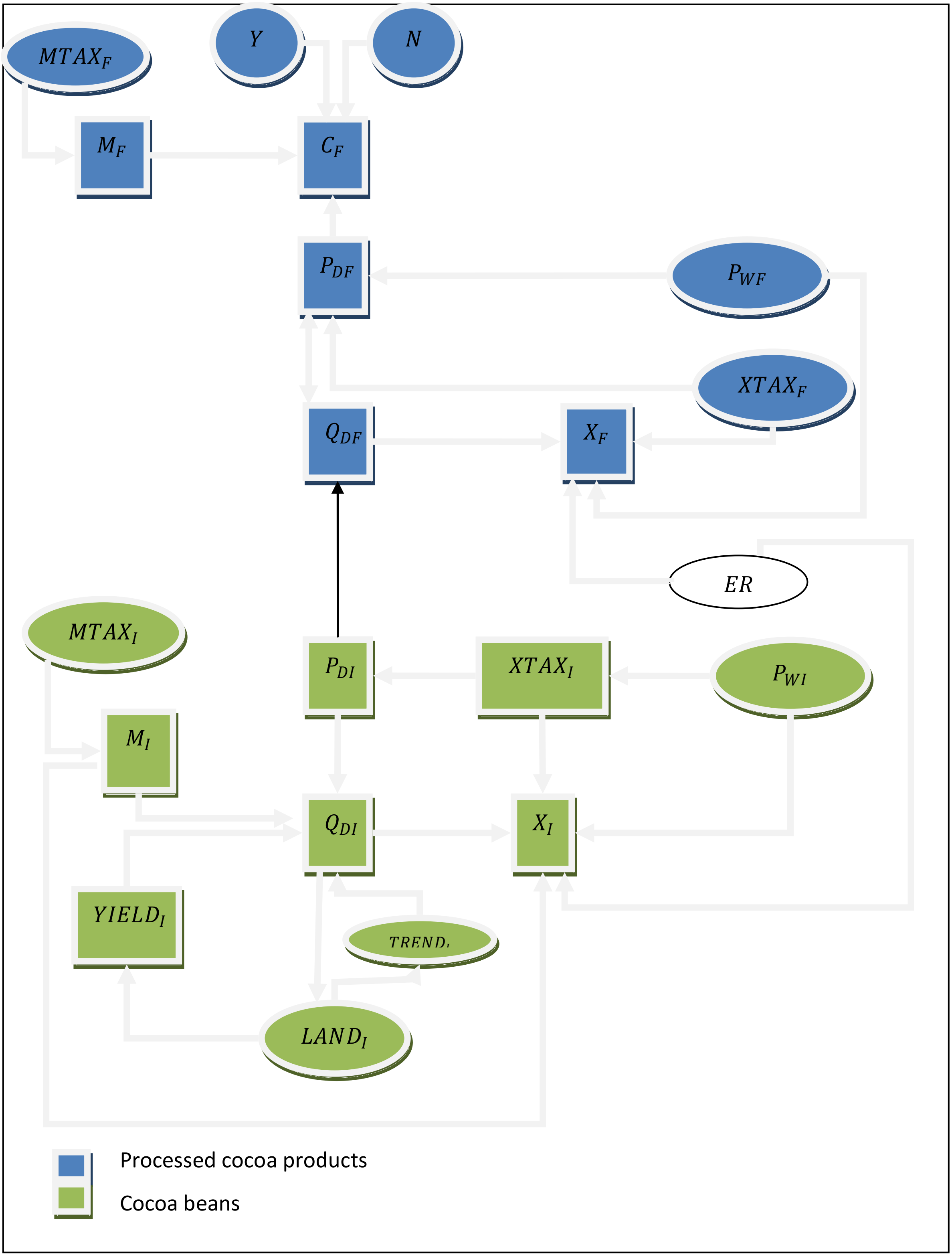
The Indonesia cocoa sector is an export-oriented industry. The sector produced around 800 thousand tonnes in 2008 and exported around 65 per cent of its domestic production. In 2008, cocoa exports were valued at US$1.3 million - ranked the third largest export commodity in the plantation sub-sector after palm and rubber. As the third largest producer of cocoa in the world after Ghana and the Ivory Coast, Indonesia's biggest competitive advantages include its low cost, high production capacity (availability of supply), efficient infrastructure and open trading/marketing system (business environment) (Panlibuton and Lusby 2006). However, with such high shares of domestic production exported to the world market, the Indonesia government argues that there is not enough incentive for developing domestic processing manufacturing of cocoa beans. Downstream industries often experience shortage in cocoa beans supply. Therefore, the Indonesian government announced an export tax in May 2010.

The export tax was introduced to promote investments in downstream value-added activities in Indonesia.2 Its rate was set as high as 15 per cent. The implementation of tax rates obviously has attracted some criticism from cocoa exporters – represented by the Indonesian Cocoa Association (ASKINDO). Unfortunately, it is likely the farmers who will suffer most. ASKINDO claims the levies will reduce the total income of cocoa farmers by Rp 1.5 trillion ($165 million) a year (Ekawati 2010). ASKINDO claims exporters would cover losses resulting from the tax by paying less to farmers for cocoa beans, significantly lowering the income of growers (Ekawati 2010). In May 2008, international cocoa prices were around $2,800 a tonne, meaning that exporters would have to pay 10 per cent or $280 a tonne in tax. ASKINDO claims that in response to the tax exporters would lower the price paid to farmers by 22 per cent from Rp 23,000 to Rp 18,000 a kilogram (Ekawati 2010). It is unclear what the impacts of cocoa export taxes on the whole economy might be.

This paper therefore attempts to analyse: (i) the impacts of cocoa export taxes on domestic welfare; (ii) whether the Indonesian government has imposed optimal taxes on cocoa beans. In particular, it attempts to develop a two-stage partial equilibrium welfare analysis in which effects of policy for upstream sectors may affect downstream sectors as presented by Figure 1. The study also provides econometric estimates of import demand and export supply elasticities using Vector Error Correction Model (VECM) to deal with cointegration and simultaneity issues. Literature search suggests that existing studies on cocoa beans use methods, mostly the Ordinary Least Squares (OLS) model, that could not deal with these two problems (Burger 2008).

2 The tax rate will fluctuate depending on the average monthly cocoa futures price on the US market. If the world prices are less than $2,000 a tonne, no tax will be imposed. For the price range from $2,000 to $2,750 a tonne, exports will be subject to a 5% tax. If the world price reaches $2,750 to $3,500 a tonne, the rate will rise to 10% and if the price is more than $3,500 a tonne, it will top out at 15%.

Figure 1 Cocoa beans sectors in Indonesia



Source: Author

2. Background and review of relevant literature

As a tropical tree crop, in the past cocoa was only produced in developing countries on and around the equator, but the trade pattern has slightly changed. Thirty years ago, countries like Côte d'Ivoire, Brazil, Ghana, Nigeria, Cameroon, Ecuador, Mexico, Colombia and Malaysia were among the top ten cocoa exporter countries (Figure 2). Together, they accounted for over 80 per cent of the world cocoa production. A big proportion of cocoa consumption occurred in developed countries.

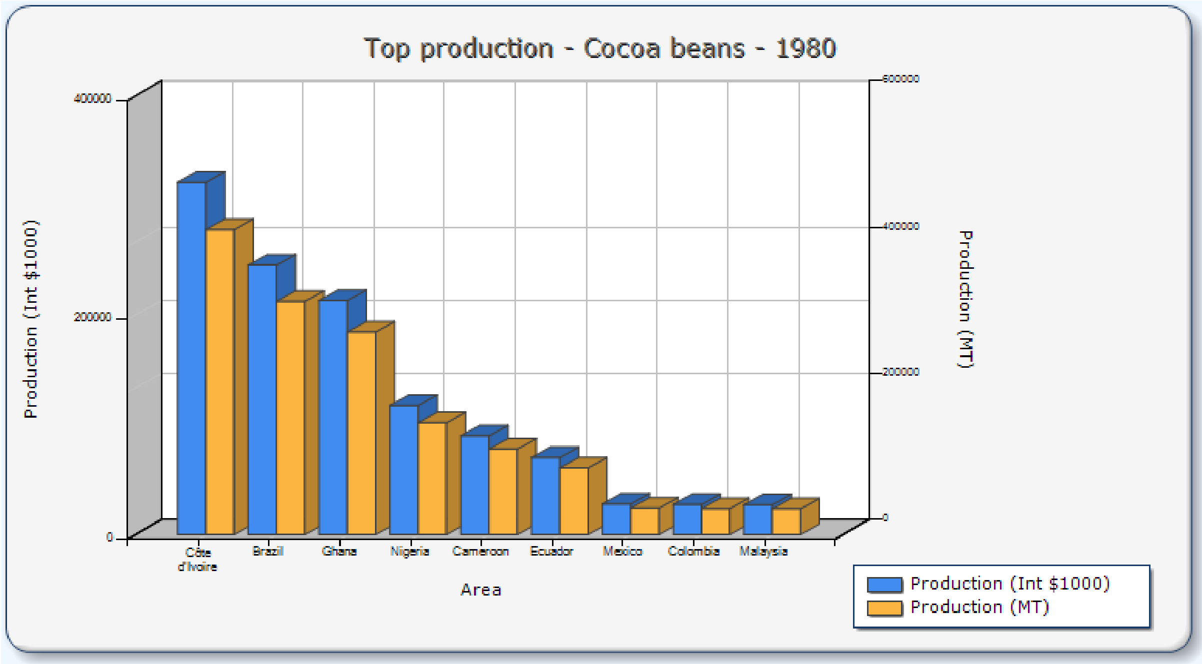
Over the decades, there have been quite significant shifts. In 2007, Côte d'Ivoire and Ghana were still among the biggest cocoa beans exporters (Figure 3). Indonesia has moved up significantly becoming the third largest cocoa bean exporter accounting for 18 per cent of the world's cocoa bean production and 14 per cent of the world's cocoa bean export in 2007. Two developed countries, The Netherlands and Belgium, where chocolate manufacturing is centred, are now among the major cocoa beans exporters. The countries import and re-export beans.

Despite the addition of The Netherlands and Belgium in the top ten major cocoa beans exporters, fluctuations in the world cocoa bean market have consistently been created by major exporting countries, particularly Côte d'Ivoire. While Figure 4 presents no common pattern in yield across major exporting countries and the rest of the world (ROW), Figures 5 and 6 suggest that trends in export volume and prices have been consistently following those of major exporting countries, particularly Côte d'Ivoire.

The above condition could be troublesome for Indonesia's cocoa beans exports. First, as indicated by common trends in the export prices across competing exporters, the introduction of export taxes, if it leads to increased export prices at the world market, most likely leads to a reduction in market share. Cocoa beans are primarily used in the manufacturing of chocolate confectioneries and account for approximately 20 per cent of total inputs in chocolate manufacturing. There are only a few multinational companies controlling the global chocolate production, while there are thousands of cocoa farmers (Yilmaz 1999). Hence, the global cocoa market is not perfectly competitive. The role of governments in big exporting countries could affect the world price (Yilmaz 1999). It is unclear whether Indonesia's position provides market power to affect the world cocoa beans price by the implementation of export taxes. To some extent, it depends on the substitutability between Indonesia's cocoa beans and cocoa beans from other countries.

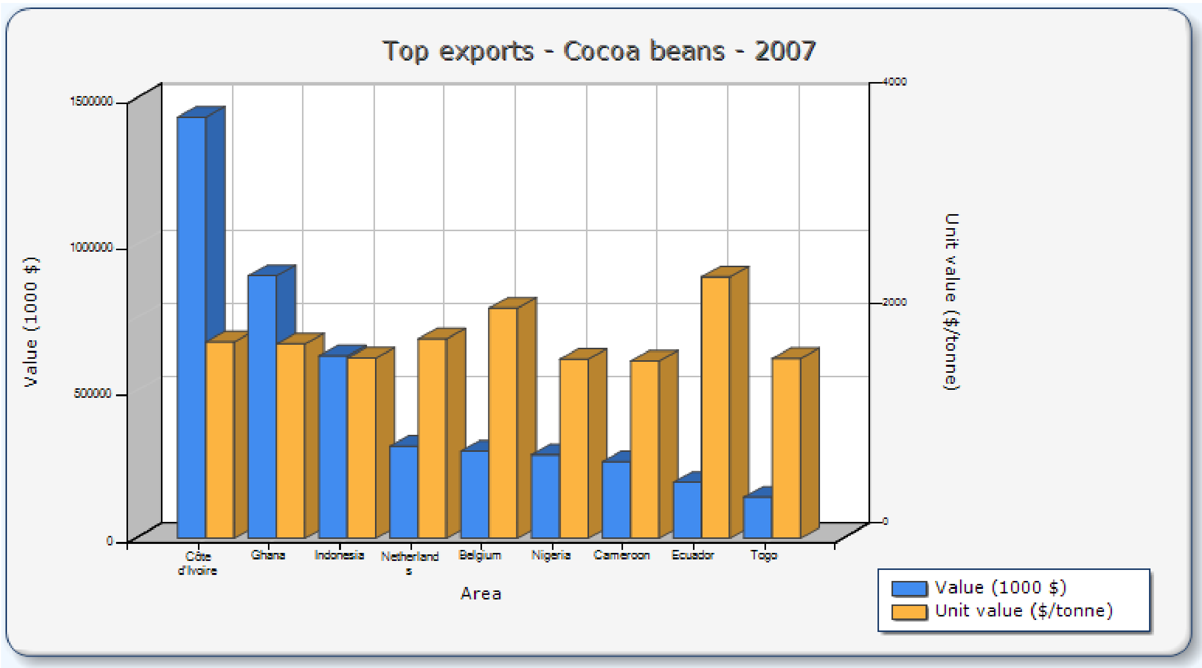
The challenge becomes more evident as the top three exporters, Côte d'Ivoire, Ghana and Indonesia, share similar markets, especially European countries, North American countries (particularly the United States) and Malaysia as suggested by Figures 7, 8 and 9. Hence, assuming a free trade global cocoa bean market and perfect substitutability between cocoa beans from various countries, importers can easily switch their demand to other exporting countries, especially Côte d'Ivoire and Ghana, if Indonesia taxes its cocoa bean exports. Despite the possible effects of export taxes, Indonesia also has limited area of production compared to other exporters (Figure 10).

