The Economic Cost of Foreign Exchange and Shadow Price of Non – Tradable Outlays for West African Economic & Monetary Union

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ABSTRACT

The prior objective of this thesis is to develop a general expression for the estimations of economic opportunity cost of foreign exchange for tradable goods and services and the shadow price of non-tradable outlays for the non-tradables for any economy. Methodologically, a three sector general equilibrium framework is used where the impacts of both financing (in relation to domestic and foreign capital market actions) and purchase along with any subsequent changes in the equilibrium quantities of goods and services due to any change in the relative prices of goods are taken into account. As the sectors of the economy involve various sets of market distortions such as tariffs, taxes, subsidies and other kinds of indirect taxes, market values diverge from their real economic worth. Therefore, while estimating the numeraire of the economic opportunity cost of foreign exchange and the shadow price of non-tradable outlays, any changes in economic welfare due to the shifts in demand and supply between the tradables and non-tradables together with these set of distortions are measured in a consistent manner.

Using the three sector general equilibrium model, the research concludes that the additional cost of the use of foreign exchange within the West African Economic and Monetary Union is about 7.3 per cent of the market value of tradable goods and there will be approximately a 2.4 per cent premium on the expenditures or receipts of non-tradable goods within the region.

Keywords: Three Sector General Equilibrium Model, Economic Cost of Foreign Exchange, Shadow Price of Non – Tradable Outlays, West African Economic and Monetary Union

ÖZET

Bu tezin öncelikli amacı ticari mallardaki dövizin iktisadi alternatif maliyetini ve gayri – ticarilerdeki gölgelendirilmiş fiyatlarını herhangi bir ülke ekonomisi için yönelik genel hesaplama metodu geliştirmektir. Method olarak üç sektöre bağli genel denge kullanılmış olup modelde hem finansman (yerli ve yabancı sermaye piyasası hareketleri) hemde satın almalarla birlikte sonradan göreceli fiyat degişikliğinden meydana gelen mal ve hizmetlerin denge miktarlarının değişimi ele alınmıştır. Ekonomideki sektörler birçok distorsiyon içerdiğinden öyleki bunlar ithalat -ihracat vergileri, sübvansiyon ve diğer dolaylı - dolaysız vergiler; pazar (mali) değerler ile iktisadi değerler arasında diverjans görülmektedir. Bundan dolayı, dövizin iktisadi alternatif maliyetini ve gayri ticarilerin gölgelendirilmis fiyatlari hesaplarken ticariler ve gayri ticariler arasındaki talep ve arz miktarlarındaki değişikilerinden meydana gelen ekonomik refahtaki değişikler distorsiyonlarla birlikte tutarlı bir şekilde ölçülmüştür.

Üç sektörlü genel denge modelini kullanaraktan Batı Afrika Ekonomi ve Para Birliği için dövizin iktisadi alternatif maliyeti yüzde 7.3 ve yine bu birlik içerisinde gayri – ticari mallarda gölgelendirilmiş maliyet ise yaklaşik yüzde 2.4 olarak hesaplanmıştır.

Anahtar Kelimeler: Üç Sektörlü Genel Denge Modeli, Dövizin Iktisadi Alternatif Maliyeti, Gayri – Ticari Gölgelendirilmiş Fiyat, Batı Afrika Ekonomi ve Para Birliği

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To my mother and sisters

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CHAPTER 1

INTRODUCTION

Cost-benefit analysis is a method for evaluating the feasibility of investment projects and to determine if they promote the best use of a country's resources. A proper feasibility study requires having both relevant input and output variables and accurate values for these variables in terms of quantities and prices. In the first instance, prices are obtained in the market, so they reflect the financial values. Financial prices include all the tariffs, taxes, subsidies and other indirect taxes that cause such prices to diverge from their economic values. To define economic values, the financial prices need to be adjusted for these tariffs, taxes, subsidies and other indirect taxes since they only account for the value of the real resources consumed and/or produced by the project.

One area where the adjustment required for these distortions are most extensive is in the market for foreign exchange (market exchange rate). To estimate the economic opportunity cost of foreign exchange (EOCFX), one must evaluate the changes in economic welfare when the quantities of goods and services in the economy are changed due to the simultaneous sourcing of funds in the capital market and then spending these funds on tradable goods and services (tradables). The result of such analysis yields an empirical value of EOCFX.

A similar exercise can also be carried out to determine the economic or shadow price of expenditures on non-tradables (SPNTO). We evaluate these variables first examining the impact of entering the capital market to obtain financing and then using these funds to purchase non-tradables.

While estimating the economic price of foreign exchange on tradables (EOCFX) and the economic cost of outlays on non-tradables (SPNTO), the sources of the funds used by the project to purchase the tradables and non-tradables must be taken into account. Both the financing and purchase along with the subsequent changes in the relative prices of goods (also created by the specific goods purchased) will change the equilibrium quantities of many goods and services. Such changes in the equilibrium quantities will create the potential for a change in the economic welfare when the markets contain taxes or subsidies or other distortions.

When funds to finance project expenditures are sourced via extractions from the domestic capital market, there are two ultimate sources of these funds: displacement of private consumption expenditures and abandoned or postponement of investment spending by others. Moreover, sourcing of funds by the project to purchase the tradables and non-tradables may also come through foreign capital inflows which will not result in an initial reduction of any investments and consumption. At the same time, foreign borrowing changes the relative prices of tradables to non-tradables (the real exchange rate). Hence, adjustments due to the changes in the relative prices of tradables to non-tradables markets will change the quantities of goods and services demanded and supplied.

The economic cost of foreign exchange (EOCFX) captures the distortions in the markets for tradables and non-tradables that arise when foreign exchange is either used or produced by a project. This economic exchange rate is used to convert the foreign exchange denominated prices of internationally tradable goods into their economic values expressed in units of domestic currency. The difference between the economic foreign exchange rate $\left(E^e\right)$ and the market exchange rate $\left(E^m\right)$ can be expressed as a proportion of the market exchange rate $\left(E^e/E^m - E^m\right)$ or $\left(E^e/E^m - 1\right)$. It is referred to as the foreign exchange premium.

In the same manner, when there are tax externalities created by the act of raising project funds in the capital market and using them for the purchase of non-tradables, the difference between the economic cost and financial outlays on non - tradable goods and services reflects the premium on non-tradable outlays. The ratio of the economic cost of non-tradables to their financial values defines the shadow price of non-tradable outlays (SPNTO). This is a number either greater or less than 1. The difference between the value of SPNTO and 1 measures the value of the premium for expenditures on non-tradables (NTP) as a proportion of their financial prices. The NTP measures the externalities gained or lost per unit of domestic currency used to purchase non-tradable inputs or earned per unit of output if a project produces a non-tradable output. In short, the NTP for the case of project purchases is the value of the changes in the economic welfare caused by the presence of market distortions per unit of funds sourced in the capital market and used to finance the non – tradable inputs.

In this study, the estimation of both EOCFX and the SPNTO along with the corresponding FEP and NTP is carried out for the West African Economic and Monetary Union. The study uses a three sector general equilibrium framework where project funds are sourced in the capital market and used to purchase tradable and non-tradable goods. The combined capital market borrowing operation and the purchase of goods and services for the project, including the feedback effect of the changes in the 'size' of the tradable sector is also taken into account in a general equilibrium setting. The general equilibrium model captures the economic welfare impacts in the economy from the shifts in demand and supply between the tradable and non-tradable sectors instigated by the combination of the financing and purchase operations.

This thesis consists of six chapters; Chapter two contains a survey of the literature for studies in the cost – benefit literature on the estimation of shadow exchange rate and shadow prices of non-tradables. Chapter three explains the methodology followed for the estimation of EOCFX and the SPNTO. Related information regarding the institutional background of the WAEMU area and information about the estimates of externalities for the WAEMU region is examined in Chapter four. Empirical estimation of estimation of the EOCFX and the SPNTO for the WAEMU is given in Chapter five. Finally, conclusions and recommendations of this study are presented in Chapter 6.

CHAPTER 2

LITERATURE REVIEW

Shadow Pricing has been an old and controversial problem in cost-benefit analysis and the literature has evolved over time. Accurate estimation of these national parameters is fundamental to estimating the relative values of benefits and costs when the project is buying or selling tradables and non- tradables. There are different definitions and shadow pricing rules for traded and non-traded commodities in the cost – benefit literature. For instance, Medalla and Power (1984) defines shadow pricing as a 'measure of the gains or losses in welfare arising from a marginal change in the use of resources'. On the other hand Bacha and Taylor's (1971) definition is 'On the estimation of shadow exchange rate, economic theorists pointed out three distinct approaches; the foreign exchange shadow price should reflect the value in terms of welfare to the economy of an additional dollar, the shadow price should reflect the opportunity cost of a dollar in other uses and the shadow price should be the equilibrium exchange rate -with varying assumptions about what the equilibrium rate may be' .

Bacha-Taylor (1971) assumes that the developing economies will adopt free trade policies except in the case of optimal tariffs and define the free trade equilibrium exchange rate as the shadow exchange rate while assuming that the economy will

move toward free trade in the lifetime of the project and implicitly assumes that free trade is the optimal regime.[1]

The UNIDO approach to the estimation of the shadow exchange rate for tradables has been to assume that a country's present protection systems will remain at least throughout the lifetime of the project being evaluated. It is argued that the appropriate shadow exchange rate is the value at tariff distorted prices of an additional unit of foreign exchange. The UNIDO measures the marginal social value of the last unit of foreign exchange given the present protection structure. It is the value of incremental consumption due to a marginal increase in foreign exchange. In addition to this, the UNIDO approach suggests that domestic resources are evaluated totally by the domestic willingness to pay, in other words, all the non-traded goods in an economy are valued in accordance with willingness to pay in the basis of domestic evaluation.[2]

The Optimal Intervention System (OIS) modifies the free-trade assumption by recommending a set of policies which would provide government revenues, correction for terms of trade effects and real protection via subsidies, and correcting

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[1] $\frac{SER}{OER} = q_i(1+T_i)^{ai} + q_j(1+S_j)^{aj}$ where T_i is the implicit tariff, S_j is the implicit subsidy, q_i and q_j are the product over all i's and j's respectively.

[2] $\frac{SER}{OER} = \frac{q_i dM_i(1+T_i) + q_j dX_j(1+S_j)}{q_i dM_i + q_j dX_j}$

where dM_i is the marginal change in imports, dX_j is the marginal change in export, T_i is the implicit tariff and S_j is the implicit subsidy, q_i is the product over all i's and finally q_j is the product over all j's.

distortions at the source for those projects which are socially desirable but not commercially profitable due to genuine market failures.[3]

Batra and Guisinger (1974) criticize the UNIDO formulation by derivations with the various assumptions made. They assume that if there are no factor market distortions, no taxes, no government expenditures or other kinds of restrictions other than the tariffs and subsidies which apply to traded commodities under full employment, then the UNIDO expression for the shadow exchange rate is the product of the official exchange rate and the weighted average of the tariffs and subsidies. The weights are to be computed as the marginal increase in imports and decrease in exports due to additional units of foreign exchange availability in the home country. Hence, the change in domestic absorption results from the change in foreign exchange availabilities as represented by the UNIDO formula.

Furthermore, Batra and Guisinger (1974) derive the UNIDO formulation in a general equilibrium framework by adding the impact of foreign aid on the model to discover its impacts on domestic absorption. They argue that the UNIDO formula signifies the domestic value of an additional unit of foreign exchange in the case where the increase in foreign exchange of a country has no effect on the value of domestic production. However, they suggest that in the case where foreign aid is often used for

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$$SER = \left\{\left(\frac{1+S_1}{1+S_1'}\right)\left(\frac{1+V_{x1}}{1+V'}\right)^{c_{x1}}\right\}^{a1}\left\{\left(\frac{1+S_1}{1+S_1'}\right)\left(\frac{1+V_{x2}}{1+V'}\right)^{c_{x2}}\right\}^{a2}\left\{\left(\frac{1+T}{1+T'}\right)\left(\frac{1+V_m}{1+V}\right)^{-cm}\right\}^{(1-a_1-a_2)}$$

where, $S_1^{'}$ stands for Subsidy (export tax) for major exportables, $S_2^{'}$ stands for the Subsidy (export tax) for minor exportables, $T^{'}$ stands for Implicit tariff for importables, $V^{'}$ stands for sales tax, V_m sales tax on importables, V_x stands for sales tax on exportables, V_m sales tax on importables

investment purposes in most developing economies, these cases would seem to be the exception.