Figure 2 World's cocoa beans top exports in 1980



Source: FAO Statistics (http://faostat.fao.org/site/342/default.aspx)

Figure 3 World's cocoa beans top exports in 2007



Source: FAO Statistics (http://faostat.fao.org/site/342/default.aspx)

Figure 4 Yield (1961-2007)

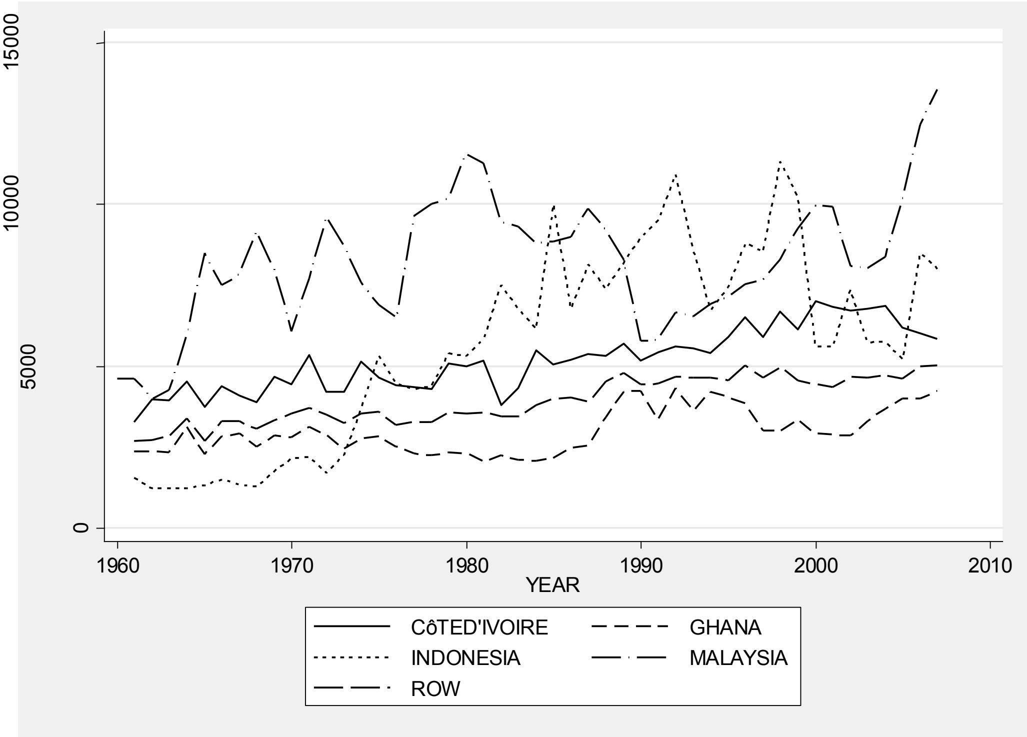


Figure 5 Cocoa beans export (1961-2007)

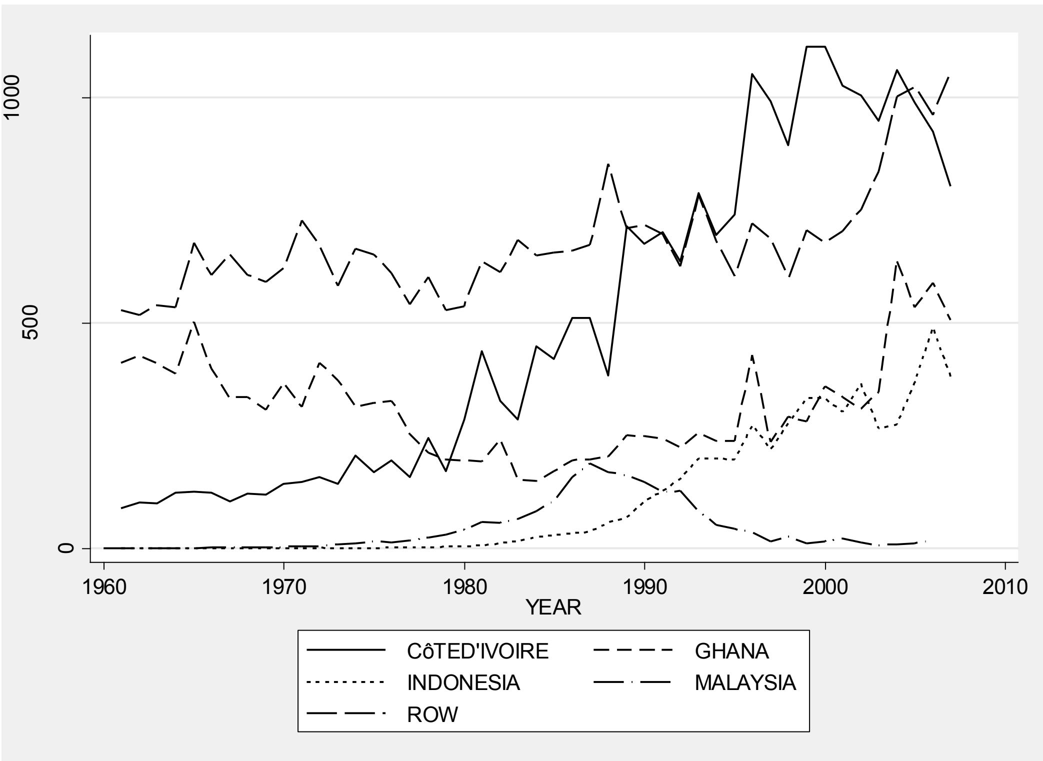


Figure 6 Export price (1961-2007)

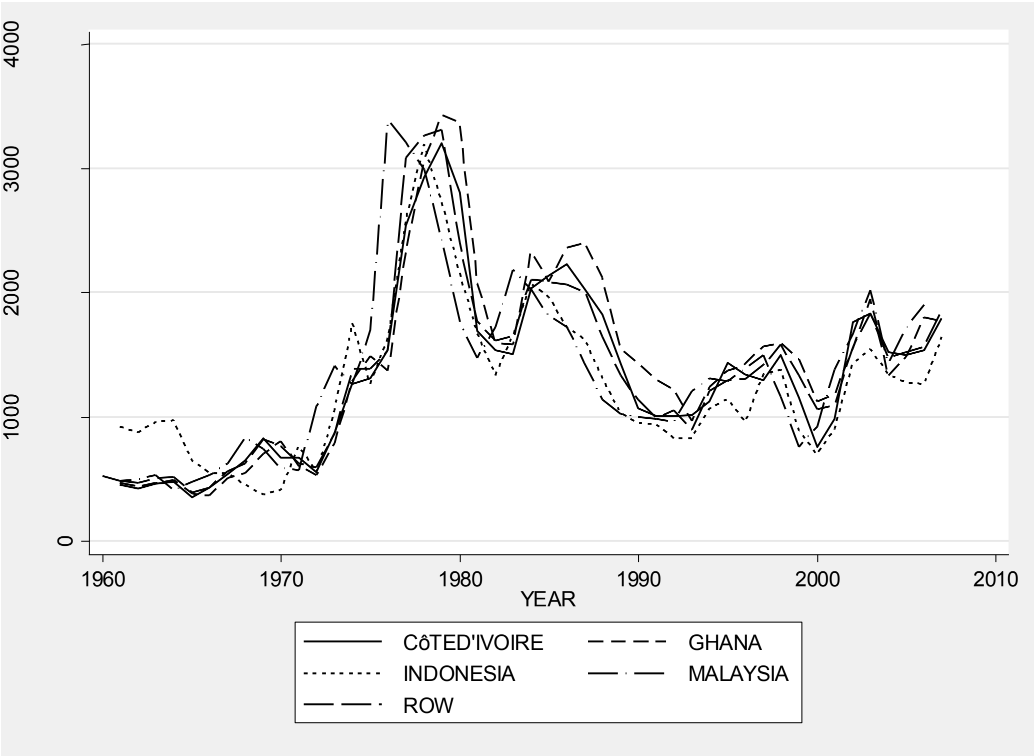
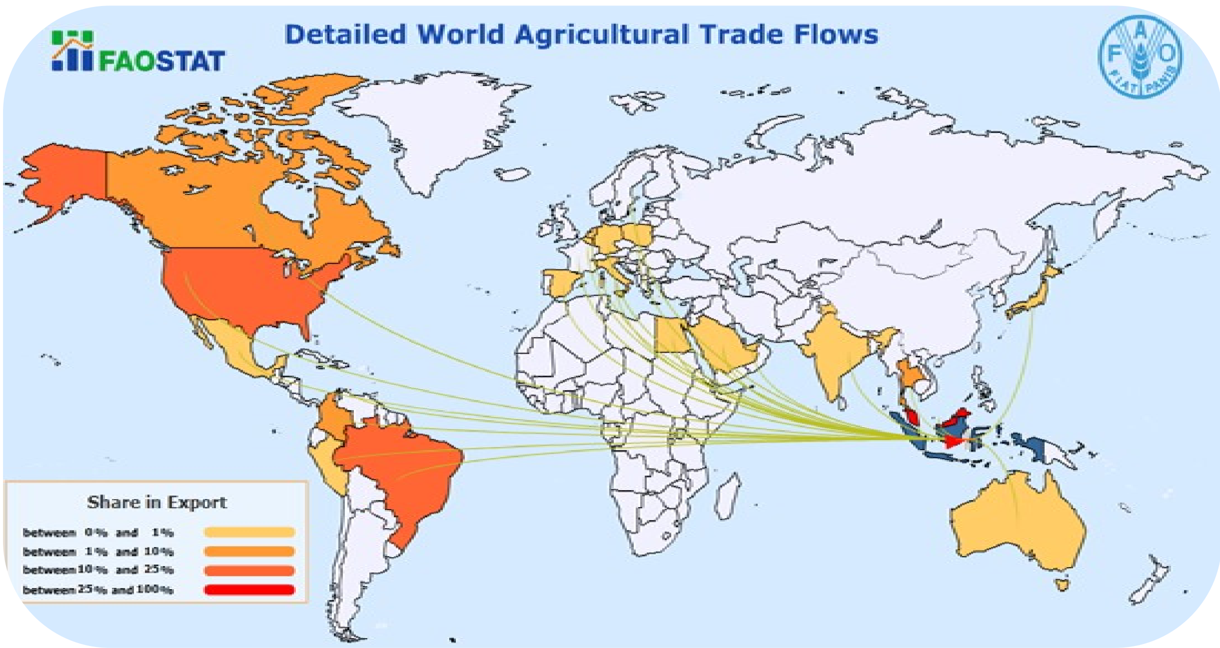


Figure 7 Indonesia's cocoa beans exports in 2007



Source: FAO statistics
(http://faostat.fao.org/DesktopModules/Faostat/WATFDetailed2/watf.aspx?PageID=536)

Figure 8 C'ote D'ivoire's cocoa beans exports in 2007

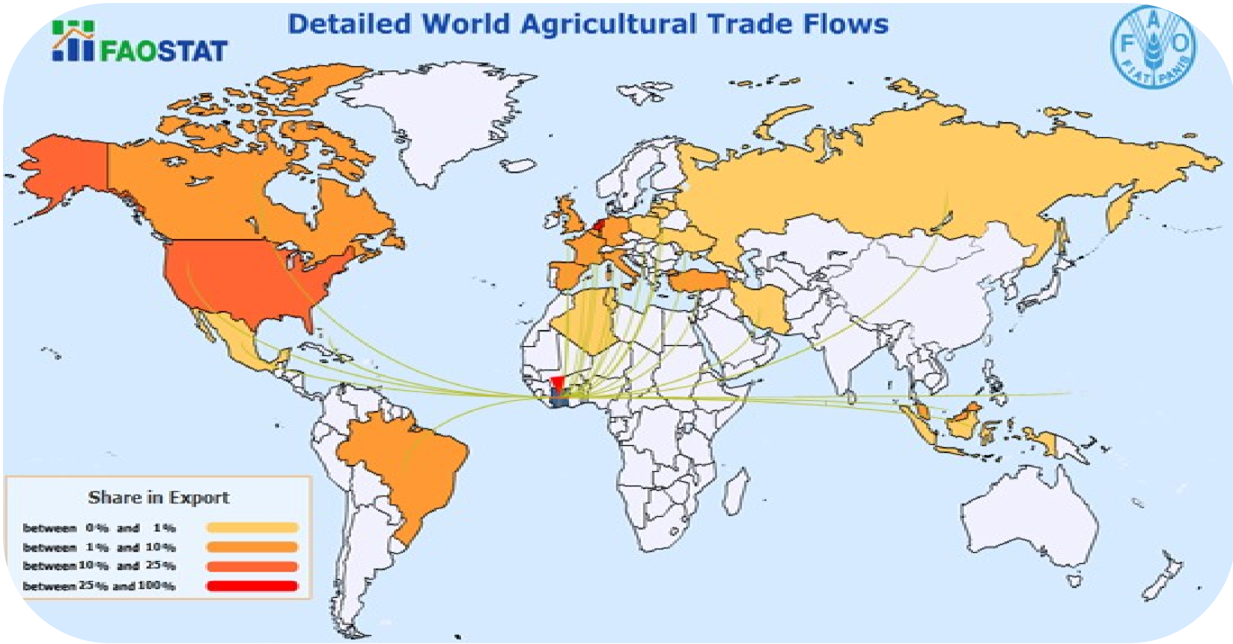


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Figure 9 Ghana's cocoa beans exports in 2007