Batra and Guisinger (1974) further argue that it is not realistic to say that the increased foreign exchange availability will leave domestic resources (income) unchanged. Moreover, they derive an Optimal Exchange Rate (OER) for evaluation of the development projects. They maximize the social welfare function in a three – traded- commodity framework subject to resource constraints and existing trade restrictions. They show that the exchange rate and trade distortions (including the import tariff and export subsidies) enter into the calculation of the marginal investment projects which involve small changes in these three commodities. They state that the allocation of the resources is most efficient when these 'marginal investment projects are evaluated at world prices showing that trade taxes are irrelevant to resource allocation. Nevertheless, trade distortions are the prime cause of resource mis-allocation, the OER in LDCs are also distorted and suggest that removal of trade distortions in both consumption and production lead to the first and best level of welfare.

Balassa (1974) criticizes the derivation of the UNIDO formula by Batra and Guisinger (1974) and suggests that to take future increases into account, it needs to introduce a multi – period framework where the effects of increased savings and investments are considered. Regarding Optimal Exchange Rate (OER) by Batra and Guisinger, Balassa (1974) defines it as an expression for the optimal rate of subsidy on the commodity or tariff imposed rather than representing the shadow exchange rate and suggests that by removing the assumption that all goods are fully traded

made by Batra and Guisinger, the shadow exchange rate can be estimated. Balassa (1974) suggests that the SER will have to be used in calculating the opportunity cost of the project whose implementation involves an increase or decrease in the production of a commodity, which faces finite foreign elasticity, or is subject to quotas (prohibitive tariffs), and / or affects the production of non- traded goods which are supplied at non-constant costs.

Dasgupta and Stiglitz (1974) apply a general equilibrium model of an open economy under the assumption of fixed world prices and suggest that the traded commodity world price is its shadow price. At the same time the price of the non-traded commodity is its foreign exchange equivalent, but in the case of government budget constraint the shadow price of the tradable good falls between its domestic value and its world price.

Boadway (1975) argues that in the case of tax and tariffs on traded commodities, shadow prices are used as world prices in the public sector. However for non-traded commodities, these shadow prices depend on existing distortions in the market if the government does not set taxes optimally and tariffs at zero. In addition to this, in the case of shadow pricing of non-traded commodities he is in favor of the Harberger type weighted average formula instead of the "foreign exchange equivalent" derivation by Little –Mirrlees.

Warr (1977) uses a utility optimization problem subject to a concave implicit production function of a firm and a concave implicit production function of a public project. Warr claims that the correct shadow prices for traded commodities are at

their relative international prices when public production of traded goods has an indirect effect on distorted prices of non-traded goods. The government has budget constraint under the assumption that any distortion in domestic market prices is due to the non-optimal tariffs and other taxes which are given and fixed. Moreover, Warr (1977) suggests that the optimal shadow price of non-traded goods reflects the marginal social cost of drawing the goods into the public sector. This is achieved by a "weighted average" of the good's market price and marginal social cost of production, the weights reflecting the proportions in which additional public demand is satisfied by a fall in consumption and a rise in production, respectively. These proportions are indicated by the relative slopes of the demand and supply relations.

Boadway (1978) derives a static general equilibrium neoclassical model as a basis when comparing the UNIDO Guidelines and the Little- Mirrlees manual. He also maximizes the social utility function where society consumes importable, exportable and non-traded commodities. In the Boadway model, the economy consists of two factors (labor and capital) and finally tariffs are assumed to be imposed on tradables. A social utility function in the model is subject to a private sector production function where the private sector is assumed to operate with production efficiency. The public sector production function does not necessarily give a positive value in the production of importable goods and the social utility function is subject to a balance of payments constraints. Boadway (1978) further proves that the UNIDO Guidelines ignore both the changes in taxes due to the implementation of any public projects which need to be financed and the indirect impact of changes in non-traded goods. Therefore, the UNIDO guidelines represents a partial equilibrium approximation for welfare changes. Boadway estimation of the Little- Mirrlees

manual suggests that although it is general equilibrium in spirit, it does not serve the net social benefit measure of a project.[4]

Warr (1982) estimates the optimal shadow price of non-tradables for an economy with a single consumer, two firms (one private and the other public) and three commodities that are importable (i), exportable (e) and non-traded (nt).In Warr model, commodities (e) and (nt) consumed domestically whereas commodity (i) is a fully imported commodity. Warr maximizes the individual utility function subject into two constraints; (a) consumption of non traded goods (nt) cannot exceed the difference between the private firm's production and the public firm's usage of that commodity, (b) exports of commodity (e) cannot exceed the net imports of commodity (i). Warr explanation of "foreign exchange equivalent" suggests that the shadow price of non-traded input used by a project produced elsewhere is the marginal cost, in terms of traded inputs valued at their international prices and non-traded inputs valued at their respective shadow prices and of supplying the goods from this source.

Dasgupta, Stiglitz and Blitzer (1982) conclude that accounting prices for the tradable goods are their border prices if there is no divergence between the marginal cost and the marginal value of domestic income in terms of foreign exchange. They further state that in pricing traded goods relative to the pricing of non-traded goods; the

[4] $e = 1 + t_1 \frac{\partial M}{\partial \delta} + t_2 \frac{\partial E}{\partial \delta}$ where e stands for the shadow price of foreign exchange, M stands for the amount of imports, E stands for the amount of exports, $\partial\delta$ stands for changes in the exchange rate induced by the net demand for foreign exchange by the project, t_i stands for trade distortions.

shadow exchange rate must be used which is the nominal exchange rate times one plus the weighted average of total indirect taxes.[5]

Jenkins and Kuo (1985) developed a multi-sectoral general equilibrium model to measure the social cost of foreign exchange for the Canadian economy which took into account both production and capital subsidies along with the import tariff and commodity taxes under the purchase of foreign exchange through income taxes. Their model explicitly takes into account the way of additional imports which are financed by the government. Then, they fount that there was a 6.5 per cent difference between the market price and the social value of foreign exchange in the Canadian economy.[6]

Fane's (1991) study argues that SER is the most convenient numeraire for shadow pricing in the case of a small open economy and further argues that Harberger's weighted average rule can be interpreted as either estimating the relative shadow prices by using the elasticities of compensated demand and supply curves or by

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[5] $P^s = \dfrac{P_I^d\left(I - \dfrac{\lambda}{\phi}\right) + \lambda P_I^w}{P_E^d\left(I - \dfrac{\lambda}{\phi}\right) + \lambda P_E^w}$ estimates the accounting price of imports and exports.

where λ is the marginal value of foreign borrowing in terms of domestic income (shadow price of foreign borrowing) and ϕ is the marginal cost of foreign exchange in terms of domestic income

$\gamma \equiv \dfrac{C_I(\alpha_N \eta_N + \varepsilon_{IN})}{C_I(\alpha_N \eta_I + \varepsilon_{IN}) + C_E(\alpha_N \eta_E + \varepsilon_{EN})}$ measures the pricing of tradables relative to the non-tradables. Where, $(\alpha_N \eta_i + \varepsilon_{i,N})$ is compensated price elasticity of good i and $C_i = C_i(P_I^c, P_E^c, P_N^c, Y^d)$, for $i = I, E, N.$

[6] $SOCFX = z[1 + (\phi/\Delta FE)]$ where, z stands for the market exchange rate, ϕ measures the change in the value of commodity taxes paid that result from the change in the expenditure made on goods and services produced domestically and finally ΔFE refers to changes in the foreign exchange on purchases that of additional imports or refers to a change in capital inflows.

means of estimating absolute shadow prices using the elasticities of a general equilibrium in a closed economy case.

Fane (1991) clarifies the relationship between the traditional (partial equilibrium) approaches of estimating the shadow price of foreign exchange with a general equilibrium approach presented by Harberger. Fane (1991) identifies the following proposition to compare the partial versus the general equilibrium approaches on estimating the social opportunity cost of foreign exchange:

> ' *...formulae in the traditional literature for the social opportunity cost of foreign exchange (or shadow exchange rate) can be interpreted as measures of either of two concepts which are absolute or relative shadow price of foreign exchange, differ in general, but are equal under the special assumption which justify the partial equilibrium approach of traditional literature…The general equilibrium approach involves setting up a fully specified model and measuring the absolute shadow price of any particular good or factor as the reduced derivative of social welfare with respect to net output of that good or factor, holding constant public sector's outputs of all other goods and factor…*'[7]

[7] For more information see full article, "The Social Opportunity Cost of Foreign Exchange: A Partial Defence of Harberger et al by Fane (1991)

Harberger and Jenkins (1997) developed a general model for the estimation of the economic cost of foreign exchange on a per unit basis which emphasizes the trade distortions through analyzing the effects of import tariff and export subsidies on the incremental changes in consumption.[8]

Franc and Naqvi (2000) analyzed the effects of international capital mobility on the shadow price of foreign exchange under qualitative and quantitative trade distortion for small and open LDCs with a convex production set and they suggest that either with and without international capital mobility the shadow price of foreign exchange is lower with tariff on one subset and VERs on another compared to that of with tariffs and quotas. However, if taxed (tariff) and quantity constraint goods (quota / VERs) are both capital intensive or both labor intensive, and both are substitutes in import demand then under the scheme of tariffs and quotas then the shadow price of foreign exchange is lessened by international capital mobility and vice versa in the presence of tariffs and VERs.

Dusansky, Franc and Naqvi (2000) estimate the shadow price of foreign exchange based on a monetary framework, for a small open economy faced with a fixed exchange regime and achieved stable equilibrium. They maximize social welfare function subject to vector of home prices of 'n' commodities plus the scalar stock of

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[8] $E^e = E^m \left[1 + \frac{\left(\varepsilon_x k - \eta_i \left(Q_i^{FX} / Q_x^{FX} \right) t \right)}{\varepsilon_x - \eta_i \left(Q_i^{FX} / Q_x^{FX} \right)} \right]$

E^m stands for market exchange rate, k stands for rate of subsidy on exported goods, t stands for rate of import tariff, ε_x stands for elasticity of supply of exports, η_i stands for elasticity of demand for importables, Q_i^{FX} stands for quantity of foreign exchange required to pay for imports and Q_x^{FX} stands for quantity of foreign exchange earned from exports.

money demanded. A model developed by Dusansky, Franc and Naqvi (2000) includes transfer of foreign exchange and nominal money stock carried over from the previous period. They consider four cases separately and claim the following propositions in accordance to their study:

Proposition 1: 'The shadow price of foreign exchange is strictly greater than the nominal exchange rate under tariffs in a fixed exchange rate regime.'

Proposition 2: 'The shadow price of foreign exchange is strictly less than the nominal exchange rate under quotas in a fixed exchange rate regime.'

Proposition 3: 'The shadow price of foreign exchange is strictly less than the nominal exchange rate under a scheme of voluntary export restraints in a fixed exchange rate regime.'

Proposition 4: 'If commodities are weakly separable from real balances in the utility function and if the exchange rate is perfectly flexible, then true shadow price of foreign exchange is the same as the shadow price of a numeraire good transfer from abroad.'

The National Economic and Development Authority (Jenkins et all, 2000) estimated the SER by considering the impact of trade taxes and subsidies on tradables, adjusting for an unsustainable current account balance and finally considering the impact of value added tax and excise taxes imposed on both tradables and non-tradables. In other words, the NEDA estimates that the SER is the sum of three components.

The first component of the NEDA model measures distortions that exist in the external trade sector. These distortions are in the form of import tariffs and export taxes and subsidies. Import tariffs lessen the demand for foreign exchange while the export subsidies net of export taxes increase the supply of foreign exchange. The market exchange rate is determined by the demand curve for imports net of tariffs and the supply of exports after export taxes and subsidies. When foreign goods are imported for use in a project, these will be accompanied by a depreciation in the domestic value. Exports will increase whilst imports will reduced. To account for these distortions, the economic value of foreign exchange should not be valued at the market exchange rate but instead should be calculated as the weighted average of the value of foregone imports and cost of resources used to produce the additional exports. At the margin, the excess amount of the economic value over the market value represents the first component of the shadow exchange rate.[9]

The second component deals with the possible existence of an unsustainable current account imbalance. In the presence of unsustainable current account imbalances, there will be pressure on the exchange rate to adjust. This adjustment will be in the form of a depreciation of the local currency if there is an unsustainable current account deficit and an appreciation if there is a current account surplus. If there is no

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[9] $C_1 = \frac{\varepsilon t_x - \eta(q_i/q_x)t_i}{\varepsilon - \eta(q_i/q_x)}$ where

ε is elasticity of supply of exports net of re-exports

η is elasticity of demand for imports net of re-exported imports

t_i is the weighted average rate of import tariffs on imports which are responsive to changes in the exchange rate

t_x is the weighted average rate of subsidies on those exports – net of export taxes- responsive to any change in foreign exchange

q_i is the amount of foreign exchange required to pay for non-re-exported imports

q_x is the amount of foreign exchange earned from exports net of re-exported imports

current account deficit or if there is small current account deficit that can be covered at the current levels of capital flows, the OER can be maintained and the value of this component will be zero.

Finally, the third component of the SER is measured by the effect of indirect taxes on the economic price of foreign exchange. NEDA simply estimates the third component as a ratio of the total amount of indirect taxes to the total amount of expenditures.[10]

Harberger et al's (2003) estimate of the economic cost of foreign exchange for South Africa uses a three sector general equilibrium framework which takes into account the capital extraction required to finance the purchase of business inputs as well as the substitution effect due to changes in the relative price of tradables to non-tradables in a general equilibrium setting. Harberger et al (2003) find that the additional cost of the use of or benefit from generating foreign exchange in South Africa is approximately 6.2 per cent of the market value of tradable goods. Their result also suggests that there is 1.4 per cent premium on the expenditures or receipts on non-tradable goods.

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[10] $C_3 = \frac{-\eta t_t + \varepsilon\left(Q^S / Q^D\right)t_{nt}}{-\eta + \varepsilon\left(Q^S / Q^D\right)}$ where

η is demand elasticity of tradable goods with respect to change in the exchange rate

ε is supply elasticity of tradables with respect to change in the exchange rate

t_t is the average rate of value added tax applied to tradable goods

t_{nt} is the average rate of value added tax applied to non-traded goods

Q^D is demand for all tradable goods

Q^S is supply of all tradable goods

CHAPTER 3

METHODOLOGY

3.1 General Equilibrium Framework

A three sectoral general equilibrium model is used to estimate the EOCFX and the SPNTO. In this model, various assumptions are made. For instance, the production functions are assumed to be a constant cost over a period of time and after the adjustment process. A country (or region) maintains the current total employment of resources both initially and after the equilibrium is established. Therefore, compensated elasticities of demand are used in the model. Together with the first assumption of the constant cost production functions, the real exchange rate is assumed to be the component that determines the relative price level between the tradables and non-tradables[11]. Thirdly, a set of indirect taxes and subsidy distortions are incorporated except non-tariff barriers as they are assumed to not change as a result of the financing and expenditures of the project. Furthermore, the present protection system is assumed to remain throughout the lifetime of the project. Fourthly, the foreign exchange premium (FEP) and the non-tradable premium (NTP)

[11] The assumption of constant cost is used to simplify the accounting for the fixed value of resources as they are shifted between producers of the different tradable and non-tradable sectors as the demands are shifted by our capital market interventions and purchase of goods. This assumption allows one to avoid having to specify the endowments of the factors and the form of the production function of importables, exportables and non-tradables. At the same time the values of the supply elasticities of importables, exportables and non-traded goods are assumed to be less than infinite in order to allow the markets to clear as a function of the real exchange rate. This creates a small triangle of error in the estimation because the changes in the areas under the supply curves as the quantities of goods supplied change, may not add up to exactly the total value of these changes when the initial supply prices are used (the constant cost assumption) to measure the resource shifts. However, this simplification of the model allows us to add greater richness in terms of the detail of distortions and enables to account for the demand side of the model, while keeping the model tractable.

are not estimated in a way to be specific to a particular commodity purchased or sold by the project. They apply to all tradables and non-tradables as groups.

Capital market borrowing is meant for both public and private investments and there are three ultimate sources of investments for the project financing; namely the displacement of other investments, reduction of private consumption and savings due to foreign capital inflows. In short, the analysis takes into account both the capital extraction used to finance the purchases of business inputs as well as the substitution effects due to the changes in the relative prices of tradables to non-tradables in a general equilibrium setting. This study measures separately the externalities associated with the purchase of tradables and non-tradables that are financed through sourcing from local capital and externalities associated with sourcing funds via foreign capital markets while estimating the EOCFX and the SPNTO.

Four cases are considered: (a) domestically sourced funds that are used to purchase tradables, (b) foreign sourced funds that are used to purchase tradables, (c) domestically sourced funds that are used to purchase non-tradables and (d) foreign sourced funds that are used to purchase non-tradables.

The economic model developed here consists of three sectors. Importables and exportables from the two traded sectors and non-tradables make up the third. Importables consist of goods and services that are actually imported plus the domestically produced goods that are substitutes for these imports. Exportables consist of goods and services that are produced and could also be consumed domestically. Non – tradable goods are only produced and consumed domestically.

While the world market determines the domestic prices of importables and exportables, the real exchange rate is the variable that defines the relative price of tradables to non-tradables. In both cases, domestic prices are modified by transportation costs and all other distortions if applicable. The demand for and supply of importables, exportables, and non-tradables along with various distortions in these markets are taken into account in a manner consistent with the resource constraints of the economy.

Before starting to explain the model, one should be aware that the economy is faced with both budget constaint while at the same time resource constraint. Besides, a small country assumption is used in this model. Then, defining the functions of demand for and supply of tradables and non-tradables by the following equations:

$$Q_{d,t} = f\left(E, F^D, F^F, Y\right) \tag{1}$$

$$Q_{d,nt} = f\left(E, F^D, F^F, Y\right) \tag{2}$$

$$Q_{s,t} = f\left(E, F^D, F^F, Q_S\right) \tag{3}$$

$$Q_{s,nt} = f\left(E, F^D, F^F, Q_S\right) \tag{4}$$

where

$Q_{d,t}$ is the quantity demand for tradables excluding the demand by project

$Q_{d,nt}$ is the quantity demand for non-tradables excluding the demand by project

$Q_{s,t}$ is the total quantity supply of tradables

$Q_{s,nt}$ is the quantity supply of non-tradables

E is the real exchange rate defined as the relative price of tradables versus non-tradables $\left(P_t / P_{nt}\right)$

F^D is the amount of funds raised through the domestic capital market

F^F is the amount of funds raised through the foreign capital market

Y is the gross national aggregate demand

Q_S is the total aggregate supply including both tradables and non-tradables

If funds are raised through the domestic capital market, there will be a displacement of demand for both tradables and non-tradables. However, if project funds are raised through the foreign capital market, there will be no immediate displacement of any types of goods and services, but the injection of foreign exchange in the economy will increase the quantity of tradables available. The total available supply of tradable goods will be increased. Hence,

$$\frac{\partial Q_{d,t}}{\partial F^D} < 0 \text{ and } \frac{\partial Q_{d,nt}}{\partial F^D} < 0 \tag{5}$$

$$\frac{\partial Q_{s,t}}{\partial F^D} = 0 \text{ and } \frac{\partial Q_{s,nt}}{\partial F^D} = 0 \tag{6}$$

$$\frac{\partial Q_{d,t}}{\partial F^F} = 0 \text{ and } \frac{\partial Q_{d,nt}}{\partial F^F} = 0 \tag{7}$$

$$\frac{\partial Q_{s,t}}{\partial F^F} > 0 \text{ and } \frac{\partial Q_{s,nt}}{\partial F^F} = 0 \tag{8}$$

Furthermore, the impact of a change in the exchange rate on demand for and supply of tradable and non-tradables (which defines the relative prices of tradable to non-tradables) are not the same. To show the impact of a change in the exchange rate on demand for and supply of tradables and non-tradables, the following propostions can be written:

$$\frac{\partial Q_{d,t}}{\partial E} < 0 \text{ and } \frac{\partial Q_{s,t}}{\partial E} > 0 \tag{9}$$

The expression in (9) indicates a positive relationship between the supply of tradables and the exchange rate whereas there is an inverse relationship between the demand for tradables and exchange rate. This is due to exchange rate increases where the producers of tradable goods find it more profitable to produce tradable goods when the exchange rate increases, but consumers consume less of tradable goods as the relative prices of tradable goods to non-tradable goods increase.

$$\frac{\partial Q_{d,nt}}{\partial E} > 0 \text{ and } \frac{\partial Q_{s,nt}}{\partial E} < 0 \tag{10}$$

Expression (10) indicates an inverse relationship between the supply of non-tradables and the exchange rate, but shows a positive relationship between the demand for non-tradables and the exchange rate. Hence, the impact of the exchange rate on non - tradables demand and supply is just opposite of its impact on tradables.

Considering the impact of demand for tradables and non-tradables by the project, the initial level of gross national expenditures (Y_0) of a country can be expressed as the sum of equations (1) and (2) plus the demand by the project.

$$Y_0 = Q^0_{d,t}(E) + Q^0_{d,nt} + Q^P_{d,t}(E) + Q^P_{d,nt} \tag{11}$$

where

Y_0 is the initial level of the gross national expenditures

$Q^o_{d,t}$ is the initial level of demand for tradables excluding the demand by the project

$Q^0_{d,nt}$ is the initial level of demand for non-tradables excluding the demand by the project

$Q^P_{d,t}$ is the quantity of demand for tradables by the project

$Q^P_{d,nt}$ is the quantity of demand for non-tradables by the project

In a similar fashion, the initial level of the gross national product (Q^S_0) can be expressed as the sum of equations (3) and (4) in the following equation:

$$Q^S_0 = Q_{s,t}(E) + Q_{s,nt} \tag{12}$$

Q^S_0 is the initial level of the gross national product

$Q_{s,t}$ is the total quantity supply of tradables

$Q_{s,nt}$ is the quantity supply of non-tradables

By definition the initial level of the gross national expenditure (Y_0) is equal to the gross national product (Q_0^S) as follows:

$$Y_0 = Q_0^S \tag{13}$$

In accordance with the assumptions made above and using equation (13), it follows that:

$$dY = dQ^S \tag{14}$$

3.2 Domestically sourced funds are spent on Tradables

The capital market is the natural place for consideration as the marginal source of funds for the financing of both public as well as private investments. Hence, in the estimation of EOCFX and SPNTO; the consistent assumption is that the funds for financing the tradables and non-tradables purchases are made by borrowing in the capital market. In the case of borrowing in the domestic capital market the country's total aggregate demand has not changed which allows us to analyze the impacts on demand and supply separately. The capital market borrowing by any market will ultimately reduce the expenditures by others on tradables and non-tradables goods and services of either consumption and/or an investment nature. Therefore, raising the funds (dF^D) from the domestic capital market to finance the expenditures for the project will lead to a displacement of demand for investment spending on both tradables and non-tradables. Likewise, there will be a reduction of expenditures on consumption type tradable and non-tradable goods.

After the borrowed funds for the project are spent entirely on tradables, there will be a wedge between the demand for and supply of tradable goods that in turn changes the real exchange rate. As previously defined, the real exchange rate determines the relative prices of tradables versus non-tradables and this change of exchange rate will move both markets into a new equilibrium. As the total aggregate demand in the economy is held constant, the sum of the changes in aggregate demand must add up to zero.