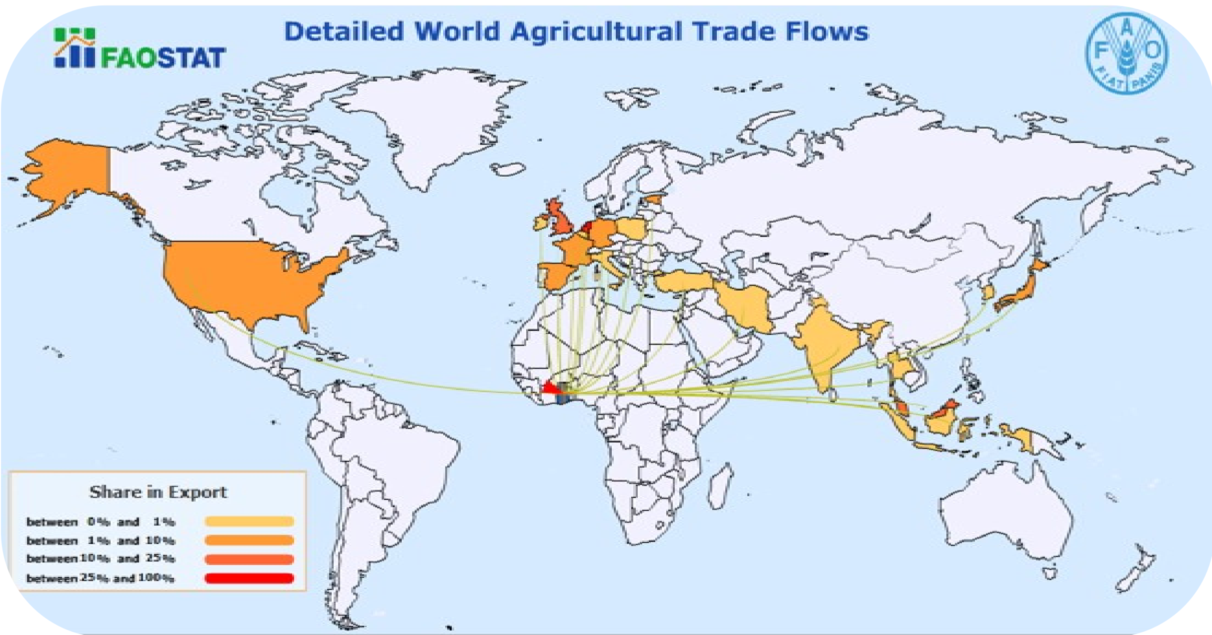

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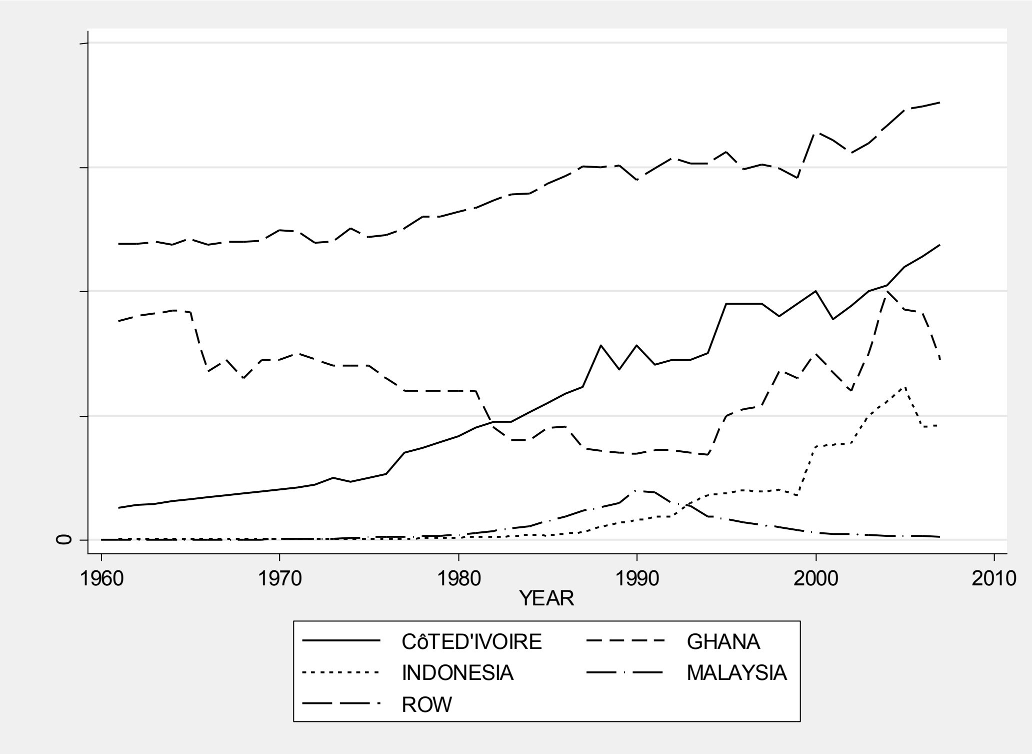
Figure 10 Area (1961-2007)

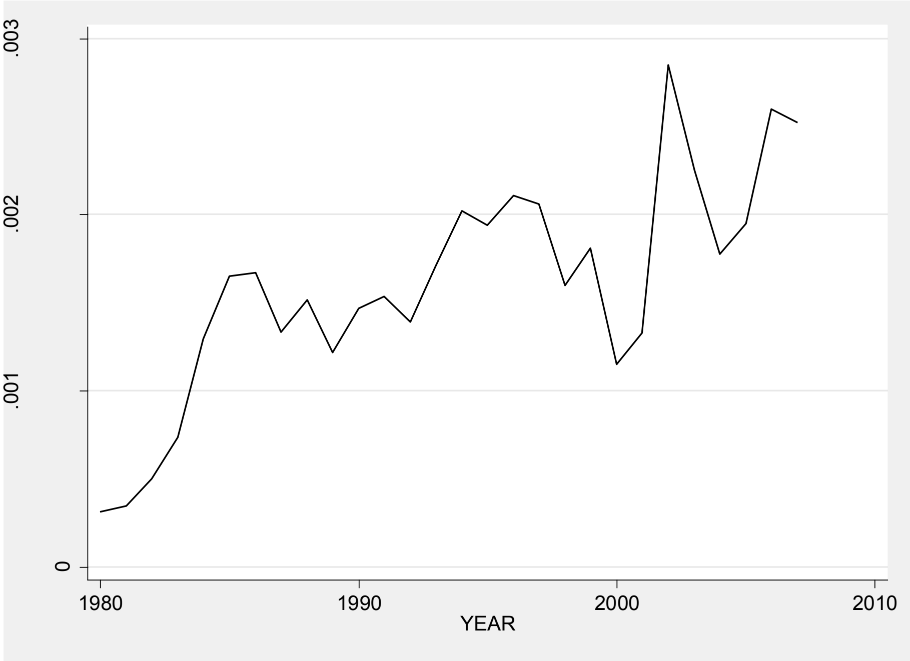


Export taxation is very common in underdeveloped countries which export primary products. Some of the most often cited justifications for the use of these methods of taxation are: (i) to reduce impacts of volatile world markets for primary products on the economy; (ii) to collect revenue; (iii) to encourage domestic use of the exported product; and (iv) to reduce rapid depletion of domestic resources. In the case of Indonesia's beans, the third objective dominates other objectives. The remaining question is whether the tax rate currently imposed is optimal and whether Indonesia will still be able to compete in the world market.

To estimate welfare effects of export taxes for cocoa beans in Indonesia, the present paper uses a partial equilibrium (PE) model. The application of the PE analysis to analyse welfare effects of export taxes for cocoa beans is suitable because of its small contribution to the overall trade. The only sector that is directly affected is cocoa manufacturing. This sector is part of the present study.

Most studies on export taxes focus on what should be the optimal export tax rate –a level which maximises welfare. (Yilmaz 1999; Kinnucan and Zhang 2004; Burger 2008; ICCO 2008). It is commonly defined as an inverse function of the relative market share and a direct function of the supply elasticities of other countries. Domestic demand and supply conditions are commonly found to have no effect on the level of optimum trade taxes. World demand for the commodity is assumed to be a log-linear function of world price. Yet, having similar theoretical baselines does not necessarily lead to similar estimates of optimal export tax rates.

Figure 11 Indonesia's exports (per cent Total exports volume)



Source: Author's calculation, percentages of total exports in GDP, GDP (PPP,current $) data are from World Development Indicator Online; Cocoa exports volume data are from FAO statistics.

One reason for mixed results in estimates of optimal export tax rates is variation in elasticities. In the case of cocoa beans, two of the most recent studies are by Burger (2008) and International Cocoa Organization (ICCO) (2008). Table 1 presents differences in estimates yielded by these two studies. It is therefore important to carefully estimate elasticities.

Earlier econometric studies estimating elasticities of supply have been focusing on how to deal with simultaneity between prices and volume of exports as well as cointegration issues (Goldstein and Khan 1978; Riedel 1988; Muscatelli, Srinivasan et al. 1992).[3] More recently, Abbott and De Vita (2002) test whether the long-run structural restrictions implied by economic theory are supported by the data. The present study therefore follows their approach by applying the Vector Error Correction Model (VECM).

3 The long-run export demand equation was introduced by Goldstein and Khan (1978) taking into account simultaneity between export volume and export prices by using a simultaneous regression analysis. Then, Riedel (1988) develops the system to include the supply side where he adds the manufacturing wages as an endogenous variable. Muscatelli et. al. (1992) simplifies Riedel's model by assuming that wages are exogenous.

Table 1 Different estimates of elasticities of cocoa beans supply

Study	Burger (2008)	ICCO (2008)
Estimation method	OLS	either cointegration analysis or OLS depending on the presence of cointegration in data
Côte d'Ivoire	0.15	0.58
Ghana	0.24	0.64
Indonesia	0.18	0.37
Malaysia	0.20	0.51
Nigeria	0.20	0.22
Cameroon	0.25	0.60
Brazil	0.33	0.67
World	0.17	0.55

3. A Theoretical Baseline

Let us assume that there are N countries producing and exporting the commodity to consumers in the rest of the world (ROW). Assuming that consumers cannot affect the world price, the world demand is a function of the world price:

$\boldsymbol{D} = \boldsymbol{D}(\boldsymbol{p}), \boldsymbol{D}^{'} < 0$ **Equation 1**

The log linear supply function for country i, $i = 1,2,\dots,N$ is a function of the domestic price of cocoa:

$\boldsymbol{Q_i} = \boldsymbol{g_i}\big((\boldsymbol{1} - \boldsymbol{\tau_i})\boldsymbol{p}\big), \boldsymbol{g}_{\boldsymbol{i}}^{'} > 0$, $\boldsymbol{i} = \boldsymbol{1}, \boldsymbol{2}, \dots, \boldsymbol{N}$ **Equation 2**

Where $\tau_i$is the ad valorem export tax in country i.

The producer price in country i is:

$\boldsymbol{p_i} = (\boldsymbol{1} - \boldsymbol{\tau_i})\boldsymbol{p}(.)$ **Equation 3**

Residual demand facing country i, D_i is defined as the world demand minus supply in the other producing countries and, therefore, is a function of export tax rates of other producing countries:

$\boldsymbol{D_i}(\boldsymbol{p}, \boldsymbol{\tau_{-i}}) = \boldsymbol{D}(\boldsymbol{p}) - \boldsymbol{D_{ROW}}$ **Equation 4**

Where $D_{ROW} = \sum_{j \neq i}^{N} g_j \left(\left(1 - \tau_j\right)p\right)$, $D_{i,p} < 0$ and $D_{i,\tau j} > 0$ for $j \neq i$. τ_{-i} is an $N - 1$ vector which contains export tax rates of countries excluding country i.

World market equilibrium is achieved when at a given p $D_i$is equal to the supply produced by country i, Q_i:

$\boldsymbol{D_i}(\boldsymbol{p}, \boldsymbol{\tau_{-i}}) = \boldsymbol{Q_i}\big((\boldsymbol{1} - \boldsymbol{\tau_i})\boldsymbol{p}\big)$, $\boldsymbol{i} = \boldsymbol{1}, \boldsymbol{2}, \dots, \boldsymbol{N}$ **Equation 5**

Solving the equilibrium condition, the world price can be written as an increasing function of the export tax rates in countries $i = 1,2,\dots,N$.

$\boldsymbol{p = p(\tau_1, \dots, \tau_N)}$ **Equation 6**

Marginal changes imply:

$\boldsymbol{\delta Q_i(.) = \delta D(.) - \delta Q}$ **Equation 7**

For a given change in D_i i.e. δD_i, we obtain:

$$\frac{\delta Q_i}{\delta p} = \underbrace{\left(\frac{\delta D_i}{\delta p}\frac{p}{D_i}\right)}_{\eta_i}\frac{D_i}{p} - \underbrace{\left(\frac{\delta Q_{ROW}}{\delta p}\frac{p}{Q_{ROW}}\right)}_{\sigma_{ROW}}\underbrace{\left(\frac{Q_{ROW}}{D_i}\right)}_{S_{ROW}}\frac{D_i}{p} \quad \textbf{Equation 8}$$

Or,

$$\frac{\delta Q_i}{\delta p} = -(\eta_i + \sigma_{ROW}S_{ROW})\frac{D_i}{p} \quad \textbf{Equation 9}$$

Where $-\eta_i$ is the demand elasticity for country i, σ_{ROW} the supply elasticity of the rest of the world and S_{ROW} the rest of the world's share in total world production. We can rewrite the effect of a change in Q_i on the world's market price p:

$$\frac{\delta p}{\delta Q_i} = -\left(\frac{p}{Q_i}\right)\frac{S_i}{\eta_i + \sigma_{ROW}(1 - S_i)} \quad \textbf{Equation 10}$$

Where $S_i$is the share of country $i$in total world production i.e. $S_{ROW} + S_i = 1$. The last factor of the right hand side of the equation is the inverse of the demand elasticity for country i.

Yilmaz (2009) argues that since only an insignificant amount of cocoa is consumed in the exporting countries, social welfare of country Π_i is equivalent to the profits of the cocoa sectors, plus tax revenue from cocoa exports. Country i takes other countries' export tax rates $\bar{\tau}_j$ for $j \neq i$as given and chooses its export tax rate to maximise its social welfare.

$$\Pi_i = p(\tau_i, \bar{\tau}_{-i})Q_i(p(.), \bar{\tau}_{-i}) - C(Q_i) \quad \textbf{Equation 11}$$

Where the total cost of producing D_i amount of cocoa is $C(D_i)$. At the profit maximising output, marginal cost is equal to domestic price:

$$\frac{\delta C(Q)}{\delta Q_i} = (1 - \tau_i^*)p. \quad \textbf{Equation 12}$$

The first order condition for the welfare maximisation of country i is:

$$\frac{\delta \Pi_i}{\delta \tau_i} = \frac{\delta p}{\delta \tau_i}\left(D_i + p(.)\frac{\delta D_i}{\delta p}\right) - \frac{\delta C_i}{\delta \tau_i} = 0 \quad \textbf{Equation 13}$$

Or,

$$\frac{\delta p}{\delta Q_i}\frac{\delta Q_i}{\delta \tau_i}Q_i + p\frac{\delta Q_i}{\delta \tau_i} - \frac{\delta C_i}{\delta Q_i}\frac{\delta Q_i}{\delta \tau_i} = 0 \quad \textbf{Equation 14}$$

Or,

$$\left(\frac{\delta p}{\delta Q_i} Q_i + p - \frac{\delta C_i}{\delta Q_i}\right)\frac{\delta Q_i}{\delta \tau_i} = 0 \quad \textbf{Equation 15}$$

Assuming,

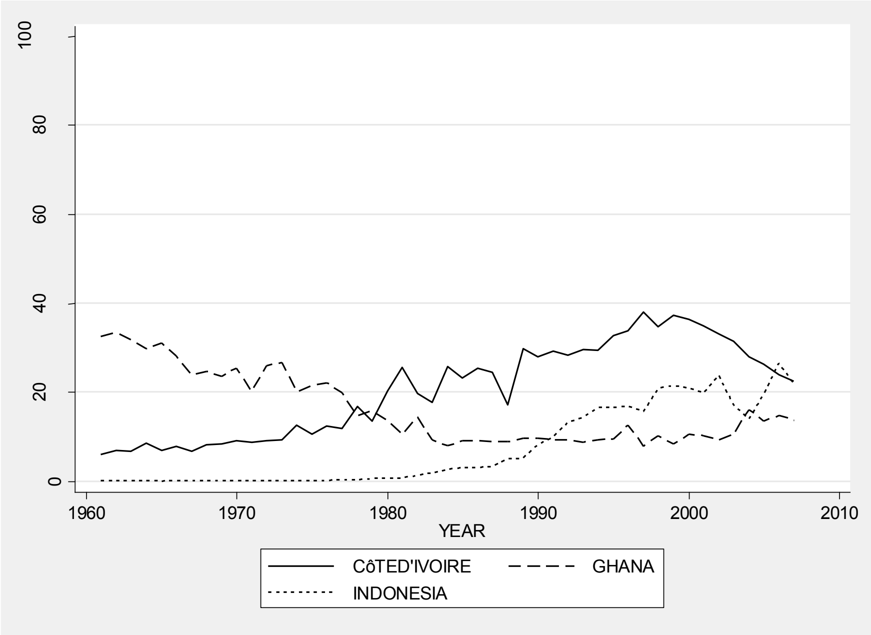
$$\frac{\delta Q_i}{\delta \tau_i} \neq 0, \frac{\delta C_i}{\delta Q_i} = p + Q_i \frac{\delta p}{\delta Q_i}. \quad \textbf{Equation 16}$$

Substituting $\frac{\delta C_i}{\delta Q_i}$ and $\frac{\delta p}{\delta Q_i}$ from previous derivations, we obtain:

$$\tau_i^* = \frac{S_i}{\eta_i + \sigma_{ROW}(1 - S_i)} \quad \textbf{Equation 17}$$

The optimal tax rates rises with the country's market share in world production (S_i) and decreases with world's demand elasticity for country i (η_i) and the rest of the world's supply elasticity (σ_{ROW}). As illustration, we set $\eta_{INDONESIA} = 01.60, \eta_{GHANA} = 0.90$, $\eta_{COTED'IVOIRE} = 0.92$ and $\sigma_{ROW} = 0.55$ as suggested by ICCO (2008). Given these parameters, Figure 12 presents optimal tax rates for three major producing cocoa beans allowing changes in shares of exports over the period. Given Indonesia's current market share, the 10 per cent export tax rate is very close to the optimal tax rate based on these parameters. We later clarify whether the assumed parameters are supported by robust empirical results.

Figure 12 Predicted optimal tax rates (Parameters based on assumptions)



Notes: See text about assumed parameters.

To estimate welfare effects, we use the GSIM modelling framework provided by Francois (2009). This approach provides a simple framework that requires users to supply their own data and parameters. We simplify the global cocoa market into five groups: Indonesia, Malaysia, Côte d'Ivoire, Ghana and the rest of the world (ROW).

Let us redefine demand for exports from country i by country j is a function of price of cocoa from country i in country j $(p_{i,j})$, price of cocoa from other exporting countries $(p_{-i,j})$ and total expenditure of importing country j on cocoa import (y_j) :[4]

$$\boldsymbol{D_{i,j} = Q_i(p_{i,j}, p_{-i,j}, y_j)} \qquad \textbf{Equation 18}$$

Francois (2009) assumes that export demand follows CES production function.

Importing country j sees the price of cocoa from country i at:

$$\boldsymbol{p_{i,j} = (1 + t_{i,j})p} \qquad \textbf{Equation 19}$$

[4] Note that the world price $p(.)$ is a function of price of each exporting country and in turn the price of an exporting country is a function of its tax rate and its competitor's tax rates. This is parallel to Equation (5) where we define the world price as a function of exporting countries' tax rates. The optimum export tax rates suggest that the tax rate is a function of shares of export from country i (S_i). We further define S_i as a function of total export demanded by country j (y_j). Therefore we can define demand for export from country i as:

$$D_i(p, \tau_{-i}) = D_i\left(p\left(p_{-i}\left(\tau_{-i}\left(S_i(y_j)\right)\right)\right)\right) = Q_i(p_i, p_{-i}, y_j)$$

Note that the producer price in country i is $p_i = (1 - \tau_i)p$ where $\tau_i$is the export tax rate. Hence we can define:

$$\boldsymbol{p_{i,j} = (1 + t_{i,j})\left(\frac{p_i}{1-\tau_i}\right)}$$ **Equation 20**

We define country i's export supply as:

$$\boldsymbol{X_i = c_1 p^{\sigma_i}}$$ **Equation 21**

Where $\sigma_i$is elasticity of export supply from country i.

The method by Francois (2009) requires calculation of two elasticities in addition to elasticities of export supply, import demand and substitution, namely own-price and cross-price elasticities. Let us define import share of cocoa from country i in country j at internal price – that is price of cocoa from country i received by consumers in country j $(p_{i,j})$:

$$\boldsymbol{\theta_{i,j} = \frac{M_{i,j}(1+t_{i,j})}{\sum_{\forall i} M_{i,j}(1+t_{i,j})}}$$ **Equation 22**

Similarly, export shares of cocoa from country i is:

$$\boldsymbol{\phi_{i,j} = \frac{M_{i,j}}{\sum_{\forall j} M_{i,j}}}$$ **Equation 23**

The own-price elasticity is therefore:

$$\boldsymbol{\gamma_{i,j} = \theta_{i,j}\eta_i - (1 - \theta_{i,j})\omega_i}$$ **Equation 24**

Where η_i is elasticity of import demand of country i and ω_i elasticity of substitution of country i.

The cross-price elasticity is:

$$\boldsymbol{\gamma'_{i,j} = \theta_{i,j}(\eta_i + \omega_i)}$$ **Equation 25**

The world equilibrium suggests that for country i change in import demand equals to change in export supply. Change in export supply can be defined as:

$$\boldsymbol{\dot{M}_{i,\forall j} = \sum_{\forall j} \phi_{i,j}\gamma_{i,j}(\dot{p}'_{i,j} + \dot{t}_{i,j}) + \sum_{\forall j} \phi_{i,j}\overline{\gamma'_{i,j}}}$$ **Equation 26**

Where $\dot{x}$ denotes change such that $\dot{x} = \frac{\delta x}{x}$; $p_{i,j}{}'$is the new price after the implementation of a new trade policy (i.e. export taxes). $\overline{\gamma'_{i,j}}$ is cross price effects on demand which can be calculated from the following equation:

$$\boldsymbol{\overline{\gamma'_{i,j}} = \sum_{\forall -i} \gamma_{-i,j}(\dot{p}'_{-i,j} + \dot{t}_{-i,j})}$$ **Equation 27**

Change in consumer surplus:

$$\boldsymbol{\Delta CS = 0.5\dot{p}_C{}^2 \sum_{\forall i} M^0_{i,j}T^0_{i,j}\eta_i(SIGN(\dot{p}_C)) - \sum_{\forall i} M^0_{i,j}T^0_{i,j}\dot{p}_C}$$ **Equation 28**

Tariff revenue = $\left(\sum_{\forall_i} \boldsymbol{M^{1}_{i,j} T^{1}_{i,j}} - \sum_{\forall i} \boldsymbol{M^{1}_{i,j}}\right) - \left(\sum_{\forall i} \boldsymbol{M^{0}_{i,j} T^{0}_{i,j}} - \sum_{\forall i} \boldsymbol{M^{0}_{i,j}}\right)$ **Equation 29**

$$\boldsymbol{\Delta PS = p_i^{'}\left(\sum_{\forall j} X^{0}_{i,j}\left(1+\left(\frac{\sigma_i p_i^{'}}{2}\right)\right)\right)}$$ **Equation 30**

Where σ_i is elasticity of export supply for country i.

4. Estimates of Elasticities

4.1 Elasticities of substitutions (Armington elasticities)

Empirical estimates are presented in this section for elasticities of substitution between the imported and domestically produced cocoa beans in Indonesia. These so-called Armington elasticities (Armington 1969) are based on the differentiation of products with respect to their origin and the imperfect substitution in demand between imports and domestic supply. These elasticities determine how the gains from trade are shared between countries.

The paper employs three alternative methods: the Ordinary Least Squares (OLS), the Partial Adjustment Model (PAM) and the Vector Error Correction Models (VECM) as used by previous studies (Kapuscinski and Warr 1999). The specifications are as follow:

(i) OLS: $\boldsymbol{\frac{q_t^i}{q_t^d} = \alpha_0 + \alpha_1\left(\frac{p_t^d}{p_t^i}\right) + e_t}$ **Equation 31**

(ii) PAM: $\boldsymbol{\left(\frac{q_t^i}{q_t^d}\right) = \alpha_0{}' + \alpha_1{}'\left(\frac{x_{t-1}^i}{x_{t-1}^d}\right) + \alpha_2{}'\left(\frac{p_t^d}{p_t^i}\right) + v_t}$ **Equation 32**

(iii) VECM: $\boldsymbol{\Delta\left(\frac{x_t^i}{x_t^d}\right) = \alpha_0{}'' + \alpha_1{}''\Delta\left(\frac{p_t^d}{p_t^i}\right) + \alpha_2{}''\left(\left(\frac{x_{t-1}^i}{x_{t-1}^d}\right) - \alpha_3{}''\left(\frac{p_t^d}{p_t^i}\right)\right) + w_t}$ **Equation 33**

Where index d, i and t refer to domestic, import and time. Δ indicates the difference operator. For simplicity, the logarithm of relative demand for imported products will be denoted as log QI_QD, while the logarithm of relative domestic price will be denoted as log PD_PI. The difference operator and the lagged operator will be denoted as "D" and "L", respectively.

OLS estimates may still be able to produce unbiased and consistent estimates. But the problem with the OLS estimates is it cannot capture the dynamics relationship between imports, domestic production and prices. Given the time-series data we use in the analysis, it is most likely that the estimates are inefficient due to auto-correlation. The inclusion of the level of relative demand for imports in the previous period eg. $t-1$ might be able to capture time-variant commodity-specific effects (Equation 32). The problem with this method, however, is autocorrelation of the error terms as a result of the inclusion of lagged dependent variable. It could yield bias estimates of elasticity of substitution $\alpha_2{}'$. More specifically, if the coefficient for $\alpha_1{}'$ is larger than one than the autoregressive estimates are non-stationary. If this is the case, then stationarity can be achieved by simple differencing or some other transformation.

Despite differencing, there is an alternative method to deal with trending variables. One problem with the PAM method is often relative demands for imports in the long-run are drifting together with the relative price index at roughly the same rate ie. cointegrated. The VECM model aims to distinguish the long –run relationship between the two variables (potentially drifting together) and the short-run dynamics ie. deviations of relative demand for imports from its long-run trend and deviations of relative price-index from its long-run trend (Engle and Granger 1987). Differencing method would not preserve such information.

The term $\left(\left(\frac{x_{t-1}^{i}}{x_{t-1}^{d}}\right) - \alpha_3^{''}\left(\frac{p_t^d}{p_t^i}\right)\right)$ refers to the Vector Error Correction term. The elasticity of substitution is estimated based on the coefficient $\alpha_1^{''}$ which captures the short-run relationship between relative domestic price and relative demand for imports. Coefficient $\alpha_2^{''}$ tells us the proportion of the disequilibrium which is corrected with each passing period. This coefficient should be negative and less than the absolute value of one indicating its re-equilibrating properties.

4.2 Elasticities of export demand and supply

The long-run export demand equation was introduced by Goldstein and Khan (1978) takes a simple framework for each country i:

$$\boldsymbol{q_t^{x_{demand}} = \beta_0 + \beta_1 p_t^x + \beta_2 y_t^W + u_t} \textbf{ Equation 34}$$

Where $q_t^x$is the log-volume of country i's exports, p_t^x the log-price of exports, p_t^W producer's prices, y_t^W the log of a trade weighted index of real GDP of country i's trading partners and u_t the error term.

The supply of exports is normally defined as a function of the export price relative to the domestic price and some domestic production capacity variable, and expressed re-normalised in the export price - that is, with prices as the dependent variable (Warr and Wollmer 1996). It can be specified as follow:

$$\boldsymbol{q_t^{x_{supply}} = \beta_0^{'} + \beta_1^{'} p_t^x + u_t^{'}} \textbf{ Equation 35}$$

We proxy the export supply by the product of yield (in Hg per Ha) and area (in Ha). We use the world's price to proxy p_t^x.

Simultaneity between supply and demand sides of the sector may require a structural equation approach. The resulting inverse supply equation is then estimated simultaneously with Equation 34 to obtain the long-run demand and supply relationships. Often, however, the demand equation is actually estimated in isolation using OLS under the assumption of an infinitely elastic export supply function or a stable demand function (Warr and Wollmer 1996). Whilst the OLS method might produce biased estimates, but due to limited data availability on the supply side such as nominal wage in agricultural sectors; structural equation systems— for example structural VECM as used in Muscatelli, Srinivasa et al. (1992)— hardly offers additional information.[5] Warr and Wollmer's (1996) approach to normalise Equation 34 by the export price also produces similar estimates of elasticities to the ones based on Equation 34. The present paper, therefore, takes a simple approach by comparing results from the OLS, PAM and VECM method as in the previous section.

4.3. Elasticities of import demand

Following Senhadji (1998), import demand equation can be stated as follow:

$$\boldsymbol{q_t^i = \omega_0 + \omega_1 p_t^i + \omega_2 (GDP_t - q_t^x) + u_t} \quad \textbf{Equation 36}$$

Where q_t^i is the imports quantity, p_t^i the relative price of imported good, GDP_t country i's real income, q_t^x exports quantity (hence the term in the bracket $(GDP_t - q_t^x)$represents 'domestic endowment') and $u_t$the error term (Senhadji 1998). Note that p_t^i and q_t^i are endogenously determined in the import demand and import supply system. Hence, $p_t^i$is most likely correlated to the error term u_t. This implies that the OLS method may produce biased estimates. As in the previous section, the paper employs three alternative methods: the Ordinary Least Squares (OLS), the Partial Adjustment Model (PAM) and the Vector Error Correction Models (VECM). The specifications are as follow:

(i) OLS: $\boldsymbol{q_t^i = \omega_0 + \omega_1 p_t^i + \omega_2 (GDP_t - q_t^x) + u_t}$ **Equation 37**

(ii) PAM: $\boldsymbol{q_t^i = \omega_0' + \omega_1' q_{t-1}^i + \omega_2' p_t^i + \omega_3' (GDP_t - q_t^x) + u_t'}$**Equation 38**

(iii) VECM: $\boldsymbol{\Delta q_t^i = \omega_0'' + \omega_1'' \Delta p_t^i + \omega_2'' \left(q_{t-1}^i - \omega_3'' p_t^i\right) + u_t''}$ **Equation 39**

Price elasticities of import demand are indicated by coefficients ω_1, $\omega_2{}'$ and ω_1''in Equation (37), (38) and (39) respectively.