3.2.1 Impacts on Demand for Tradables and Non-Tradables

Differentiating the equation (11) for an extraction of funds from the domestic capital market $\left(dF^{F}\right)$and using the demand equations (1) and (2) we have:

$$\frac{\partial Y_0}{\partial F^D}=\left[\left(\frac{\partial Q_{d,t}}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D+\left(\frac{\partial Q^P{}_{d,t}}{\partial F^D}dF^D\right)(E)+\left[\left(\frac{\partial Q_{d,t}}{\partial E}*\frac{\partial E}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial E}*\frac{\partial E}{\partial F^D}\right)\right]dF^D=0 \quad (15)$$

The first term in the parenthesis in equation (15) shows us the initial reduction in demand for tradables and non-tradables caused by the extraction from the capital market. The term $\left(\frac{\partial Q^P_{d,t}}{\partial F^D}dF^D\right)(E)$ implies that entire borrowed funds for the project are spent on tradables, so $\frac{\partial Q^P{}_{d,t}}{\partial F^D}$ is equal to '1_t'

Therefore, the equation (15) can be re-written as:

$$\frac{\partial Y_0}{\partial F^D} = \left[\left(1_t + \frac{\partial Q_{d,t}}{\partial F^D}\right)(E) + \left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right] dF^D + \left[\left(\frac{\partial Q_{d,t}}{\partial E}(E)\right) + \left(\frac{\partial Q_{d,nt}}{\partial E}\right)\right] \frac{\partial E}{\partial F^D} dF^D = 0$$

The term of "1_t" above tells us that borrowed project funds are entirely spent on tradables. Note that to analyze the feedback effect of a change in size of the tradable sector through the adjustment of the exchange rate, we need to determine the gap between the demand for and supply of tradables $\left(G^T\right)$ that has been created by the above two operations and to assess how changes in this gap affects the exchange rate which must be analyzed. This relationship is shown in the equation below by the term $\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D} dF^D$. Hence,

$$\frac{\partial Y_0}{\partial F^D} = \left[\left(1_t + \frac{\partial Q_{d,t}}{\partial F^D}\right)(E) + \left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right] dF^D + \left[\left(\frac{\partial Q_{d,t}}{\partial E}(E)\right) + \left(\frac{\partial Q_{d,nt}}{\partial E}\right)\right] \frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D} dF^D = 0 \quad (16)$$

Thus, the last term in the equation (16) shows the impact of a relative price change after spending the entire funds on tradable goods. Also note that:

$$\frac{dG^T}{dF^D} = \left(1 + \frac{\partial Q_{d,t}}{\partial F^D}\right) \quad (17)$$

Equation (17) shows the ''gap'' in the tradable sector between the demand for and supply of tradable goods. This is due to the effect of the borrowing that reduces the demand for tradable goods plus the impact on the demand for tradable goods due to the project spending of the borrowed funds entirely on tradables. To summarize, the

term $\frac{dG^T}{\partial F^D}$ is the amount of either excess demand or excess supply of tradable goods that results from project spending.

In addition to the equation (17), to determine the change in exchange rate due to a change in the excess demand for tradable goods $\left(G^T\right)$, the following equation can be derived[12]:

$$\frac{\partial E}{\partial G^T} = \left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_t^s - \eta_t^d} \right) \tag{18}$$

The term $\frac{\partial Q_{d,t}}{\partial G}$ is equal to 1 in the case of project funds used to purchase tradables. Then, expressing the changes in the demand for tradables and non-tradables due to the change in the exchange rate using the elasticities, the following equation can be derived:

$$\frac{\partial Y_0}{\partial F^D} = \left[\left(1_t + \frac{\partial Q_{d,t}}{\partial F^D} \right)(E) + \left(\frac{\partial Q_{d,nt}}{\partial F^D} \right) \right] dF^D + \left[\left(\frac{\partial Q_{d,t}}{\partial E}\frac{E}{Q_{d,t}}\frac{Q_{d,t}}{E}(E) \right) + \left(\frac{\partial Q_{d,nt}}{\partial E}\frac{E}{Q_{d,nt}}\frac{Q_{d,nt}}{E} \right) \right] \frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D} dF^D = 0 \tag{19}$$

Defining:

$$\eta_t^d = \frac{\partial Q_{d,t}}{\partial E}\frac{E}{Q_{d,t}} \tag{20}$$

[12] See Nicholson, W., "Microeconomics Theory: Basic Principles and Extensions", 9th , pp. 293-294

$$\eta_{nt}^{d} = \frac{\partial Q_{d,nt}}{\partial E}\frac{E}{Q_{d,nt}} \tag{21}$$

where

η_{t}^{d} is a compensated own price elasticity of demand for tradables with respect to a change in the exchange rate

η_{nt}^{d} is a compensated cross – price elasticity of demand for non –tradables with respect to a change in the exchange rate

Substituting the equation (17) and (18) into (19); the following equation can be derived:

$$\frac{\partial Y_{0}}{\partial F^{D}} = \left[\left(1_{t} + \frac{\partial Q_{d,t}}{\partial F^{D}}\right)(E) + \left(\frac{\partial Q_{d,nt}}{\partial F^{D}}\right)\right]dF^{D} + \left[\left(\eta_{t}^{d}\frac{Q_{d,t}}{E}(E)\right) + \left(\eta_{nt}^{d}\frac{Q_{d,nt}}{E}\right)\right] * \left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_{t}^{s} - \eta_{t}^{d}}\right) * \left(1 + \frac{\partial Q_{d,t}}{\partial F^{D}}\right)dF^{D} = 0$$

Rearranging the terms:

$$\frac{\partial Y_{0}}{\partial F^{D}} = \left[\left(1_{t} + \frac{\partial Q_{d,t}}{\partial F^{D}}\right)(E) + \left(\frac{\partial Q_{d,nt}}{\partial F^{D}}\right)\right]dF^{D} + \left[\frac{\left(\eta_{t}^{d}\frac{Q_{d,t}}{E}\frac{E}{Q_{d,t}}(E)\right) + \left(\eta_{nt}^{d}\frac{Q_{d,nt}}{E}\frac{E}{Q_{d,t}}\right)}{\varepsilon_{t}^{s} - \eta_{t}^{d}}\right] * \left(1 + \frac{\partial Q_{t}}{\partial F^{D}}\right)dF^{D} = 0$$

By simplifying the above equation:

$$\frac{\partial Y_{0}}{\partial F^{D}} = \left[\left(1_{t} + \frac{\partial Q_{d,t}}{\partial F^{D}}\right)(E) + \left(\frac{\partial Q_{d,mt}}{\partial F^{D}}\right)\right]dF^{D} + \left[\frac{\eta_{t}^{d}(E) + \eta_{nt}^{d}\left(\frac{Q_{d,nt}}{Q_{d,t}}\right)}{\varepsilon_{t}^{s} - \eta_{t}^{d}}\right] * \left(1 + \frac{\partial Q_{t}}{\partial F^{D}}\right)dF^{D} = 0 \tag{22}$$

3.2.2 Impacts on Supply of Tradables and Non-Tradables

As a result of domestic borrowing that is spent on tradable goods, there will be an adjustment on the relative quantities of tradable and non-tradable goods supplied as well. The feedback effect of increasing the relative price level of tradable goods works in an opposite direction such as where there will be a cutback in the supply of non-tradables as the producers of non-tradable goods will find it less profitable to produce. In other words, production of tradables will be increased due to the increase in the relative price of tradables. Under the assumption of producing on the current PPF, being able to produce more tradable goods until a new equilibrium is re-established, some of the resources previously employed in the non-traded sector will need to be released and transferred into the tradables sector. By the time the final equilibrium is reached, the total resources released from production in the non-traded sector will be just equal to resources needed to produce the additional quantities demanded of importable and exportable goods. In other words, the changes in the supply of the sectors due to change in the exchange rate must sum to zero in order for the current full employment status of factors of production to remain unchanged.

Using the supply equations (3) and (4) and differentiating the right hand side of the equation (12) with respect to a change in 'dF^D' and then setting the result equal to zero:

$$\left[\frac{\partial Q_{s,t}}{\partial E}(E)+\frac{\partial Q_{s,nt}}{\partial E}\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D+\left[\frac{\partial Q_{s,t}}{\partial F^D}+\frac{\partial Q_{s,nt}}{\partial F^D}\right]dF^D=0 \qquad (23)$$

where

$$\frac{\partial Q_{s,t}}{\partial F^D} = 0 \quad and \quad \frac{\partial Q_{s,nt}}{\partial F^D} = 0$$

Therefore,

$$\left[\frac{\partial Q_{s,t}}{\partial E}(E) + \frac{\partial Q_{s,nt}}{\partial E}\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D = 0 \tag{24}$$

Substituting the equations (17) and (18) into equation (24) gives us[13]:

$$\left[\frac{\partial Q_{s,t}}{\partial E}(E) + \frac{\partial Q_{s,nt}}{\partial E}\right] * \left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_t^s - \eta_d^t}\right)\left(1 + \frac{\partial Q_{d,t}}{\partial F^D}\right)dF^D = 0$$

Defining:

$$\varepsilon_t^s = \frac{\partial Q_{s,t}}{\partial E}\frac{E}{Q_{s,t}} \tag{25}$$

$$\varepsilon_{nt}^s = \frac{\partial Q_{s,nt}}{\partial E}\frac{E}{Q_{s,nt}} \tag{26}$$

where

ε_t^s is the supply elasticity of tradables with respect to change in the exchange rate

ε_{nt}^s is the cross price supply elasticity of non – tradables with respect to change in the exchange rate

[13] Note that $Q_{d,t} = Q_{s,t}$

$$\left[\frac{\partial Q_{s,t}}{\partial E}\frac{E}{Q_{s,t}}\frac{Q_{s,t}}{E}(E)+\frac{\partial Q_{s,nt}}{\partial E}\frac{E}{Q_{s,nt}}\frac{Q_{s,nt}}{E}\right]*\left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_t^s-\eta_d^t}\right)\left(1+\frac{\partial Q_{d,t}}{\partial F^D}\right)dF^D=0$$

Using the definitions in (25) and (26)

$$\left[\varepsilon_t^s\frac{Q_{s,t}}{E}(E)+\varepsilon_{nt}^s\frac{Q_{s,nt}}{E}\right]*\left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_t^s-\eta_d^t}\right)\left(1+\frac{\partial Q_{d,t}}{\partial F^D}\right)dF^D=0$$

Simplification yields:

$$\left[\frac{\varepsilon_t^s\frac{Q_{s,t}}{E}\frac{E}{Q_{d,t}}(E)+\varepsilon_{nt}^s\frac{Q_{s,nt}}{E}\frac{E}{Q_{d,t}}}{\varepsilon_t^s-\eta_t^d}\right]*\left(1+\frac{\partial Q_{d,t}}{\partial F^D}\right)dF^D=0$$

Finally,

$$\left[\frac{\varepsilon_t^s(E)+\varepsilon_{nt}^s\left(\frac{Q_{s,nt}}{Q_{d,t}}\right)}{\varepsilon_t^s-\eta_t^d}\right]*\left(1+\frac{\partial Q_{d,t}}{\partial F^D}\right)dF^D=0 \qquad (27)$$

By the time the final equilibrium is reached, the total resources released from production in the non-tradable sector will be equal to the resources needed to produce the additional quantities demanded of importable and exportable goods.

Market equilibrium requires the equalizing equations (22) and (27) as already defined in equation (14) as follows:

$$\left[\left(1_t+\frac{\partial Q_{d,t}}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,mt}}{\partial F^D}\right)\right]dF^D+\left[\frac{\eta_t^d(E)+\eta_{mt}^d\left(\frac{Q_{d,nt}}{Q_{d,t}}\right)}{\varepsilon_t^s-\eta_t^d}\right]*\left(1+\frac{\partial Q_t}{\partial F^D}\right)dF^D=\left[\frac{\varepsilon_t^s(E)+\varepsilon_{mt}^s\left(\frac{Q_{s,nt}}{Q_{d,t}}\right)}{\varepsilon_t^s-\eta_t^d}\right]\left(1+\frac{\partial Q_t}{\partial F^D}\right)dF^D$$

$$\left[\left(1_t+\frac{\partial Q_{d,t}}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D+\left[\frac{\left(\eta_t^d-\varepsilon_t^s\right)(E)+\left(\eta_{nt}^d-\varepsilon_{nt}^s\right)\frac{Q_{d,nt}}{Q_{d,t}}}{\varepsilon_t^s-\eta_t^d}\right]*\left(1+\frac{\partial Q_t}{\partial F^D}\right)dF^D=0 \quad (28)$$

The principal distortions are the tariffs, value added tax (VAT), sales taxes, excise taxes, export taxes and production and consumption subsidies. Their impact on economic welfare needs to be accounted for when the quantities of goods and services in the economy are changed due to the simultaneous borrowing of funds in the capital market and spending on tradables or on non-tradables. To calculate the total distortion costs on demand for and supply of tradables and non-tradables, we employ the well known proposition by Harberger (1972) that the change in the economic welfare is measured by $\Delta WC=\sum D_i\Delta X_i$ where 'D_i' is the value of distortion on good 'i' that separates the demand price from the supply price and 'ΔX_i' is the change in the quantity of good 'X_i' demanded and supplied.