4.4 Cross elasticities of supply and processed cocoa elasticities

Given the nature of the analysis which involves two agricultural sectors i.e cocoa beans and processed cocoa, the estimates of cross elasticities of supply and other elasticities for processed cocoa are crucial. The ATPSM dataset has information on these elasticities (Table 2).

[5] Several studies develop the econometric method to take into account simultaneity between export volume and export prices by using a simultaneous regression analysis, for example Riedel (1988), Muscatelli, Srinivasan and Vines (1992), Abbott and De Vita (2002).

Table 2 ATPSM Elasticities

Country	Commodity Code	Cross Commodity Code	Supply	Demand
Ghana	Cocoa beans	Cocoa beans	0.45	-0.47
Indonesia	Cocoa beans	Cocoa beans	0.45	-0.31
Ivory Coast	Cocoa beans	Cocoa beans	0.45	-0.47
Malaysia	Cocoa beans	Cocoa beans	0.45	-0.31
Ghana	Cocoa beans	Processed cocoa	0.02	-0.011
Indonesia	Cocoa beans	Processed cocoa	0.02	-0.013
Ivory Coast	Cocoa beans	Processed cocoa	0.02	-0.01
Malaysia	Cocoa beans	Processed cocoa	0.02	-0.125
Ghana	Processed cocoa	Cocoa beans	-0.04	0
Indonesia	Processed cocoa	Cocoa beans	-0.03	0
Ivory Coast	Processed cocoa	Cocoa beans	-0.04	0
Malaysia	Processed cocoa	Cocoa beans	-0.03	0
Ghana	Processed cocoa	Processed cocoa	0.47	0
Indonesia	Processed cocoa	Processed cocoa	0.31	0
Ivory Coast	Processed cocoa	Processed cocoa	0.47	0
Malaysia	Processed cocoa	Processed cocoa	0.31	0

Source: the ATPSM dataset (UNCTAD 2004)

The paper uses processed cocoa export supply elasticities from the ATPSM dataset (Table 2). In ATPSM, there is no variation in export supply elasticities between countries in the same region eg. Indonesia and Malaysia; Ghana and Ivory Coast. Due to unavailability of data on domestic price, we cannot calculate Armington elasticities of processed cocoa.

This section therefore estimates:

- Export demand elasticities; to simplify, we use the world GDP to proxy trade-weighted importing countries' income.
- Import demand elasticities of processed cocoa; it is zero for all countries in ATPSM
- Processed cocoa-cocoa beans cross elasticities of export supply; it is zero for all countries in ATPSM
- Cocoa beans-processed cocoa cross elasticities of export supply

Variables used to estimate import demand and Armington elasticities follow estimates for cocoa beans. To estimate cross elasticities of export supply, we simultaneously estimate export supply functions of the two commodities based on the following specification:

$$q_t^{xBEANS} = c_o + c_1 p_t^{XBEANS} + c_2 p_t^{XPROC} + v_{1t} \quad \textbf{Equation 40}$$

$$q_t^{XPROC} = c_3 + c_4 p_t^{XPROC} + c_5 p_t^{XPROC} + v_{2t} \quad \textbf{Equation 41}$$

We compare the results between the OLS, PAM and VECM methods as in the previous section.

4.5 Results of elasticities estimation

We begin with estimates of export supply and demand elasticities. One problem with estimating elasticities of export supply is to estimate trade share to trading partners which is needed to estimate y_t^w. FAO statistics online homepage only has data covering the 1986-2007 period, 1997-2007 period, 1998-2004 period, and 1986-2007 period for Indonesia, Ivory coast, Ghana and Malaysia respectively. Furthermore, even over these periods some data are missing. The approach we use is, first, to limit observed trading partners into nine top importing countries, namely Belgium, France, Germany, Malaysia, Netherlands, Singapore, Spain, United Kingdom and United States. Over the period these countries normally imported over 50 per cent of total exports by volume from Indonesia, Ivory Coast, Ghana and Malaysia. This trade-weighted average GDP (ln_y_w in Figure 14) has a correlation index over 0.8 with export quantity. Where data on trade-weights are not available, we use the average of real GDP of the nine major importing countries (ln_y_i in Figure 14). Compared to the use of the world GDP (ln_y_world in Figure 14), this proxy has much stronger correlation to variation in export quantity.

Before turning to estimates, we present the stationarity properties of the data. Table 3 and 4 presents results for stationarity and cointegration tests for variables used to estimate export demand and supply elasticities respectively. Note that we use the world price to estimate export supply elasticities. The null hypothesis is that the variable has a unit root (i.e. non-stationery). There is strong evidence that export quantity, supply (as proxied by area multiplied by yield) and the world price have a unit root (e.g. non-stationery). In contrast, export price is stationery. Results regarding whether the two variables have a cointegrating relationship are mixed across countries. Unlike Malaysia and Indonesia, bigger exporting countries, Ivory Coast and Ghana tend to have cointegrated export price and quantity. Similarly, Table 4 suggests that major producing countries tend to have cointegrated supply and the world price. If cointegration is evident, the use of VECM is preferred.

Table 4 presents estimates of elasticities of export demand. Clearly, in all countries OLS is not preferred due to the presence of serial correlation as indicated by the Durbin-Watson test. The problem is most coefficients on elasticities are statistically insignificant. These results raise a concern over validity of coefficients produced in previous studies. For Indonesia and Malaysia, the PAM method seems preferable. First, the Johansen test does not indicate the presence of cointegration. Second, the Durbin-Watson test suggests no evidence of autocorrelation which is the main issue in this specification. Third, the PAM models offer better goodness of fit (as indicated by R2). Therefore, the paper finds elasticities of export demand for Indonesia and Malaysia are -0.109 and -0.126, respectively. For Ivory Coast, Ghana and ROW, as a unit root problem exists, VECM is recommended. The paper finds elasticities of export demand for Ivory Coast, Ghana and ROW are -0.186, -0.137 and -0.286.

Using the same reasoning, we find elasticities of export supply for Indonesia, Ivory Coast, Malaysia and ROW are 0.132, 0.156, 0.171 and 0.069, respectively. Uncommon results of elasticities of export supply for Ghana are found. The VECM which is more preferred in the presence of a unit root problem produces negative elasticities. This could indicate specification bias due to exclusion of important variables. In this case, we rely on estimates produced by Burger (2008).

Table 7 present results from stationary and cointegration tests using variables which are used to estimate Armington elasticities. The main problem with estimating Armington elasticities and import demand elasticities is for major exporting countries Ghana and Ivory Coast, which in many years had zero import volumes. Therefore, the study is only able to estimate Armington elasticities for Indonesia, Malaysia and ROW. The price index, ratio of domestic price to import price, appears to be stationery in Indonesia and ROW. It is non-stationery in Malaysia at 10 per cent level of significance. By contrast, the quantity index, ratio of import to export quantity, is non-stationery. The cointegration test suggests at 5 per cent level of significance, price and quantity indexes show cointegrating relationships in Indonesia and ROW, but there is no evidence of cointegration in Malaysia. The pattern seems to follow our test on cointegration using export price and quantity, that is larger exporting countries tend to have a cointegrating relationship.

Taking into account the presence of cointegration, serial correlation and goodness of fit, as well as the sign of coefficient (i.e. whether it is positive as expected), Table 8 suggests that Armington elasticities for Indonesia, Malaysia and ROW are 0.62, 0.891 and 0.442, respectively. These very low Armington elasticities suggest low substitutability of cocoa beans from various exporting countries.

Table 9 present results from stationary and cointegration tests using variables which are used to estimate import demand elasticities. Import price appears to be stationery in Indonesia and non-stationery in Malaysia and ROW. Import quantity is non-stationery in all countries. The cointegration test suggests at 5 per cent level of significance, import price and quantity show cointegrating relationships in all countries.

Taking into account the presence of cointegration, serial correlation and goodness of fit, as well as the sign of coefficient (ie. whether it is positive as expected), Table 10 suggests that import demand elasticities for Indonesia, Malaysia and ROW are -0.239, −0.364, and -0.317, respectively. Some difficult decions must be made. The Indonesia's case is for example. Panel A shows serial correlation although it shows the expected sign i.e. negative. Panels C and D, more appropriate for data with cointegration, show positive signs. In this case, we chose the coefficient from panel A.

Figure 13 Percentage of Export to 9 Top Importers

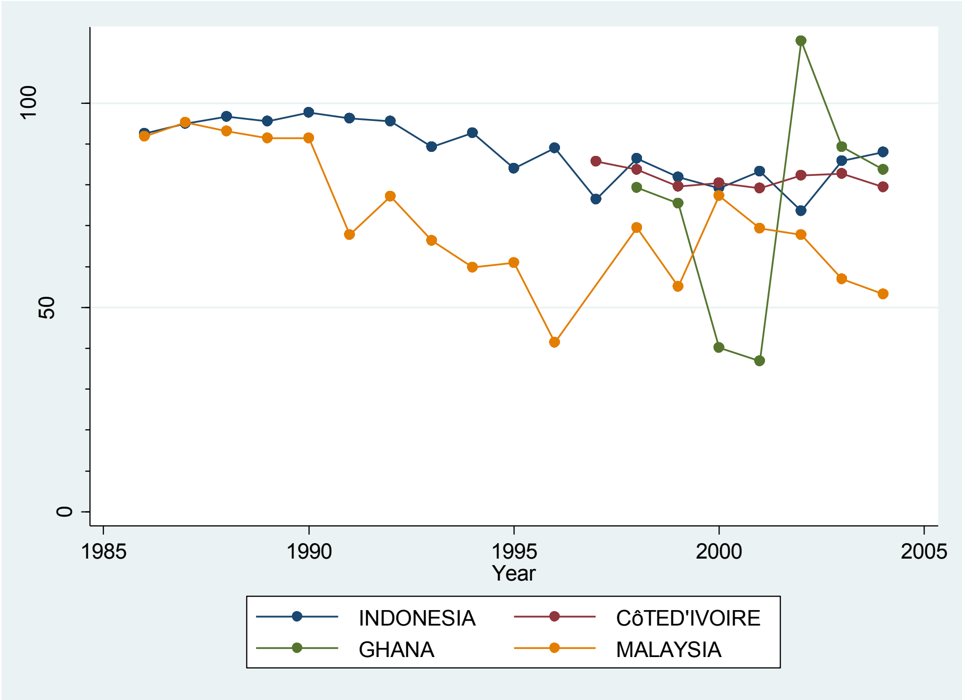


Figure 14 Correlation between Imputed Values and Real Data

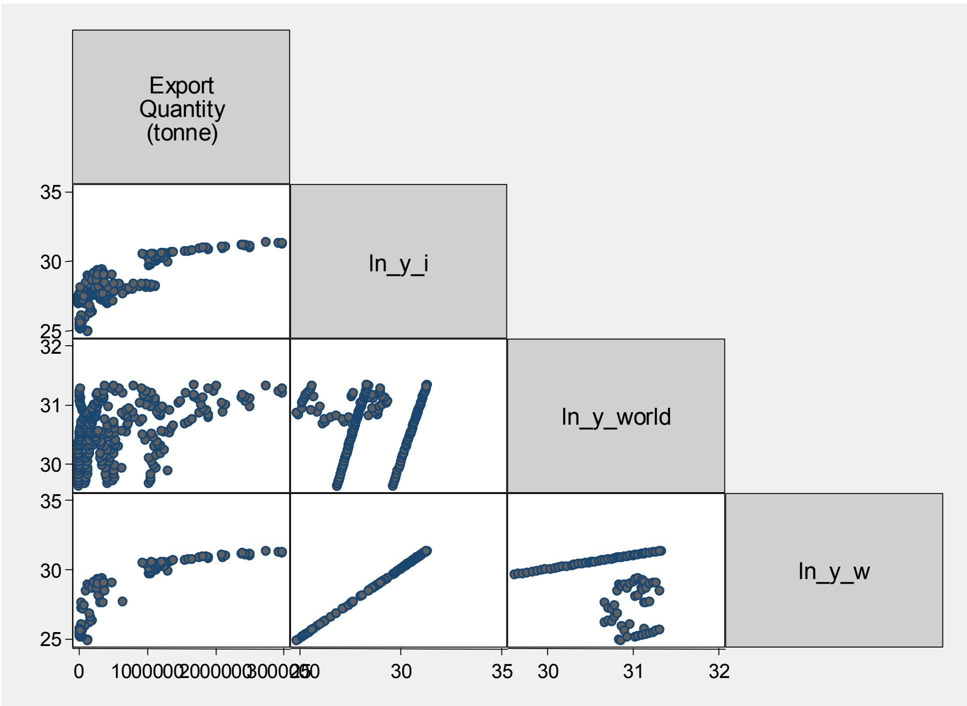


Table 3 Stationary and Cointegration Test (Export Demand Elasticities)

COUNTRY	PRICE Export price		QUANTITY Export quantity		JOHANSEN TEST FOR COINTEGRATION H_0=number of cointegration relations=1	
	ADF H0: non stationary	P-value	ADF H0: non stationary	P-value		
IVORY COAST	-4.391	0.000	-1.218	0.666	1.725	Accept H0
GHANA	-2.968	0.038	-1.174	0.685	1.692	Accept H0
INDONESIA	-3.307	0.015	-1.583	0.492	3.645	Reject H0
MALAYSIA	-4.734	0.000	-2.397	0.143	5.676	Reject H0
ROW	-3.857	0.002	-0.939	0.775	0.867	Accept H0

Notes: 5 per cent critical value of Johansen statistics is 3.76

Table 4 Stationary and Cointegration Test (Export Supply Elasticities)