It is noteworthy that value added tax (VAT) and excise tax exclusions (credits) for investment demand must be introduced where the fraction of the displaced goods that come at the expense of displaced investments are taken into account in the calculation of both EOCFX and the SPNTO. Consumption type taxes such as VAT

are administrated by giving a credit for taxes paid on inputs. The excise tax is reasonably simply excluded from purchases made for investment purposes. However, if the VAT is a consumption type VAT, then credit is given based both on inputs and capital expenditure, so the taxes on capital expenditure are removed from the welfare cost calculations. Note that the act of raising funds in the capital market and the process of demand for substitution due to the real exchange rate adjustment have different impacts on investment and consumption. Hence, instead of a single adjustment to account for crediting, one downward adjustment by a certain percentage the distortion costs linked to the both VAT and the excise tax in the response to the initial displacement of project funds in the capital market (e_{ia}) and the other one is an adjustment downward by a different percentage for the distortion costs associated with relative price changes due to the change in the real exchange rate (e_{is}). These are calculated as 1 minus a fraction of the change value added stemming from a capital market intervention that takes the form of consumption goods and services for the initial displacement process. For the substitution effect it is calculated as 1 minus a fraction of the change in value added stemming from an equilibrating real exchange rate adjustment that takes the form of consumption goods and services.

To sum up, in the calculation of the change in economic welfare brought about by the capital market extraction of funds and the spending of the funds on either tradable or non tradable goods we do not include the taxes or subsidies in the markets for the specific tradables or non-tradables that are purchased. The accounting for these distortions is made at the point where we estimate the economic cost or benefit of the actual goods purchased for the project or produced by the project. The changes

in welfare that we wish to estimate at this point are the changes that arise every time we purchase tradables in general (ie the foreign exchange premium) or non-tradables (ie non-tradable premium).

Finally to calculate the total distortion costs in the economy, the following equation can be derived:

$$\left[\left(1_t + v_t(1-e_{is})\frac{\partial Q_{d,t}}{\partial F^D}\right)(E) + \left(v_{nt}(1-e_{is})\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D + \left[\left(\frac{v_t(1-e_{ia})\eta_t^d}{\varepsilon_t^s - \eta_t^d} - \frac{k_t\varepsilon_t^s}{\varepsilon_t^s - \eta_t^d}\right)(E) + \left(\frac{v_{nt}(1-e_{ia})\eta_{nt}^d}{\varepsilon_t^s - \eta_t^d} - \frac{k_{nt}\varepsilon_{nt}^s}{\varepsilon_t^s - \eta_t^d}\right)\frac{Q_{d,nt}}{Q_{d,t}}\right] * \left(1_t + \frac{\partial Q_t}{\partial F^D}\right)dF^D \neq 0$$

(29)

Defining:

v_t is the effective V.A.T rate on tradables demand

v_{nt} is the effective V.A.T. rate on non – tradable demand

K_t is the production subsidy on tradable

K_{nt} is the production subsidy on non-tradable

e_{is} stands for the proportion of the capital market extraction that is exclusied creating a less in VAT and excise taxes because it is the investment that is reduced during the process of the initial market extraction

e_{ia} stands for the proportion of the changes in demand that is excluded from the VAT and excise tax because it affects an investment during the process of exchange rate adjustment

Defining:

$$\Delta WC_1 = \left[\left(v_t (1 - e_{is}) \frac{\partial Q_{d,t}}{\partial F^D} \right) E + v_{nt} (1 - e_{is}) \frac{\partial Q_{d,nt}}{\partial F^D} \right] dF^D$$

$$\Delta WC_2 = \left[\left(\frac{v_t (1 - e_{ia}) \eta_t^d}{\varepsilon_t^s - \eta_t^d} - \frac{k_t \varepsilon_t^s}{\varepsilon_t^s - \eta_t^d} \right) E + \left(\frac{v_{nt} (1 - e_{ia}) \eta_{nt}^d}{\varepsilon_t^d - \eta_t^d} - \frac{k_{nt} \varepsilon_{nt}^s}{\varepsilon_t^s - \eta_t^d} \right) \left(\frac{Q_{d,nt}}{Q_{d,t}} \right) \right] \left(1 + \frac{\partial Q_t}{\partial F^D} \right) dF^D$$

In equation (30), the term ΔWC_1 is the actual change in the economic welfare cost due to the change in the domestic indirect taxes and production subsidies collected excluding the trade and excise taxes during the process of extraction of funds from the domestic capital market and the term ΔWC_2 is the actual change in the economic welfare cost due to the change in the domestic indirect taxes and production subsidies collected excluding the trade and excise taxes because of the change in demand results from the change in the exchange rate.

Therefore, the equation (29) is non-zero and in fact it is equal to:

$$\left[\left(E^M * 1_t \right) dF^D + \left(\Delta WC_1 + \Delta WC_2 \right) \right] \tag{30}$$

3.2.3 Impacts on Imports and Exports

There will be changes in the equilibirum quantities of imports and exports in the economy due to financing and purchase along with the subsequent changes in the relative prices of goods. The external sector also involves a set of distortions which should be accounted for while estimating the total change in the welfare cost in the economy. In order to assess the impacts of the sourcing of domestic funds and spending them on tradables, let us now consider equation (11) and (12) and separate the demand for and supply of traded goods into their importable and exportable components. For instance,

$$Q_{d,t} = Q_{d,i} + Q_{d,e} \tag{31}$$

where

$Q_{d,i}$ stands for quantity demand for importables

$Q_{d,e}$ stands for quantity demand for exportables

Defining the functions of demand for importables and exportables by the following equation:

$$Q_{d,i} = f\left(E, F^D, F^F, Y\right) \tag{32}$$

$$Q_{d,e} = f\left(E, F^D, F^F, Y\right) \tag{33}$$

Similarly,

$$Q_{s,t} = Q_{s,i} + Q_{s,e} \tag{34}$$

where

$Q_{s,i}$ stands for quantity supply of importables

$Q_{s,e}$ stands for quantity supply of exportables

Defining the functions of the supply of importables and exportables by the following equation:

$$Q_{s,i} = f\left(E, F^D, F^F, Q_S\right) \tag{35}$$

$$Q_{s,e} = f\left(E, F^D, F^F, Q_S\right) \tag{36}$$

This allows us to write down the initial level of the gross national expenditure and the initial level of the gross national product functions defined in (11) and (12) as follows:

$$Y_0 = \left(Q_{d,i}^0 + Q_{d,e}^0\right)E + Q_{d,nt}^0 + \left(Q_{d,i}^P + Q_{d,e}^P\right)E + Q_{d,nt}^P \tag{37}$$

$$Q_0^S = \left(Q_{s,i} + Q_{s,e}\right)E + Q_{s,nt} \tag{38}$$

Substituting equation (37) and (38) into equation (13) and then differentiating the equation with respect to a change in dF^D yields:

$$\left[\left(1_t + \frac{\partial Q_{d,i}}{\partial F^D} + \frac{\partial Q_{d,e}}{\partial F^D}\right)(E) + \frac{\partial Q_{d,nt}}{\partial F^D}\right]dF^D + \left[\left(\frac{\partial Q_{d,i}}{\partial E} + \frac{\partial Q_{d,e}}{\partial E}\right)(E) + \frac{\partial Q_{d,nt}}{\partial E}\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D = \left(\frac{\partial Q_{s,i}}{\partial E} + \frac{\partial Q_{s,e}}{\partial E} + \frac{\partial Q_{s,nt}}{\partial E}\right)\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D = 0 \tag{39}$$

Taking all the terms to the left hand side gives us:

$$\left[\left(1_t+\frac{\partial Q_{d,i}}{\partial F^D}+\frac{\partial Q_{d,e}}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D+\left[\left(\frac{\partial Q_{d,nt}}{\partial E}-\frac{\partial Q_{s,nt}}{\partial E}\right)+\left(\left(\frac{\partial Q_{d,i}}{\partial E}-\frac{\partial Q_{s,i}}{\partial E}\right)-\left(\frac{\partial Q_{s,e}}{\partial E}\frac{\partial Q_{d,e}}{\partial E}\right)\right)(E)\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D=0$$

To measure the changes in demand for and the supply of goods in both sectors, the above equation can be expressed in terms of elasticities as follows:

$$\left[\left(1_t+\frac{\partial Q_{d,i}}{\partial F^D}+\frac{\partial Q_{d,e}}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D+\left[\begin{array}{l}\left(\frac{\partial Q_{d,nt}}{\partial E}\frac{E}{Q_{d,nt}}\frac{Q_{d,nt}}{E}-\frac{\partial Q_{s,nt}}{\partial E}\frac{E}{Q_{s,nt}}\frac{Q_{s,nt}}{E}\right)+\\ \left(\left(\frac{\partial Q_{d,i}}{\partial E}\frac{E}{Q_{d,i}}\frac{Q_{d,i}}{E}-\frac{\partial Q_{s,i}}{\partial E}\frac{E}{Q_{s,i}}\frac{Q_{s,i}}{E}\right)-\right.\\ \left.\left(\frac{\partial Q_{s,e}}{\partial E}\frac{E}{Q_{s,e}}\frac{Q_{s,e}}{E}-\frac{\partial Q_{d,e}}{\partial E}\frac{E}{Q_{d,e}}\frac{Q_{d,e}}{E}\right)\right)(E)\end{array}\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D=0$$

Defining the following elasticities:

$$\eta_i^d=\frac{\partial Q_{d,i}}{\partial E}\frac{E}{Q_{d,i}} \tag{40}$$

$$\eta_e^d=\frac{\partial Q_{d,e}}{\partial E}\frac{E}{Q_{d,e}} \tag{41}$$

$$\varepsilon_i^s=\frac{\partial Q_{s,i}}{\partial E}\frac{E}{Q_{s,i}} \tag{42}$$

$$\varepsilon_e^s=\frac{\partial Q_{s,e}}{\partial E}\frac{E}{Q_{s,e}} \tag{43}$$

where

η_i^d is the own – price elasticity of importable demand with respect to a change in the exchange rate.

η_e^d is the own – price elasticity of exportable demand with respect to a change in the exchange rate.

ε_i^s is the supply elasticity of importables with respect to a change in the exchange rate

ε_e^s is the supply elasticity of exportables with respect to a change in the exchange rate

Therefore,

$$\left[\left(1_t+\frac{\partial Q_{d,i}}{\partial F^D}+\frac{\partial Q_{d,e}}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D+\left[\left(\eta_{nt}^d\frac{Q_{d,nt}}{E}-\varepsilon_{nt}^s\frac{Q_{s,nt}}{E}\right)+\left(\left(\eta_i^d\frac{Q_{d,i}}{E}-\varepsilon_i^s\frac{Q_{s,i}}{E}\right)-\left(\varepsilon_e^s\frac{Q_{s,e}}{E}-\eta_e^d\frac{Q_{d,e}}{E}\right)\right)(E)\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D=0$$

(44)

Substituting $\frac{\partial E}{\partial G}=\left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_t^s-\eta_t^d}\right)$ and $\frac{\partial G^T}{\partial F^D}=\left(1+\frac{\partial Q_{d,t}}{\partial F^D}\right)$ into the equation (44):

$$\left[\left(1_t+\frac{\partial Q_{d,i}}{\partial F^D}+\frac{\partial Q_{d,e}}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D+\left[\frac{\left(\eta_{nt}^d\frac{Q_{d,nt}}{Q_{d,t}}-\varepsilon_{nt}^s\frac{Q_{s,nt}}{Q_{d,t}}\right)+\left(\left(\eta_i^d\frac{Q_{d,i}}{Q_{d,t}}-\varepsilon_i^s\frac{Q_{s,i}}{Q_{d,t}}\right)-\left(\varepsilon_e^s\frac{Q_{s,e}}{Q_{d,t}}-\eta_e^d\frac{Q_{d,e}}{Q_{d,t}}\right)\right)(E)}{\varepsilon_t^s-\eta_t^d}\right]*\left(1+\frac{\partial Q_{d,t}}{\partial F^D}\right)dF^D=0$$

(45)

Note that $Q_X=Q_{s,e}-Q_{d,e}$ and $Q_M=Q_{d,i}-Q_{s,i}$

Q_X stands for the total amount of exports

Q_M stands for the total amount of imports

The total supply for tradables is equal to the sum of the supply of importables and exportables: $Q_{s,T}=Q_{s,i}+Q_{s,e}$. Therefore,

$$\frac{\partial Q_{s,T}}{\partial E}\frac{E}{Q_{s,T}}=\left(\frac{\partial Q_{s,i}}{\partial E}\frac{E}{Q_{s,i}}\frac{Q_{s,i}}{Q_{s,T}}\right)+\left(\frac{\partial Q_{s,e}}{\partial E}\frac{E}{Q_{s,e}}\frac{Q_{s,e}}{Q_{s,T}}\right)$$

$$\varepsilon_T^s = \left(\varepsilon_i^s \frac{Q_{s,i}}{Q_{s,T}} \right) + \left(\varepsilon_e^s \frac{Q_{s,e}}{Q_{s,T}} \right)$$

$$\varepsilon_T^s = \varepsilon_i^s \theta_i^s + \varepsilon_e^s \theta_e^s$$

On this basis, the supply elasticity of tradables is the weighted average of the elasticities of supply of importables and exportables.