COUNTRY	PRICE World price		QUANTITY Export quantity		JOHANSEN TEST FOR COINTEGRATION H_0=number of cointegration relations=1	
	ADF H0: non stationary	P-value	ADF H0: non stationary	P-value		
IVORY COAST	-2.279	0.179	-1.63669	0.463992	3.009857	Accept H0
GHANA	-2.279	0.179	-1.05744	0.731741	0.977323	Accept H0
INDONESIA	-2.279	0.179	-0.53598	0.884803	0.378241	Accept H0
MALAYSIA	-2.279	0.179	-2.38169	0.14697	5.990011	Reject H0
ROW	-2.279	0.179	-0.74667	0.834287	0.696462	Accept H0

Notes: 5 per cent critical value of Johansen statistics is 3.76

Table 5 Elasticities of export demand

	INDONESIA				GHANA				IVORY COAST				MALAYSIA				ROW			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
logGDP	2.999***	0.26	-0.07	0.262	0.111	0.024	0.037	0	2.016***	0.832**	-0.032	0.810*	-0.324	0.07	0.089	0.071	0.260***	0.109**	0.007	0.110**
	(8.069)	(1.171)	(-0.552)	(1.151)	(0.686)	(0.293)	(0.532)	(-0.000)	(25.364)	(2.820)	(-0.540)	(2.634)	(-1.713)	(1.110)	(1.411)	(1.106)	(5.980)	(2.751)	(0.204)	(2.726)
logPE	-2.41	-0.109			-1.370*	-0.059			-0.293	0.117			-1.802*	-0.126			-0.149	-0.296		
	(-1.972)	(-0.165)			(-2.649)	(-0.146)			(-0.561)	(0.251)			(-2.166)	(-0.688)			(-0.318)	(-0.903)		
L.logQE		0.896***		-0.107		0.820***		-0.166		0.575***		-0.418**		0.927***		-0.066**		0.608***		-0.393**
		(10.208)		(-1.137)		(8.425)		(-1.636)		(4.282)		(-3.008)		(46.596)		(-2.992)		(4.857)		(-3.117)
D.logPE			-0.02	-0.007			-0.318	-0.137			-0.186	0.103			-0.117	-0.115			-0.152	-0.286
			(-0.032)	(-0.012)			(-1.021)	(-0.324)			(-0.625)	(0.218)			(-0.908)	(-0.625)			(-0.527)	(-0.768)
L.logPE				-0.154				0.117				0.433				-0.106				-0.316
				(-0.183)				(0.269)				(0.542)				(-0.464)				(-0.972)
L.EC			-0.081				-0.176				-0.426**				-0.053**				-0.391**	
			(-0.868)				(-1.899)				(-3.227)				(-2.816)				(-3.197)	
_cons	-74.686***	-6.126	2.137	-6.148	9.581*	1.612	-1.032	2.096	-43.063***	-17.591**	0.949	-17.058*	18.312***	-1.059	-2.282	-1.17	5.475***	1.921	-0.207	1.933
	(-7.111)	(-1.119)	(0.590)	(-1.100)	(2.149)	(0.714)	(-0.532)	(0.872)	(-19.588)	(-2.708)	(0.573)	(-2.516)	(3.699)	(-0.586)	(-1.348)	(-0.628)	(4.141)	(1.346)	(-0.193)	(1.346)
coef_elasticity	-2.41	-0.109	-0.02	-0.007	-1.37	-0.059	-0.318	-0.137	-0.293	0.117	-0.186	0.103	-1.802	-0.126	-0.117	-0.115	-0.149	-0.296	-0.152	-0.286
r2	0.799	0.953	0.035	0.059	0.136	0.658	0.074	0.092	0.926	0.946	0.193	0.21	0.123	0.971	0.156	0.191	0.498	0.643	0.177	0.185
d_watson	0.54	2.848	2.898	2.851	0.546	2.474	2.477	2.49	0.877	2.277	2.31	2.294	0.149	2.089	2.149	2.103	0.836	2.152	2.16	2.15
no_parameter	3	4	4	5	3	4	4	5	3	4	4	5	3	4	4	5	3	4	4	5
Durbin watson (H0: no serial correlation)	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Accept H0	Accept H0	Accept H0
N	47	46	46	46	47	46	46	46	47	46	46	46	46	46	45	45	47	46	46	46

Table 6 Elasticities of export supply

	INDONESIA				GHANA				IVORY COAST				MALAYSIA				ROW			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
logP_WORLD	2.119***	0.153***			-0.228***	-0.006			0.908***	0.072			2.266***	0.171***			0.246**	0.032		
	(3.811)	(3.569)			(-3.534)	(-0.112)			(4.765)	(1.780)			(6.356)	(3.736)			(3.322)	(1.172)		
L.logQE		0.984***		-0.016		0.848***		-0.15		0.941***		-0.052*		0.914***		-0.100***		0.937***		-0.055
		(89.035)		(-1.546)		(11.508)		(-2.007)		(43.274)		(-2.228)		(44.745)		(-4.089)		(24.929)		(-1.512)
D.logP_WORLD			0.052	0.132			-0.059	-0.049			0.146	0.156			0.049	0.027			0.059	0.069
			(0.415)	(1.036)			(-0.473)	(-0.371)			(1.839)	(1.787)			(0.387)	(0.193)			(1.030)	(1.073)
L.logPWORLD				0.155***				-0.003				0.062				0.193***				0.028
				(3.641)				(-0.052)				(1.575)				(4.208)				(1.108)
L.EC			-0.017				-0.173*				-0.052*				-0.101***				-0.056	
			(-1.613)				(-2.109)				(-2.289)				(-4.081)				(-1.662)	
Dummy 1982					-0.497***	-0.266***	-0.269***	-0.273***												
					(-7.755)	(-7.709)	(-7.349)	(-7.009)												
Dummy 1983					-0.677***	-0.286***	-0.203***	-0.285***												
					(-10.314)	(-6.557)	(-7.305)	(-6.484)												
_cons	4.41	-0.629*	0.141***	-0.633*	23.609***	3.405	0.018	3.336	15.835***	0.868	0.056**	0.778	3.375	0.537	0.084**	0.665	21.356***	1.243	0.02	1.081
	(1.150)	(-2.312)	(5.662)	(-2.290)	(55.374)	(1.902)	(0.631)	(1.827)	(11.998)	(1.944)	(2.921)	(1.635)	(1.343)	(1.004)	(2.847)	(1.158)	(41.702)	(1.377)	(1.602)	(1.217)
coef_elasticity	2.119	0.153	0.052	0.132	-0.228	-0.006	-0.059	-0.049	0.908	0.072	0.146	0.156	2.266	0.171	0.049	0.027	0.246	0.032	0.059	0.069
r2	0.234	0.996	0.052	0.197	0.263	0.781	0.136	0.135	0.333	0.979	0.14	0.144	0.502	0.988	0.303	0.31	0.21	0.93	0.062	0.072
d_watson	0.047	2.261	1.977	2.278	0.446	2.132	2.109	2.161	0.081	2.706	2.686	2.688	0.166	1.328	1.311	1.315	0.109	2.691	2.64	2.653
no_parameter	2	3	3	4	4	5	5	6	2	3	3	4	2	3	3	4	2	3	3	4
Durbin watson (H0: no serial correlation)	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Incon-clusive	Incon-clusive	Incon-clusive	Reject H0	Accept H0	Accept H0	Accept H0
N	47	46	46	46	47	46	46	46	47	46	46	46	47	47	46	46	47	46	46	46

Table 7 Stationary and Cointegration Test (Armington Elasticities)

COUNTRY	PRICE Ratio of domestic price to import price		QUANTITY Ratio of import to export quantity		JOHANSEN TEST FOR COINTEGRATION H_0=number of cointegration relations=1	
	ADF H0: non stationary	P-value	ADF H0: non stationary	P-value		
INDONESIA	-3.557	0.007	-1.682	0.440	2.936	Accept H0
MALAYSIA	-2.583	0.097	-1.198	0.674	6.081	Reject H0
ROW	-3.849	0.002	-1.483	0.542	3.181	Accept H0

Notes: 5 per cent critical value of Johansen statistics is 3.76

Table 8 Elasticities of substitution (Armington elasticities)

	INDONESIA				MALAYSIA				ROW			
	A	B	C	D	A	B	C	D	A	B	C	D
logPE	-1.362	-0.97			2.591**	0.524			0.404**	0.357*		
	(-0.689)	(-0.914)			(3.249)	(1.691)			(3.163)	(2.623)		
L.logQE		0.557		0.404		0.870***		-0.146		0.339		-0.490*
		(1.716)		(1.330)		(12.716)		(-1.683)		(1.820)		(-2.835)
D.logPE			0.62	-0.811			0.991***	0.891**			0.442**	0.379***
			(0.464)	(-0.488)			(4.338)	(3.700)			(3.494)	(4.508)
L.logPE				-2.19				0.19				0.074
				(-1.025)				(0.461)				(0.472)
L.EC			0.343				-0.15				-0.494*	
			(0.776)				(-1.806)				(-2.790)	
_cons	-5.440**	-2.228	-0.463	0.523	0.571	0.546**	0.465**	0.501*	0.680***	0.467**	0.009	0.328*
	(-4.153)	(-1.850)	(-0.690)	(0.306)	(0.877)	(3.111)	(3.482)	(3.031)	(16.149)	(3.116)	(0.301)	(2.446)
coef_elasticity	-1.362	-0.97	0.62	-0.811	2.591	0.524	0.991	0.891	0.404	0.357	0.442	0.379
r2	0.021	0.424	0.178	0.423	0.151	0.947	0.455	0.463	0.242	0.346	0.517	0.529
d_watson	0.253	0.865	0.568	0.726	0.214	2.095	2.399	2.397	0.969	1.697	1.895	1.849
no_parameter	2	3	3	4	2	3	3	4	2	3	3	4
Durbin watson (H0: no serial correlation)	Reject H0	Incon-clusive	Reject H0	Incon-clusive	Reject H0	Accept H0	Accept H0	Accept H0	Incon-clusive	Incon-clusive	Accept H0	Incon-clusive
N	15	13	12	12	16	16	15	15	17	17	16	16

Table 9 Stationary and Cointegration Test (Import Demand Elasticities)

COUNTRY	PRICE Import price		QUANTITY Import quantity		JOHANSEN TEST FOR COINTEGRATION H_0=number of cointegration relations=1	
	ADF H0: non stationary	P-value	ADF H0: non stationary	P-value		
INDONESIA	-2.942	0.041	-1.592	0.487	2.609	Accept H0
MALAYSIA	-2.432	0.133	-1.738	0.412	0.239	Accept H0
ROW	-2.246	0.190	-0.124	0.947	0.241	Accept H0

Notes: 5 per cent critical value of Johansen statistics is 3.76

Table 10 Elasticities of import demand

	INDONESIA				MALAYSIA				ROW			
	A	B	C	D	A	B	C	D	A	B	C	D
GDP-exports	1.877**	0.313	0.081	0.566	4.259***	1.778*	0.205	1.927**	0.838***	0.773***	0.004	0.512**
	(2.806)	(0.374)	(0.192)	(0.693)	(9.190)	(2.326)	(0.756)	(2.868)	(21.869)	(3.995)	(0.157)	(3.244)
logPE	-0.239	0.103			-0.971	-0.364			-0.268***	-0.243***		
	(-0.343)	(0.290)			(-1.330)	(-0.548)			(-12.969)	(-3.870)		
L.logQE		0.811**		-0.18		0.633***		-0.426***		0.094		-0.608**
		(3.637)		(-0.765)		(4.903)		(-3.863)		(0.418)		(-3.313)
D.logPE			0.237	0.169			0.28	0.084			-0.320***	-0.317***
			(0.875)	(0.466)			(0.487)	(0.104)			(-4.553)	(-4.555)
L.logPE				-0.187				-0.711				-0.151**
				(-0.533)				(-1.257)				(-2.893)
L.EC			-0.182				-0.414**				-0.553**	
			(-0.789)				(-3.464)				(-3.119)	
_cons	-39.118**	-7.361	-2.042	-11.835	-89.645***	-38.015	-4.842	-38.742*	-9.468***	-9.004***	-0.104	-5.912**
	(-2.776)	(-0.399)	(-0.195)	(-0.650)	(-5.829)	(-1.940)	(-0.718)	(-2.245)	(-8.696)	(-3.706)	(-0.122)	(-2.917)
coef_elasticity	-0.239	0.103	0.237	0.169	-0.971	-0.364	0.28	0.084	-0.268	-0.243	-0.320	-0.317
r2	0.142	0.61	0.101	0.104	0.807	0.9	0.304	0.323	0.947	0.949	0.586	0.606
d_watson	0.5	1.859	1.79	1.795	0.63	2.248	2.05	2.027	1.054	1.301	1.561	1.538
no_parameter	3	4	4	5	3	4	4	5	3	4	4	5
Durbin watson (H0: no serial correlation)	Reject H0	Accept H0	Accept H0	Incon-clusive	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Incon-clusive	Incon-clusive	Incon-clusive
N	37	33	33	33	38	35	35	35	47	46	46	46

Table 11 Stationary and Cointegration Test (Export Demand Elasticities)

COUNTRY	PRICE Export price		QUANTITY Export quantity		JOHANSEN TEST FOR COINTEGRATION H_0=number of cointegration relations=1	
	ADF H0: non stationary	P-value	ADF H0: non stationary	P-value		
IVORY COAST	-2.278	0.179	-2.373	0.149	3.273	Accept H0
GHANA	-2.815	0.056	-2.389	0.145	5.984	Accept H0
INDONESIA	-2.969	0.038	-1.303	0.628	1.835	Reject H0
MALAYSIA	-2.934	0.042	-1.575	0.496	2.695	Reject H0
ROW	-2.518	0.111	0.357	0.980	0.108	Accept H0

Notes: 5 per cent critical value of Johansen statistics is 3.76

Table 12 Elasticities of export demand – cocoa powder and cake

	INDONESIA				GHANA				IVORY COAST				MALAYSIA				ROW			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
logGDP	0.001***	0.000*	0	0.000*	0	0	0	0	0	0	0	0	0.002***	0	0	0	0.000***	0	0	0
	(8.608)	(2.367)	(0.309)	(2.452)	(0.823)	(0.848)	(-0.187)	(0.404)	(0.692)	(0.107)	(-1.161)	(-0.022)	(8.494)	(1.026)	(-1.230)	(0.979)	(17.870)	(1.155)	(0.284)	(0.541)
logPE	0.185	-0.338			-0.376**	-0.286			0.544**	0.107			0.103	0.124			0.049	-0.011		
	(0.447)	(-0.904)			(-3.270)	(-1.882)			(3.237)	(1.125)			(0.190)	(0.696)			(1.209)	(-0.597)		
L.logQE		0.624***		-0.387**		0.657**		-0.28		0.543**		-0.479**		0.875***		-0.128		0.920***		-0.038
		(4.592)		(-3.152)		(3.527)		(-1.536)		(3.133)		(-2.880)		(10.334)		(-1.572)		(10.521)		(-0.414)
D.logPE			0.242	-0.087			-0.371*	-0.406*			0.096	-0.012			0.29	0.31			-0.072*	-0.071*
			(0.490)	(-0.154)			(-2.628)	(-2.460)			(0.438)	(-0.086)			(0.990)	(1.118)			(-2.026)	(-2.049)
L.logPE				-0.452				-0.178				0.126				0.046				-0.006
				(-1.226)				(-1.168)				(1.223)				(0.215)				(-0.368)
L.EC			-0.431***				-0.284				-0.480*				-0.126				-0.02	
			(-3.772)				(-1.532)				(-2.675)				(-1.482)				(-0.236)	
_cons	3.379	4.345	0.137	5.172*	11.400***	4.78	0.043	3.617	5.951***	3.747*	0.237	3.873**	1.507	0.013	0.622	0.585	11.141***	1.026	0.047**	0.516
	(1.273)	(1.921)	(0.259)	(2.444)	(18.258)	(1.968)	(0.638)	(1.502)	(5.795)	(2.656)	(1.989)	(2.812)	(0.381)	(0.009)	(1.750)	(0.330)	(43.689)	(1.046)	(2.904)	(0.504)
coef_elasticity	0.185	-0.338	0.242	-0.087	-0.376	-0.286	-0.371	-0.406	0.544	0.107	0.096	-0.012	0.103	0.124	0.29	0.31	0.049	-0.011	-0.072	-0.071
r2	0.55	0.819	0.322	0.368	0.13	0.557	0.326	0.331	0.406	0.559	0.33	0.362	0.791	0.956	0.137	0.145	0.952	0.99	0.1	0.109
d_watson	0.451	1.187	1.162	1.221	0.543	1.814	1.845	1.88	0.823	1.343	1.227	1.241	0.205	1.975	2.096	2.1	0.365	2.392	2.564	2.528
no_parameter	3	4	4	5	3	4	4	5	3	4	4	5	3	4	4	5	3	4	4	5
Durbin watson (H0: no serial correlation)	Reject H0	Incon-clusive	Incon-clusive	Incon-clusive	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Reject H0	Reject	Incon-clusive	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Accept H0	Accept H0	Accept H0
N	32	30	30	30	47	46	46	46	44	43	43	43	42	39	39	39	47	46	46	46

Table 13 Stationary and Cointegration Test (Import Demand Elasticities) - cocoa powder and cake

COUNTRY	PRICE Import price		QUANTITY Import quantity		JOHANSEN TEST FOR COINTEGRATION H_0=number of cointegration relations=1	
	ADF H0: non stationary	P-value	ADF H0: non stationary	P-value		
INDONESIA	-2.702	0.074	-1.083	0.722	1.586	Accept H0
MALAYSIA	-3.224	0.019	-1.424	0.571	3.457	Accept H0
ROW	-2.451	0.128	-1.287	0.635	1.062	Accept H0

Notes: 5 per cent critical value of Johansen statistics is 3.76

Table 14 Elasticities of import demand – cocoa powder and cake

	INDONESIA				MALAYSIA				WORLD			
	A	B	C	D	A	B	C	D	A	B	C	D
GDP-exports	2.252***	0.894**	-0.048	0.761*	0.613***	0.077	0.009	0.08	1.792***	1.300***	-0.002	1.562***
	(13.801)	(3.116)	(-0.366)	(2.318)	(5.306)	(0.847)	(0.119)	(0.895)	(56.154)	(7.065)	(-0.092)	(9.316)
logPE	-0.383*	-0.217			0.305	-0.325			-0.107***	-0.086***		
	(-2.336)	(-1.766)			(0.927)	(-1.182)			(-6.389)	(-5.367)		
L.logQE		0.601***		-0.366*		0.873***		-0.138		0.290**		-0.849***
		(4.682)		(-2.599)		(9.821)		(-1.554)		(2.765)		(-8.828)
D.logPE			-0.491	-0.467			0.069	-0.172			-0.023	-0.027
			(-1.495)	(-1.505)			(0.300)	(-0.549)			(-0.821)	(-1.130)
L.logPE				-0.096				-0.391				-0.106***
				(-0.509)				(-1.408)				(-6.637)
L.EC			-0.357*				-0.166				-0.692***	
			(-2.603)				(-1.631)				(-5.557)	
_cons	-48.049***	-18.515**	1.351	-16.189*	-10.921**	1.311	-0.153	1.77	-41.716***	-30.390***	0.123	-36.546***
	(-11.793)	(-2.961)	(0.409)	(-2.356)	(-2.947)	(0.500)	(-0.087)	(0.690)	(-44.494)	(-7.084)	(0.170)	(-9.427)
coef_elasticity	-0.383	-0.217	-0.491	-0.467	0.305	-0.325	0.069	-0.172	-0.107	-0.086	-0.023	-0.027
r2	0.785	0.857	0.245	0.249	0.298	0.762	0.066	0.158	0.992	0.995	0.404	0.559
d_watson	0.731	2.116	2.19	2.183	0.406	2.291	2.142	2.391	1.221	2.142	2.164	2.109
no_parameter	3	4	4	5	3	4	4	5	3	4	4	5
Durbin watson (H0: no serial correlation)	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Accept H0	Accept H0	Accept H0
N	46	45	45	45	47	46	46	46	47	46	46	46

Table 15 Cross Elasticities of export demand – cocoa beans

	INDONESIA				GHANA				IVORY COAST				MALAYSIA				ROW			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
logGDP	0.001***	0	-0.000**	0	0.000**	0	0	0	0.000***	0	0	0	0	0	0	0	0.000***	0.000**	0	0.000**
	(6.916)	(-0.568)	(-3.232)	(-0.546)	(3.226)	(1.375)	(0.906)	(1.204)	(9.251)	(1.254)	(-0.174)	(1.153)	(2.023)	(-1.403)	(-2.030)	(-1.369)	(14.793)	(2.955)	(0.792)	(2.955)
LogPE_proc	-0.331	-0.049	-0.067	-0.049	-0.180*	-0.046	-0.023	-0.047	-0.015	-0.009	0.003	-0.005	-0.545	0.11	0.137	0.117	-0.121***	-0.078	-0.001	-0.078
	(-1.126)	(-0.583)	(-0.923)	(-0.575)	(-2.660)	(-0.764)	(-0.317)	(-0.665)	(-0.325)	(-0.210)	(0.060)	(-0.128)	(-1.302)	(1.517)	(1.525)	(1.343)	(-4.532)	(-1.951)	(-0.050)	(-1.951)
logPE	-2.588	-0.734*			-1.720***	-0.345			-0.348	0.244			-1.644*	-0.061			0	0		
	(-1.574)	(-2.341)			(-5.292)	(-0.860)			(-0.525)	(0.487)			(-2.066)	(-0.282)			(.)	(.)		
L.logQE		0.958***		-0.043		0.745***		-0.256*		0.791***		-0.201		0.950***		-0.046		0.361		-0.639***
		(21.004)		(-0.953)		(7.766)		(-2.406)		(6.495)		(-1.629)		(32.817)		(-1.422)		(2.002)		(-3.551)
D.logPE			-0.751**	-0.733*			-0.335	-0.341			-0.112	0.24			-0.004	-0.026			0	0
			(-3.352)	(-2.274)			(-1.065)	(-0.806)			(-0.359)	(0.477)			(-0.022)	(-0.111)			(.)	(.)
L.logPE				-0.763				-0.356				0.596				-0.087				0
				(-1.388)				(-0.799)				(0.660)				(-0.336)				(.)
L.EC			-0.053				-0.247*				-0.264				-0.042				-0.712***	
			(-1.192)				(-2.452)				(-1.843)				(-1.168)				(-3.837)	
_cons	9.128***	0.982	0.923	0.996	13.450***	3.389**	0.078	3.416*	11.789***	2.572	0.044	2.469	12.840***	-0.009	-0.65	-0.104	14.514***	9.289**	0.007	9.289**
	(4.299)	(1.223)	(1.773)	(1.225)	(36.825)	(2.821)	(0.206)	(2.396)	(43.689)	(1.860)	(0.169)	(1.774)	(4.328)	(-0.015)	(-0.978)	(-0.144)	(91.556)	(3.493)	(0.043)	(3.493)
coef_elasticity	-0.331	0.958	-0.067	-0.049	-0.18	0.745	-0.023	-0.047	-0.015	0.791	0.003	-0.005	-0.545	0.95	0.137	0.117	-0.121	0.361	-0.001	-0.078
r2	0.83	0.992	0.506	0.343	0.304	0.677	0.127	0.133	0.851	0.932	0.105	0.109	0.254	0.966	0.204	0.233	0.929	0.937	0.296	0.313
d_watson	0.262	1.939	1.956	1.949	0.893	2.519	2.479	2.518	0.598	2.531	2.461	2.553	0.163	2.073	2.074	2.082	1.315	2.021	1.904	2.021
no_parameter	4	5	5	6	4	5	5	6	4	5	5	6	4	5	5	6	3	4	4	4
Durbin watson (H0: no serial correlation)	Reject H0	Accept H0	ccept H0	ccept H0	Reject H0	ccept H0	ccept H0	ccept H0	Reject H0	ccept H0	ccept H0	ccept H0	Reject H0	ccept H0	ccept H0	ccept H0	Reject H0	ccept H0	ccept H0	ccept H0
N	32	32	30	32	47	46	46	46	44	44	43	44	41	41	38	40	47	46	46	46

Table 16 Cross Elasticities of export demand – cocoa powder and cake

	INDONESIA				GHANA				IVORY COAST				MALAYSIA				ROW			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
logGDP	0.001***	0	0	0.000*	0	0	0	0	0	0	0	0	0.002***	0	0	0	0.000***	0	0	0
	(6.994)	(1.919)	(-0.453)	(2.083)	(1.878)	(0.849)	(-0.011)	(0.494)	(0.620)	(0.180)	(-1.160)	(0.018)	(9.037)	(0.387)	(-0.997)	(0.416)	(17.870)	(1.155)	(0.284)	(0.541)
LogPE_beans	0.557	-3.290*	-3.344	-3.154	-1.872**	-0.353	-0.114	-0.35	1.604	-1.103	-1.147	-1.429	-0.711	0.874*	0.812*	0.847	0	0	0	0
	(0.180)	(-2.077)	(-1.973)	(-1.932)	(-2.958)	(-0.516)	(-0.222)	(-0.528)	(0.865)	(-0.604)	(-0.625)	(-0.729)	(-0.786)	(2.496)	(2.300)	(2.026)	(.)	(.)	(.)	(.)
logPE	0.168	-0.277			-0.410***	-0.295			0.551**	0.085			0.291	0.142			0.049	-0.011		
	(0.377)	(-0.838)			(-4.264)	(-1.851)			(3.400)	(0.693)			(0.558)	(0.792)			(1.209)	(-0.597)		
L.logQE		0.670***		-0.340**		0.633**		-0.303		0.566**		-0.457*		0.928***		-0.075		0.920***		-0.038
		(5.357)		(-2.989)		(2.873)		(-1.400)		(2.891)		(-2.477)		(10.155)		(-0.811)		(10.521)		(-0.414)
D.logPE			0.161	-0.099			-0.389*	-0.415*			0.07	-0.081			0.141	0.175			-0.072*	-0.071*
			(0.342)	(-0.190)			(-2.639)	(-2.430)			(0.266)	(-0.378)			(0.461)	(0.613)			(-2.026)	(-2.049)
L.logPE				-0.361				-0.187				0.104				0.129				-0.006
				(-1.078)				(-1.165)				(0.830)				(0.555)				(-0.368)
L.EC			-0.366**				-0.322				-0.467*				-0.081				-0.02	
			(-3.206)				(-1.414)				(-2.417)				(-0.832)				(-0.236)	
_cons	3.536	3.501	-0.056	4.130*	11.528***	5.041	0.035	3.876	5.938***	3.645*	0.226*	3.783*	-0.083	-0.332	0.549	-0.226	11.141***	1.026	0.047**	0.516
	(1.230)	(1.743)	(-0.098)	(2.138)	(22.157)	(1.824)	(0.503)	(1.407)	(5.964)	(2.498)	(2.030)	(2.689)	(-0.021)	(-0.223)	(1.523)	(-0.118)	(43.689)	(1.046)	(2.904)	(0.504)
coef_elasticity	0.557	0.67	-3.344	-3.154	-1.872	0.633	-0.114	-0.35	1.604	0.566	-1.147	-1.429	-0.711	0.928	0.812	0.847	0	0.92	0	0
r2	0.551	0.842	0.403	0.444	0.227	0.56	0.341	0.335	0.416	0.566	0.342	0.377	0.818	0.959	0.213	0.217	0.952	0.99	0.1	0.109
d_watson	0.462	1.444	1.417	1.473	0.78	1.832	1.837	1.903	0.907	1.352	1.178	1.225	0.301	2.039	2.057	2.052	0.365	2.392	2.564	2.528
no_parameter	4	5	5	6	4	5	5	6	4	5	5	6	4	5	5	6	3	4	4	5
Durbin watson (H0: no serial correlation)	Reject H0	Incon-clusive	ncon-clusive	ncon-clusive	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	ncon-clusive	Accept H0	ncon-clusive	Reject H0	Accept H0	Accept H0	Accept H0	Reject H0	Accept H0	Accept H0	Accept H0
N	32	30	30	30	47	46	46	46	44	43	43	43	41	38	38	38	47	46	46	46