Since $S_T - D_T = S_X - D_M$ (46)

$$\varepsilon_T^s - \eta_T^d = \left(\varepsilon_e^s \frac{Q_{s,e}}{Q_{s,T}} - \eta_e^d \frac{Q_{d,e}}{Q_{d,T}} \right) - \left(\eta_i^d \frac{Q_{d,i}}{Q_{d,T}} - \varepsilon_i^s \frac{Q_{s,i}}{Q_{s,T}} \right)$$

If $\varepsilon_X^s = \left(\varepsilon_e^s \frac{Q_{s,e}}{Q_{s,T}} - \eta_e^d \frac{Q_{d,e}}{Q_{d,T}} \right)$, $\eta_M^d = \left(\eta_i^d \frac{Q_{d,i}}{Q_{d,T}} - \varepsilon_i^s \frac{Q_{s,i}}{Q_{s,T}} \right)$

$$\varepsilon_T^s - \eta_T^d = \varepsilon_X^s - \eta_M^d \quad (47)$$

Hence, using the relationship defined in equation (47), equation (45) can be re-written as:

$$\left[\left(1_t + \frac{\partial Q_{d,i}}{\partial F^D} + \frac{\partial Q_{d,e}}{\partial F^D} \right)(E) + \left(\frac{\partial Q_{d,nt}}{\partial F^D} \right) \right] dF^D + \left[\frac{\left(\eta_{nt}^d \frac{Q_{d,nt}}{Q_{d,t}} - \varepsilon_{nt}^s \frac{Q_{s,nt}}{Q_{d,t}} \right) + (\eta_M^d - \varepsilon_X^s)(E)}{\varepsilon_X^s - \eta_M^d} \right] * \left(1 + \frac{\partial Q_{d,t}}{\partial F^D} \right) dF^D = 0$$

(48)

Equation (48) measures the change in exports and imports due to the extraction of funds from the domestic capital market to purchase tradables. It should be noted here that any increase in the relative price of tradables will result in a reduction in both the importable and exportable demand. The reduction in demand for importables will automatically decrease the amount of imports whereas a decrease in the demand for exportables will increase the amount of exports of a country.

By following the same framework as done in equation (29) and modifying it with an effective rate of taxes imposed on trade by the region, the following equation can be derived to estimate the total welfare cost rise in the trade sector of the economy:

$$\left[1_t+\left(t_m\frac{\partial Q_{d,i}}{\partial F}+t_e(1+t_m)(1-e_{is})\frac{\partial Q_{d,i}}{\partial F^D}+t_x\frac{\partial Q_{d,e}}{\partial F^D}\right)\right](E)dF^D+\left[\frac{t_m\eta_M^d}{\varepsilon_X^s-\eta_M^d}+\frac{t_e(1+t_m)(1-e_{ia})\eta_M^d}{\varepsilon_X^s-\eta_M^d}-\frac{t_x\varepsilon_X^s}{\varepsilon_X^s-\eta_M^d}\right](E)*\left(1+\frac{\partial Q_{d,t}}{\partial F^D}\right)dF^D\neq 0 \quad (49)$$

where

t_m is the effective import tariff rate

t_e is the effective excise tax rate

t_x is the effective export tax rate

Defining:

$$\Delta WC_3=\left[\left(t_m\frac{\partial Q_{d,i}}{\partial F}\right)E+\left(t_e(1+t_m)(1-e_{is})\frac{\partial Q_{d,i}}{\partial F^D}\right)E+\left(t_x\frac{\partial Q_{d,e}}{\partial F^D}\right)E\right]dF^D$$

$$\Delta WC_4=\left[\left(\frac{t_m\eta_M^d}{\varepsilon_X^s-\eta_M^d}\right)E+\left(\frac{t_e(1+t_m)(1-e_{ia})\eta_M^d}{\varepsilon_X^s-\eta_M^d}\right)E-\left(\frac{t_x\varepsilon_X^s}{\varepsilon_X^s-\eta_M^d}\right)E\right]\left(1+\frac{\partial Q_{d,t}}{\partial F^D}\right)dF^D$$

The terms of ΔWC_3 and ΔWC_4 represent the actual changes in the welfare cost being caused by a change in trade and excise taxes (totally excluding the domestic indirect taxes and production subsidies) during the process of extraction of funds from the domestic capital market. The change in the welfare cost is caused by a change in trade and excise taxes because of the change in imports and exports due to the change in the exchange rate, respectively.

Therefore, equation (49) is non-zero and clearly it is equal to:

$$\left[\left(E^M * 1_t\right)dF^D + \left(\Delta WC_3 + \Delta WC_4\right)\right] \tag{50}$$

3.3 Foreign capital market sourced funds are spent on tradables

In the case of the foreign capital market; there will be no immediate initial displacement of any type of goods within the country but the injection of foreign exchange in the economy will increase the quantity of tradables available as already mentioned in expressions (7) and (8). To put it differently, since the prices of all tradables are measured in foreign currency, there is no market adjustment when funds are obtained abroad and spent entirely on tradables because there is no excess demand for foreign exchange or domestic currency. Therefore, there is no foreign exchange premium if funds are sourced abroad and spent entirely on tradables as the financing is obtained entirely in foreign currency. However, it is believed that there is a need to prove that there is no foreign exchange premium when project funds are sourced abroad and these funds are used to finance expenditures made on tradable items.

3.3.1 Impacts on Demand for and Supply of Tradables and Non – Tradables

Substituting equation (11) and (12) into equation (13) and then differentiating with respect to dF^F, the following equation can be derived:

$$\left[\frac{\partial Q_t^d}{\partial F^F}(E)+\frac{\partial Q_{nt}^d}{\partial F^F}\right]dF^F+\left(\frac{\partial Q_{d,t}^P}{\partial F^F}dF^F\right)(E)+\left[\left(\frac{\partial Q_{d,t}}{\partial E}\frac{\partial E}{\partial F^F}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial E}\frac{\partial E}{\partial F^F}\right)\right]dF^F$$
$$=$$
$$\left[\frac{\partial Q_{s,t}}{\partial F^F}(E)+\frac{\partial Q_{s,nt}}{\partial F^F}\right]dF^F+\left[\left(\frac{\partial Q_{s,t}}{\partial E}\frac{\partial E}{\partial F^F}\right)(E)+\left(\frac{\partial Q_{s,nt}}{\partial E}\frac{\partial E}{\partial F^F}\right)\right]dF^F$$

(51)

For instance, if these foreign funds are used to purchase tradable items for the use of the project, we must add the following term into analysis:

$$\frac{\partial Q_{d,t}^P}{\partial F^F}=1_f^d \tag{52}$$

Note that the injection of foreign exchange in the economy will increase the quantity supply of tradables available. However this will leave the supply of non-tradables unchanged. Therefore,

$$\frac{\partial Q_{s,t}}{\partial F^F}>0 \text{ and } \frac{\partial Q_{s,nt}}{\partial F^F}=0 \tag{53}$$

By using the expressions (7), (52) and (53), then taking all the terms to the left hand side the equation (51) can be simplified as:

$$\left[\left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)E\right]dF^F + \left[\left(\frac{\partial Q_{d,t}}{\partial E} - \frac{\partial Q_{s,t}}{\partial E}\right)E + \left(\frac{\partial Q_{d,nt}}{\partial E} - \frac{\partial Q_{s,nt}}{\partial E}\right)\right]\frac{\partial E}{\partial F^F}dF^F = 0 \qquad (54)$$

Expressing the response of demand for and supply of tradable and non-tradables with respect to changes in the exchange rate, equation (54) by using the corresponding elasticities already defined in equations (20), (21), (25) and (26) yields:

$$\left[\left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)E\right]dF^F + \left[\left(\frac{\partial Q_{d,t}}{\partial E}\frac{E}{Q_{d,t}}\frac{Q_{d,t}}{E} - \frac{\partial Q_{s,t}}{\partial E}\frac{E}{Q_{s,t}}\frac{Q_{s,t}}{E}\right)E + \left(\frac{\partial Q_{d,nt}}{\partial E}\frac{E}{Q_{d,nt}}\frac{Q_{d,nt}}{E} - \frac{\partial Q_{s,nt}}{\partial E}\frac{E}{Q_{s,nt}}\frac{Q_{s,nt}}{E}\right)\right]\frac{\partial E}{\partial F^F}dF^F = 0$$

Therefore,

$$\left[\left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)E\right]dF^F + \left[\left(\eta_t^d\frac{Q_{d,t}}{E} - \varepsilon_t^s\frac{Q_{s,t}}{E}\right)E + \left(\eta_{nt}^d\frac{Q_{d,nt}}{E} - \varepsilon_{nt}^s\frac{Q_{s,nt}}{E}\right)\right]\frac{\partial E}{\partial F^F}dF^F = 0$$

(55)

In the case of external borrowing and spending on tradable items, there will be no 'gap' in the tradable sector to change the demand for and supply of tradables and non-tradables due to any exchange rate adjustment. Thus,

$$\frac{dG^T}{dF^F} = \left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)dF^F \qquad (56)$$

Using the equation (18) and (56), the following equation can be obtained:

$$\left[\left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)E\right]dF^F + \left[\frac{\left(\eta_t^d - \varepsilon_t^s\right)E + \left(\eta_{nt}^d - \varepsilon_{nt}^s\right)\frac{Q_{d,nt}}{Q_{d,t}}}{\varepsilon_t^s - \eta_t^d}\right]\left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)dF^F = 0 \qquad (57)$$

When the funds are sourced from abroad, this represents an increase (a shift) in supply of foreign exchange and hence the supply of tradable goods available in the economy. Saying that $\frac{\partial Q_{s,t}}{\partial F^F} = 1_f^s$ that there will be an excess supply of foreign exchange amount to be 1$ or 1€.

$$\frac{\partial Q_{s,t}}{\partial F^F} = 1_f^s \qquad (58)$$

By using (58), the equation (57) can be written as follows:

$$\left[\left(1_f^d - 1_f^s\right)E\right]dF^F + \left[\frac{\left(\eta_t^d - \varepsilon_t^s\right)E + \left(\eta_{nt}^d - \varepsilon_{nt}^s\right)\frac{Q_{d,nt}}{Q_{d,t}}}{\varepsilon_t^s - \eta_t^d}\right]\left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)dF^F = 0 \qquad (59)$$

We know apply the various rate of distortions to calculate the total welfare costs associated with the sourcing from the foreign capital market and using these foreign exchanges funding in case of purchase of tradables.

$$\left[\left(1_f^d - \left(\delta * 1_f^s\right)\right)E\right]dF^F + \left[\left(\frac{v_t(1-e_{ia})\eta_t^d}{\varepsilon_t^s - \eta_t^d} - \frac{k_t\varepsilon_t^s}{\varepsilon_t^s - \eta_t^d}\right)E + \left(\frac{v_{nt}(1-e_{ia})\eta_{nt}^d}{\varepsilon_t^s - \eta_t^d} - \frac{k_{nt}\varepsilon_{nt}^s}{\varepsilon_t^s - \eta_t^d}\right)\frac{Q_{d,nt}}{Q_{d,t}}\right] * \left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)dF^F \neq 0$$

(60)

where δ is the distortion on inflow of foreign exchange supply.

Definining:

$$\Delta WC_5 = -\left(\delta * 1_f^s E\right)dF^F$$

$$\Delta WC_6 = \left[\left(\frac{v_t(1-e_{ia})\eta_t^d}{\varepsilon_t^s - \eta_t^d} - \frac{k_t\varepsilon_t^s}{\varepsilon_t^s - \eta_t^d}\right)E + \left(\frac{v_{nt}(1-e_{ia})\eta_{nt}^d}{\varepsilon_t^d - \eta_t^d} - \frac{k_{nt}\varepsilon_{nt}^s}{\varepsilon_t^s - \eta_t^d}\right)\left(\frac{Q_{d,nt}}{Q_{d,t}}\right)\right]\left(1_f^d - \frac{\partial Q_t}{\partial F^F}\right)dF^F$$

Therefore, equation (60) is non-zero and clearly it is equal to:

$$\left[\left(E^M * 1_f^d\right)dF^F + \left(\Delta WC_5 + \Delta WC_6\right)\right] \qquad (61)$$

It should be noted here that if there is no tax imposed on inflow of foreign exchange supply, '$\left(\delta = 0\right)$' the term on the left hand side of equation will also be equal to '0' as well defined by the term WC_5. If it is a tax then has a positive sign, but if there is a subsidy it would have a negative sign. Also note that the term $\left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)dF^F$ equals '0' as foreign capital market sourced foreign exchanges are used entirely to purchase tradables. In other words, $\frac{dG^T}{dF^F} = 0$. Furthermore, the right hand side of the above equation equals '0' defined by the term WC_6.

Under these two circumstances, there will be no change in the economic welfare cost when project funds are sourced in the foreign capital market and spent entirely on taradables where the foreign exchange supply is not subject to any tax.

3.3.2 Impacts on Imports and Exports

To analyze the impacts of capital market sourcing and spending on tradables on the external sector, one must use the definitions provided in equations (37) and (38) and substitute them into equation (13). Finally, differentiating the new with respect to a change in dF^F gives us:

$$\left[\left(\frac{\partial Q_{d,i}}{\partial F^F}+\frac{\partial Q_{d,e}}{\partial F^F}\right)(E)+\frac{\partial Q_{d,nt}}{\partial F^F}\right]dF^F+\frac{\partial Q^P_{d,t}}{\partial F^F}dF^F\left[\left(\frac{\partial Q_{d,i}}{\partial E}+\frac{\partial Q_{d,e}}{\partial E}\right)(E)+\frac{\partial Q_{d,nt}}{\partial E}\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^F}dF^F=\left(\frac{\partial Q_{s,i}}{\partial E}+\frac{\partial Q_{s,e}}{\partial E}+\frac{\partial Q_{s,nt}}{\partial E}\right)\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^F}dF^F=0 \quad (62)$$

Using the definitions in (52) and (53) then taking all the terms to the right hand side yields:

$$\left[\left(1^d_f-\frac{\partial Q_{s,t}}{\partial F^F}\right)E\right]dF^F+\left[\left(\frac{\partial Q_{d,nt}}{\partial E}-\frac{\partial Q_{s,nt}}{\partial E}\right)+\left(\left(\frac{\partial Q_{d,i}}{\partial E}-\frac{\partial Q_{s,i}}{\partial E}\right)-\left(\frac{\partial Q_{s,e}}{\partial E}\frac{\partial Q_{d,e}}{\partial E}\right)\right)(E)\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^F}dF^F=0$$

This equation can be expressed in terms of elasticities as follows:

$$\left[\left(1^d_f-\frac{\partial Q_{s,t}}{\partial F^F}\right)E\right]dF^F+\left[\begin{array}{l}\left(\frac{\partial Q_{d,nt}}{\partial E}\frac{E}{Q_{d,nt}}\frac{Q_{d,nt}}{E}-\frac{\partial Q_{s,nt}}{\partial E}\frac{E}{Q_{s,nt}}\frac{Q_{s,nt}}{E}\right)+\\ \left(\left(\frac{\partial Q_{d,i}}{\partial E}\frac{E}{Q_{d,i}}\frac{Q_{d,i}}{E}-\frac{\partial Q_{s,i}}{\partial E}\frac{E}{Q_{s,i}}\frac{Q_{s,i}}{E}\right)-\right)(E)\\ \left(\frac{\partial Q_{s,e}}{\partial E}\frac{E}{Q_{s,e}}\frac{Q_{s,e}}{E}-\frac{\partial Q_{d,e}}{\partial E}\frac{E}{Q_{d,e}}\frac{Q_{d,e}}{E}\right)\end{array}\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^F}dF^F=0$$

From the definitions of elasticities (40) to (43), it follows that:

$$\left[\left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)E\right]dF^F + \left[\left(\eta_{nt}^d \frac{Q_{d,nt}}{E} - \varepsilon_{nt}^s \frac{Q_{s,nt}}{E}\right) + \left(\left(\eta_i^d \frac{Q_{d,i}}{E} - \varepsilon_i^s \frac{Q_{s,i}}{E}\right) - \left(\varepsilon_e^s \frac{Q_{s,e}}{E} - \eta_e^d \frac{Q_{d,e}}{E}\right)\right)(E)\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^F}dF^F = 0$$

(63)

Using the facts expressed in both (18) and (56), the following equation can be obtained:

$$\left[\left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)E\right]dF^F + \left[\left(\eta_{nt}^d \frac{Q_{d,nt}}{E} - \varepsilon_t^s \frac{Q_{s,nt}}{E}\right) + \left(\left(\eta_i^d \frac{Q_{d,i}}{E} - \varepsilon_i^s \frac{Q_{s,i}}{E}\right) - \left(\varepsilon_e^s \frac{Q_{s,e}}{E} - \eta_e^d \frac{Q_{d,e}}{E}\right)\right)E\right] * \left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_t^s - \eta_t^d}\right) * \left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)dF^F = 0$$

Mathematical manipulation and using the equations in (47):

$$\left[\left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)E\right]dF^F + \left[\frac{\left(\eta_{nt}^d \frac{Q_{d,nt}}{Q_{d,t}} - \varepsilon_{nt}^s \frac{Q_{s,nt}}{Q_{d,t}}\right) + \left(\eta_M^d - \varepsilon_X^s\right)(E)}{\varepsilon_X^s - \eta_M^d}\right] * \left(1_f^d - \frac{\partial Q_{s,t}}{\partial F^F}\right)dF^F = 0 \quad (64)$$

In this section, one should be careful about the welfare cost calculations. In equation (61), the economic welfare cost calculation from the imposition of tax on supply of foreign exchange is already estimated, shown by the term (ΔWC_5). Therefore, in order to avoid an over-estimation of welfare cost, one must equalize the left hand side of equation (65) to zero. By using the equation (58), it will allow us to write (64) as:

$$0+\left[\frac{\left(\eta_{nt}^{d}\frac{Q_{d,nt}}{Q_{d,t}}-\varepsilon_{nt}^{s}\frac{Q_{s,nt}}{Q_{d,t}}\right)+\left(\eta_{M}^{d}-\varepsilon_{X}^{s}\right)(E)}{\varepsilon_{X}^{s}-\eta_{M}^{d}}\right]*\left(1_{f}^{d}-\frac{\partial Q_{s,t}}{\partial F^{F}}\right)dF^{F}=0$$

Total welfare costs associated with foreign exchange funding in case of purchase of tradables is calculated by the following equation.

$$0+\left[\frac{t_m\eta_M^d}{\varepsilon_X^s-\eta_M^d}+\frac{t_e(1+t_m)(1-e_{ia})\eta_M^d}{\varepsilon_X^s-\eta_M^d}-\frac{t_x\varepsilon_X^s}{\varepsilon_X^s-\eta_M^d}\right](E)*\left(1_f^d-\frac{\partial Q_{s,t}}{\partial F^F}\right)dF^F\neq 0 \tag{65}$$

Defining

$$\Delta WC_7=\left[\left(\frac{t_m\eta_M^d}{\varepsilon_X^s-\eta_M^d}\right)E+\left(\frac{t_e(1+t_m)(1-e_{ia})\eta_M^d}{\varepsilon_X^s-\eta_M^d}\right)E-\left(\frac{t_x\varepsilon_X^s}{\varepsilon_X^s-\eta_M^d}\right)E\right]\left(1-\frac{\partial Q_{s,t}}{\partial F^F}\right)dF^F$$

Therefore, equation (65) is non-zero and it is equal to:

$$\Delta WC_7 \tag{66}$$

As defined earlier the term $\left(1_f^d-\frac{\partial Q_{s,t}}{\partial F^F}\right)dF^F$ equals '0' as foreign capital market sourced foreign exchanges are used entirely to purchase tradables. In other words, $\frac{dG^T}{dF^F}=0$. Furthermore, the right hand side of the above equation equals '0' defined by the term WC_7.

To sum up briefly, the economic opportunity cost of foreign exchange is calculated as 1_t plus the foreign exchange premium (FEP). In order to calculate the foreign exchange premium, there is a need to obtain the welfare cost per unit of $ over the fund. Welfare cost per unit of funds is calculated as the actual changes in the welfare cost divided by the total available funds. It should be noted here that, the change in the economic welfare costs calculated above are all in actual values (All welfare cost calculations from 1 to 7 are calculated with the actual change as they represent the changes in the equilibrium amounts by capital market extraction and change due to a shift in the tradable sector – either surplus or shortage).

Hence, to get the corresponding foreign exchange premium, all of them must be divided by the amount of funds raised for the project use. Algebraically:

$$FEP_{1,2} = \frac{\sum \Delta WC_{1,2,3,4}}{dF} + \frac{\sum \Delta WC_{5,6,7}}{dF} \tag{67}$$

Finally, using the proportion of funds sourced from the domestic capital market$\left(\frac{\partial F^D}{\partial F}\right)$ and foreign capital market$\left(\frac{\partial F^F}{\partial F}\right)$, the EOCFX is to be estimated.

$$EOCFX = E + \left(\frac{\partial F^D}{\partial F} * FEP_1\right) + \left(\frac{\partial F^F}{\partial F} FEP_2\right) \tag{68}$$

The general expression for the empirical estimation of the EOCFX for any economy is provided in equation (69).

General Expression on the Economic Opportunity Cost of Foreign Exchange (EOCFX)

$$EOCFX=\left[\left(\left(\left(1_t+\frac{v_t(1-e_{is})\frac{\partial Q_{d,t}}{\partial F^D}}{dF}\right)E+\left(\frac{v_{nt}(1-e_{is})\frac{\partial Q_{d,nt}}{\partial F^D}}{dF}\right)\right)\frac{\partial F^D}{\partial F}+\left(1_f-\frac{\delta\frac{\partial Q_s}{\partial F^F}}{dF}\right)\frac{\partial F^F}{\partial F}\right)+\left[\frac{\left(\frac{v_t(1-e_{ia})\eta_t^d}{\varepsilon_t^s-\eta_t^d}-\frac{k_t\varepsilon_t^s}{\varepsilon_t^s-\eta_t^d}\right)(E)}{dF}+\frac{\left(\frac{v_{nt}(1-e_{ia})\eta_{nt}^d}{\varepsilon_t^s-\eta_t^d}-\frac{k_{nt}\varepsilon_{nt}^s}{\varepsilon_t^s-\eta_t^d}\right)\frac{Q_{d,nt}}{Q_{d,t}}}{dF}\right]*\left[\frac{\partial F^D}{\partial F}\left(1_t+\frac{\partial Q_t}{\partial F^D}\right)+\frac{\partial F^F}{\partial F}\left(1_f-\frac{\partial Q_s}{\partial F^F}\right)\right]$$

$$+$$

$$\left[\frac{\partial F^D}{\partial F}\left[\frac{\left(t_m\frac{\partial Q_{d,i}}{\partial F}+\left(t_e(1+t_m)(1-e_{ia})\right)\frac{\partial Q_{d,i}}{\partial F}\right)}{dF}+\frac{t_x\frac{\partial Q_{d,e}}{\partial F}}{dF}\right](E)\right]+\left[\frac{\frac{t_m\eta_M^d}{\varepsilon_X^d-\eta_M^d}+\frac{\left(t_e(1+t_m)(1-e_{is})\right)\eta_M^d}{\varepsilon_X^s-\eta_M^d}}{dF}-\frac{\frac{t_x\varepsilon_X^s}{\varepsilon_X^s-\eta_M^d}}{dF}\right](E)\left[\frac{\partial F^D}{\partial F}\left(1+\frac{\partial Q_{d,t}}{\partial F^D}\right)+\frac{\partial F^F}{\partial F}\left(1_f-\frac{\partial Q_s}{\partial F^F}\right)\right]$$

[69]

3.4 Domestically sourced funds are spent on non – tradables

In this case, project funds are again raised on the domestic capital market, but entirely spent entirely on non-tradables. Note that everything is the same at the beginning except on where the project funds are spent. Therefore,equation (11) and (12) again holds the analysis.