Table 17 Summary of elasticity estimates

(i) Cocoa beans

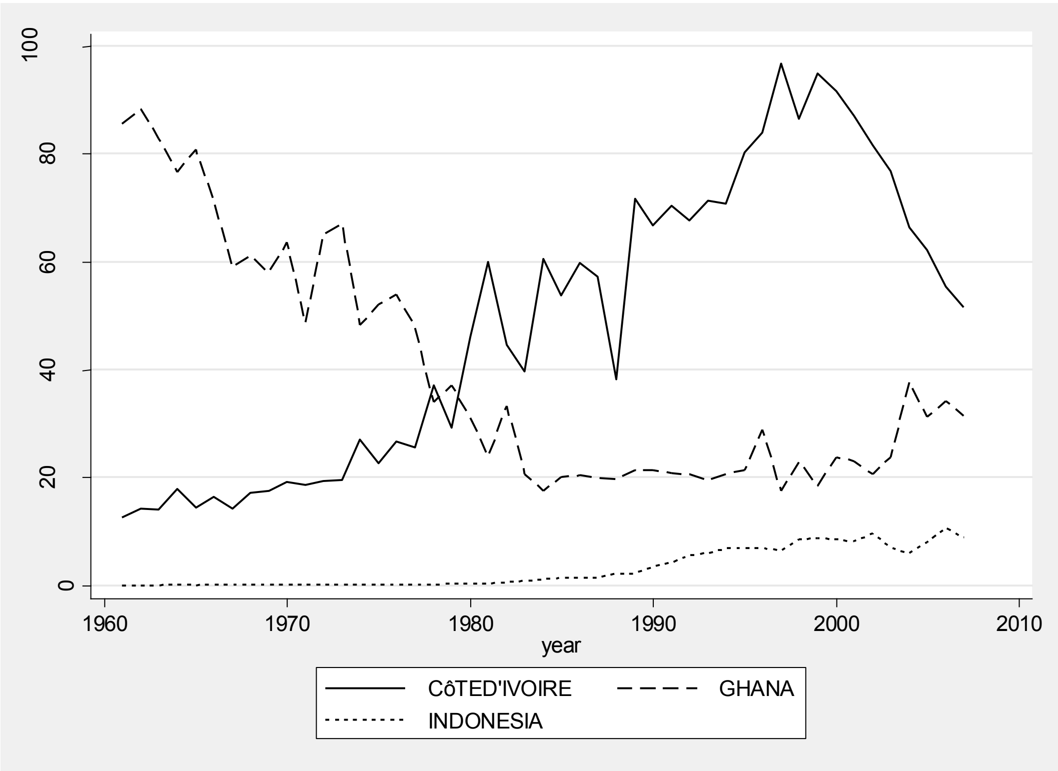
Country	Export demand	Export supply	Substitution	Import demand	Cross supply
Ivory Coast	-0.18	0.156	n/a	n/a	-0.09
Ghana	-0.137	**0.237(a)**	n/a	n/a	-0.047
Indonesia	-1.09	0.132	0.62	-0.239	-0.049
Malaysia	-1.26	0.171	0.891	-0.364	*0.11*
ROW	-0.286	**0.55(b)**	0.442	-0.317	-0.078

(ii) Processed cocoa

Country	Export demand	Export supply	Substitution	Import demand	Cross supply
Ivory Coast	-0.012	0.47**(c)**	n/a	n/a	-1.429
Ghana	-0.371	0.47**(c)**	n/a	n/a	-0.353
Indonesia	-0.338	0.31**(c)**	n/a	-0.467	-3.290
Malaysia	*0.31*	0.31**(c)**	n/a	-0.172	*0.812*
ROW	-0.072	n/a	n/a	-0.027	n/a

(a) Taken from Burger (2008)
(b) Taken from ICCO (2008)
(c) Taken from the ATPSM database (UNCTAD 2004)

Figure 15 Estimated Optimal Taxes



Notes: Parameters: export demand elasticities for Indonesia, Ivory Coast and Ghana are 1.09, 0.18 and 0.137, respectively. We follow ICCO (2008) by setting world's supply elasticity 0.55.

Table 18 Baseline Elasticities

Elasticities		Cocoa beans					Processed cocoa				
		Ivory Coast	Ghana	Indonesia	Malaysia	ROW	Ivory Coast	Ghana	Indonesia	Malaysia	ROW
Em	Composite Demand	**-0.010**	**-0.100**	-0.239	-0.364	-0.317	**-0.050**	**-0.100**	-0.467	-0.172	-0.027
Ex	Industry Supply	0.156	0.237	0.132	0.171	0.550	0.470	0.470	0.310	0.310	**0.400**
Xex	Cross Supply	-0.090	-0.047	-0.049	0.110	-0.078	-1.429	-0.353	-3.290	0.812	**-1.000**
Es	Substitution	**0.500**	**0.500**	0.620	0.891	0.442	**0.500**	**0.500**	**0.500**	**0.500**	**0.500**

Note: red numbers are based on 'best-prediction'

Table 19 Trade Flows (in USD '000)

Cocoa beans

Origin	Export 1801 (2008)	Cote d'Ivoire	Ghana	Indonesia	Malaysia	ROW
	Cote d'Ivoire	0	0	19710	31656	1702748
	Ghana	0	0	669	119790	910696
	Indonesia	0	0	460000	468788	385797
	Malaysia	0	0	0	0	18036
	ROW		0	0	0	1535377

Processed cocoa

Origin	Export 1803-1806 (2008)	Cote d'Ivoire	Ghana	Indonesia	Malaysia	ROW
	Cote d'Ivoire	0	1564	0	0	937490
	Ghana	1314	0	0	193	64501
	Indonesia		204	15663 [a]	7918	404800
	Malaysia	8	386	20528	0	962168
	ROW	2550	4212	28689	90664	23577882

Source: WITS; (a) Taken from 0.06% of world's total consumption as suggested by Chairman of Asosiasi Industri Kakao Indonesia (AIKI) (source: http://www.bisnis.com/industri/manufaktur/2054-hilirisasi-industri-butuh-cetak-biru).

Table 20 Simulation: Indonesia's 10 per cent export taxes for cocoa beans

	Cocoa beans				Processed cocoa				
	A	B	C	D=A+B+C	E	F	G	H=E+F+G	I=D+H
	Producer surplus	Consumer surplus	Change In tax receipt payments	Net welfare effect	Producer surplus	Consumer surplus	Change In tax receipt payments	Net welfare effect	Net welfare
Cote d'Ivoire	2042.9	0.0	0.0	2042.9	-515.8	-3.2	0.0	-519.0	1523.9
Ghana	3758.0	0.0	0.0	3758.0	-115.7	3.1	0.0	-112.6	3645.4
Indonesia	-78462.2	27727.8	78698.0	27963.6	13918.2	396.6	0.0	14314.8	42278.4
Malaysia	19.0	-21482.0	0.0	-21463.0	-850.7	180.3	0.0	-670.4	-22133.4
ROW	998.7	-23515.3	0.0	-22516.6	-8726.1	3007.7	0.0	-5718.4	-28235

Source: Authors' simulation results

Table 17 presents the summary of our estimates. It is worth noting that for Malaysia positive cross elasticities suggesting cocoa beans and processed cocoa are substitutes. In the pre-1970 period, cocoa beans for Malaysia was dominated by other commodities especially rubber and palm oil. Since 1970s, the development of cocoa beans sector has been an important part of the export-led strategy that the economy adopted along with government's attempts to diversify its agricultural sectors. In terms of grinding, Malaysia is the largest cocoa grinder in Asia. Unlike Indonesia, its cocoa downstream manufacturing has developed quite rapidly.

In more recent years, given the incoming of new technology Malaysia has been able to not only grind cocoa beans but also cultivate them becoming one of the major cocoa exporting countries in the world. The cocoa fermentation technique allows to match the taste of Malaysian cocoa with that of West African cocoa (Abdullah 2011). This is important to meet the world's demand as most consumers in European and North America are used to the flavour of West African cocoa. Given a positive cross elasticity, there is an indication that Malaysia has attempted to self-fulfil its demands for cocoa beans to cater to its cocoa downstream manufacturing.

Given our estimates, we recalculate optimal export taxes. Note that in the previous section, using elasticities from previous studies Figure 12 suggests that current 10 per cent tax rate is close to the optimal rate based on the theory. Figure 15 also suggests similar rates. However, we identify that Indonesia's rates should be much lower than those of Ghana and Cote d'Ivoire whereas Figure 12 suggests the optimal rates of Indonesia is very close to Ghana's.

Given incomplete datasets, after drawing some figures from previous studies to perform a welfare analysis there are still some elasticities of some countries need to be best-predicted. Table 18 presents our best prediction.

1. Import demand elasticities for Ghana and Cote d'Ivoire's cocoa beans are set to be 0.010 and 0.100. As we can see from Table 19, there was no import of cocoa beans coming into Cote d'Ivoire suggesting the elasticity to be a very small number close (if not equal) to zero. Ghana, on the other hand, had about 50 per cent of Indonesia's total import volume. Our best prediction is that Ghana's elasticity is less than Indonesia's, but higher than Cote d'Ivoire.

2. Elasticity of substitution for Ghana and Cote d'Ivoire's cocoa beans are set to be 0.5 each. Characteristics of cocoa beans from Ghana, Cote d'Ivoire and Indonesia vary quite significantly. Given 0.6 Indonesia's elasticity and 0.4 ROW's elasticity, we set substitution elasticities for these countries to be somewhere in between the two figures.

3. Similar to cocoa beans, there was less volume of imports of processed cocoa flowing to Ghana and Cote d'Ivoire than imports to Indonesia and Malaysia. Our prediction is that Ghana and Cote d'Ivoire have less elastic import demand than the other two countries. The pattern from our estimates is that bigger importing countries have more elastic import demand. We therefore set 0.05 and 0.1 for Cote d'Ivoire and Ghana, respectively.

4. Given different characteristics of processed cocoa across producing countries, we set elasticities of substitution to 0.5 for all countries.

5. For the ROW, we predict that export supply elasticities for processed cocoa are somewhere between elasticities of major exporting countries. We set to 0.4. As for elasticity of cross supply, we set it to a unit-elastic assuming that for most countries cocoa beans must pass through some process before they can be consumed. Therefore, industries only demand for cocoa beans when they are producing processed cocoa.

Based on Table 19, we identify three main points:

1. Cote d'Ivoire and Ghana do not import cocoa beans.

2. Among four individual countries we choose, Malaysia is the biggest cocoa bean importer with most cocoa beans coming from Indonesia.

3. While over half of Indonesia's cocoa beans are exported to Malaysia, almost half of Indonesia's processed cocoa imports are from Malaysia.

Using the GSIM software, we simulate the implementation of 10 per cent export taxes.[6] Table 20 presents results from our simulation. We find the following key points:

6 The GSIM software can be downloaded from (http://www.i4ide.org/content/wpaper/dp20090803.zip)

1. Indonesia is predicted to obtain $42m as a result of the 10 per cent export taxes. Change in tax receipts outweighs a decrease in producer surplus. Users of beans (i.e. processors) are better off with nearly $28m gains.

2. The increases in net welfare in the cocoa beans sector, however, are not translated to a significant increase in welfare in downstream industries.

3. Other major exporting countries, Cote d'Ivoire and Ghana, also receive improved welfare but to the lesser extent than Indonesia. This is because the Indonesian export tax raises world prices. This terms of trade effect is the source of producer gains in Indonesia, but some of the benefits are captured by competing exporters.

4. Malaysia is hit quite substantially given its high reliance on Indonesia's cocoa beans. Yet, given the high substitutability between cocoa beans and processed cocoa in Malaysia, reduced supply of cocoa beans does not significantly affect its downstream manufacturing.

5. The global effect of an Indonesian export tax is a reduction in welfare. Gains to cocoa processors in Indonesia are outweighed by losses to processors in Malaysia and elsewhere.

One possible concern is the robustness of our welfare analysis. To check the sensitivity of results to parameter values, we compare results from various elasticities of substitution, which is 0.5, 0.1 and 5.0.

Table 21 indicates that in terms of the magnitude there is significant variation across three simulations, with no change in sign. In this model the Armington elasticity determines the distribution of welfare gains but leaves global welfare unchanged. The various parameter values make no difference to the welfare gains in the cocoa bean sector in each country. There are, however, greater differences in the welfare gains in the cocoa processing sector. Indonesia gains at the expense of other countries as the elasticity of substitution rises.

Table 21 Robustness Check – Varying Elasticities of Substitution for Processed Cocoa

NET WELFARE	Elasticity=0.1	Elasticity=0.5	Elasticity=5.0
Cote d'Ivoire	-42.8	-519.0	-1056.1
Ghana	-17.9	-112.6	-221.7
Indonesia	3791.5	14314.8	24067.7
Malaysia	-4.4	-670.4	-1057.0
ROW	2884.9	-5718.4	-13733.2

5. Concluding Remarks

This paper uses the GSIM partial equilibrium modelling framework to analyse the implications of Indonesia's export tax on cocoa beans. The purpose of this analysis is to see whether export taxes on cocoa beans may bring improved welfare of cocoa downstream manufacturing. Our analysis also derives optimal tax rates suggesting that Indonesia's rates should be positive, although below those of competitors Cote d'Ivoire and Ghana.

Three key lessons can be drawn for this study. First, an export tax on Indonesian exports of cocoa beans would indeed divert some of the crop to domestic use. However, this leads to significant losses to cocoa bean producers and does little to develop a processing sector. Second, interdependence between major cocoa exporting countries' policy is evident. Third, due to limited readily available data, better econometric techniques do not necessarily lead to improved robustness of estimates of elasticities. This could significantly affect estimates of optimal export taxes and, therefore, analysis of welfare effects.

Whilst our analysis shows positive effects of export taxes because Indonesia is able to improve its terms of trade through an increase in export prices, the policy does little to encourage the development of a downstream processing industry, the stated objective of the policy. The main effect is a transfer from cocoa producers to taxpayers. Although the analysis shows net gains, we do not wish to draw the conclusion that an export tax on cocoa beans would be desirable for Indonesia. The implementation of such a tax would have important effects not captured in our analysis. With over 1 million people working in this sector, imposing an export tax would lead to increased unemployment.[7]

One caveat with this paper is obvious. Drawbacks of the PE framework are well-known. PE models ignore inter-sectoral linkages and often don't take limited resources into account. Therefore, they can produce a close approximation to reality only when the sector in question accounts for a small share of total domestic output. According to the pure theory of international trade, there is no difference between the PE and GE definitions of the optimum trade tax as long as the economy is characterised by perfect competition with constant returns to scale technology. This is a very strong assumption. However, the standard trade model – that is a general equilibrium model which highlights the way in which goods and factor markets are inter-related- requires some information that is often difficult to find. The fundamental drivers, the production possibility frontier and community indifference curves are some examples. In this case, the PE analysis offers a good alternative especially to analyse trade in a good which does not contribute to a large part of total trade and, therefore, has limited impacts on the whole economy.

There are some questions our study has not addressed. One of them is whether Indonesia's cocoa downstream manufacturing has a potential comparative advantage. Processing cocoa requires quite technology-intensive processes in which Indonesia might still have limitation.

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[7] There is a version of GSIM that includes change in labour use. But lack of data limits our analysis.

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