$$Y_0 = Q^0_{d,t}(E) + Q^0_{d,nt} + Q^P_{d,t}(E) + Q^P_{d,nt} = Q_{s,T}(E) + Q_{s,NT}$$

$$Q^S_0 = Q_{s,t}(E) + Q_{s,nt}$$

3.4.1 Impacts on Demand for Tradables and Non-Tradables

However, since domestically sourced funds are now spent entirely on non-tradable goods and services by the project, so equation (15) is now represented as:

$$\frac{\partial Y_0}{\partial F^D} = \left[\left(\frac{\partial Q_{d,t}}{\partial F^D}\right)(E) + \left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D + \left(\frac{\partial Q^P{}_{d,nt}}{\partial F^D}\right)dF^D + \left(\frac{\partial Q_{d,t}}{\partial E} * \frac{\partial E}{\partial F^D}\right)dF^D(E) + \left(\frac{\partial Q_{d,nt}}{\partial E} * \frac{\partial E}{\partial F^D}\right)dF^D = 0 \quad (70)$$

The first difference from the equation (15) is the equation of $\left(\frac{\partial Q^P{}_{d,nt}}{\partial F^D}\right)dF^D$ written in the middle of (70). It implies that the entire domestic funds for the project use are now spent on non – tradables, hence $\frac{\partial Q^P{}_{d,nt}}{\partial F^D}$ is equal to 1_{nt}. Therefore, we can re-write the equation (70) as:

$$\frac{\partial Y_0}{\partial F^D} = \left[1_{nt} + \left(\frac{\partial Q_{d,t}}{\partial F^D}(E)\right) + \left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right] dF^D + \left[\left(\frac{\partial Q_{d,t}}{\partial E}(E)\right) + \left(\frac{\partial Q_{d,nt}}{\partial E}\right)\right] \frac{\partial E}{\partial G} \frac{\partial G^T}{\partial F^D} dF^D = 0 \quad (71)$$

Secondly, the term of $\frac{\partial G^T}{\partial F^D}$ has a negative sign in this case. In other words, the 'gap' between the demand for and supply of tradable goods due to spending the domestically borrowed funds entirely on non-tradables is the amount of displaced demand for tradables by the domestic borrowing times the amount of raised funds. In other words, there will be an excess supply of tradables. Algebraically;

$$\frac{dG^T}{\partial F^D} = \left(\frac{\partial Q_{d,t}}{\partial F^D}\right) \quad (72)$$

Using equation (18) together with equation (72), equation (71) can be re-written as:

$$\frac{\partial Y_0}{\partial F^D} = \left[1_{nt} + \left(\frac{\partial Q_{d,t}}{\partial F^D}(E)\right) + \left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right] dF^D + \left[\left(\frac{\partial Q_{d,t}}{\partial E}(E)\right) + \left(\frac{\partial Q_{d,nt}}{\partial E}\right)\right] * \left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_t^s - \eta_t^d}\right)\left(\frac{\partial Q_{d,t}}{\partial F^D}\right) dF^D = 0 \quad (73)$$

Expression of equation (73) in terms of demand elasticities already defined in (20) and (21) yields:

$$\frac{\partial Y_0}{\partial F^D} = \left[1_{nt} + \left(\frac{\partial Q_{d,t}}{\partial F^D}(E)\right) + \left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right] dF^D + \left[\left(\frac{\partial Q_{d,t}}{\partial E}\frac{E}{Q_{d,t}}\frac{Q_{d,t}}{E}\right)E + \left(\frac{\partial Q_{d,nt}}{\partial E}\frac{E}{Q_{d,nt}}\frac{Q_{d,nt}}{E}\right)\right] * \left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_t^s - \eta_t^d}\right)\left(\frac{\partial Q_{d,t}}{\partial F^D}\right) dF^D = 0$$

Hence,

$$\frac{\partial Y_0}{\partial F^D} = \left[1_{nt} + \left(\frac{\partial Q_{d,t}}{\partial F^D}(E)\right) + \left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right] dF^D + \left[\left(\eta_d^t \frac{Q_{d,t}}{E}(E)\right) + \left(\eta_d^{nt} \frac{Q_{d,nt}}{E}\right)\right] * \left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_t^s - \eta_t^d}\right)\left(\frac{\partial Q_{d,t}}{\partial F^D}\right) dF^D = 0$$

(74)

$$\frac{\partial Y_0}{\partial F^D} = \left[1_{nt} + \left(\frac{\partial Q_{d,t}}{\partial F^D}(E)\right) + \left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right] dF^D + \left[\frac{\left(\eta_d^t \frac{Q_{d,t}}{E}\frac{E}{Q_{d,t}}(E)\right) + \left(\eta_d^{nt} \frac{Q_{d,nt}}{E}\frac{E}{Q_{d,t}}\right)}{\varepsilon_t^s - \eta_t^d}\right] * \left(\frac{\partial Q_t}{\partial F^D}\right) dF^D = 0$$

In simpler form:

$$\frac{\partial Y_0}{\partial F^D} = \left[1_{nt} + \left(\frac{\partial Q_{d,t}}{\partial F^D}(E)\right) + \left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right] dF^D + \left[\frac{\eta_t^d + \eta_{nt}^d \left(\frac{Q_{d,nt}}{Q_{d,t}}\right)}{\varepsilon_t^s - \eta_t^d}\right] * \left(\frac{\partial Q_t}{\partial F^D}\right) dF^D = 0 \qquad (75)$$

3.4.2 Impacts on Supply of Tradables and Non-Tradables

Unlike in the case 3.2.3 the wedge between the demand for and supply of tradables is the excess supply of tradables which will stimulate the market in a way with a cutback in the supply of tradables due to an increase in the relative price of non-tradables. The adjustment process is just a reversal of what has been discussed already in part 3.2.3

$$\left[\frac{\partial Q_{s,t}}{\partial E}(E) + \frac{\partial Q_{s,nt}}{\partial E}\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D} dF^D + \left[\frac{\partial Q_{s,t}}{\partial F^D} + \frac{\partial Q_{s,nt}}{\partial F^D}\right] dF^D = 0 \qquad (76)$$

Using the facts expressed in (6), it follows that:

$$\left[\frac{\partial Q_{s,t}}{\partial E}(E) + \frac{\partial Q_{s,nt}}{\partial E}\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D} dF^D = 0 \qquad (77)$$

Using the definitions in (18) and (72), equation (77) can be re – written as follows:

$$\left[\frac{\partial Q_{s,nt}}{\partial E}(E)\frac{Q_{s,nt}}{E}\right]*\left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_t^s-\eta_d^t}\right)\left(\frac{\partial Q_{d,t}}{\partial F^D}\right)dF^D=0$$

Expressing the above equation in terms of elasticities:

$$\left[\left(\frac{\partial Q_{s,t}}{\partial E}\frac{E}{Q_{s,t}}\frac{Q_{s,t}}{E}\right)(E)+\frac{\partial Q_{s,nt}}{\partial E}\frac{E}{Q_{s,nt}}\frac{Q_{s,nt}}{E}\right]*\left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_t^s-\eta_d^t}\right)\left(\frac{\partial Q_{d,t}}{\partial F^D}\right)dF^D=0$$

If $\varepsilon_t^s=\frac{\partial Q_{s,t}}{\partial E}\frac{E}{Q_{s,t}}$ and $\varepsilon_{nt}^s=\frac{\partial Q_{s,nt}}{\partial E}\frac{E}{Q_{s,nt}}$ and simple mathematical manipulation gives:

$$\left[\frac{\varepsilon_t^s\frac{Q_{s,t}}{E}\frac{E}{Q_{d,t}}(E)+\varepsilon_{nt}^s\frac{Q_{s,nt}}{E}\frac{E}{Q_{d,t}}}{\varepsilon_t^s-\eta_t^d}\right]*\left(\frac{\partial Q_t}{\partial F^D}\right)dF^D=0$$

Simply,

$$\left[\frac{\varepsilon_t^s(E)+\varepsilon_{nt}^s\left(\frac{Q_{s,nt}}{Q_{d,t}}\right)}{\varepsilon_t^s-\eta_t^d}\right]*\left(\frac{\partial Q_t}{\partial F^D}\right)dF^D=0 \qquad (78)$$

Market equilibrium requires the equalizing equations (75) and (78) such that:

$$\left[1_{nt}+\left(\frac{\partial Q_{d,t}}{\partial F^{D}}(E)\right)+\left(\frac{\partial Q_{d,nt}}{\partial F^{D}}\right)\right]dF^{D}+\left[\frac{\eta_{t}^{d}(E)+\eta_{nt}^{d}\left(\frac{Q_{d,nt}}{Q_{d,t}}\right)}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right]*\left(\frac{\partial Q_{t}}{\partial F^{D}}\right)dF^{D}=\left[\frac{\varepsilon_{t}^{s}(E)+\varepsilon_{nt}^{s}\left(\frac{Q_{s,nt}}{Q_{d,nt}}\right)}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right]*\left(\frac{\partial Q_{t}}{\partial F^{D}}\right)dF^{D}$$

$$\left[1_{nt}+\left(\frac{\partial Q_{d,t}}{\partial F^{D}}(E)\right)+\left(\frac{\partial Q_{d,nt}}{\partial F^{D}}\right)\right]dF^{D}+\left[\frac{\left(\eta_{nt}^{d}-\varepsilon_{nt}^{s}\right)\frac{Q_{s,nt}}{Q_{d,t}}+\left(\eta_{t}^{d}-\varepsilon_{t}^{s}\right)(E)}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right]*\left(\frac{\partial Q_{t}}{\partial F^{D}}\right)dF^{D}=0 \qquad (79)$$

To calculate the total distortion costs using the various effective rates of distortions, the following equation can be driven:

$$\left[1_{nt}+\left(v_{t}(1-e_{is})\frac{\partial Q_{d,t}}{\partial F^{D}}(E)\right)+\left(v_{nt}(1-e_{is})\frac{\partial Q_{d,nt}}{\partial F^{D}}\right)\right]dF^{D}+\left[\left(\frac{v_{nt}(1-e_{ia})\eta_{nt}^{d}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}-\frac{k_{nt}\varepsilon_{nt}^{s}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right)\frac{Q_{s.nt}}{Q_{d,t}}+\left(\frac{v_{t}(1-e_{is})\eta_{t}^{d}}{\varepsilon_{t}^{s}-\eta_{d}^{t}}-\frac{k_{t}\varepsilon_{t}^{s}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right)(E)\right]*\left(\frac{\partial Q_{t}}{\partial F^{D}}\right)dF^{D}\neq 0$$
(80)

Defining:

$$\Delta WC_{8}=\left[\left(v_{t}(1-e_{is})\frac{\partial Q_{d,t}}{\partial F^{D}}\right)E+v_{nt}(1-e_{is})\frac{\partial Q_{d,nt}}{\partial F^{D}}\right]dF^{D}$$

$$\Delta WC_{9}=\left[\left(\frac{v_{t}(1-e_{ia})\eta_{t}^{d}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}-\frac{k_{t}\varepsilon_{t}^{s}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right)E+\left(\frac{v_{nt}(1-e_{ia})\eta_{nt}^{d}}{\varepsilon_{t}^{d}-\eta_{t}^{d}}-\frac{k_{nt}\varepsilon_{nt}^{s}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right)\left(\frac{Q_{d,nt}}{Q_{d,t}}\right)\right]\left(\frac{\partial Q_{t}}{\partial F^{D}}\right)dF^{D}$$

Therefore, equation (80) is non-zero and in fact it is equal to:

$$\left[(1_{nt})dF^{D}+(\Delta WC_{8}+\Delta WC_{9})\right] \qquad (81)$$

The term ΔWC_8 is the change in the economic welfare cost due to the change in the domestic indirect taxes and production subsidies collected (so excluding the trade and excise taxes) during the process of extraction of funds from the domestic capital market. Also, the term ΔWC_9 is the change in the economic welfare cost due to the change in the domestic indirect taxes and production subsidies collected (excluding the trade and excise taxes) because of a change in demand such as a change in the exchange rate.

3.4.3 Impacts on Imports and Exports

The impacts of spending domestically sourced funds on non-tradables on imports and exports are analyzed by using the definitions (37) and (38) and substituting into (13) and then taking its derivative with respect to change in dF^D yields:

$$\left[1_{nt}+\left(\frac{\partial Q_{d,i}}{\partial F^D}+\frac{\partial Q_{d,e}}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D+\left[\left(\frac{\partial Q_{d,i}}{\partial E}+\frac{\partial Q_{d,e}}{\partial E}\right)(E)+\frac{\partial Q_{d,nt}}{\partial E}\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D=\left(\frac{\partial Q_{s,i}}{\partial E}+\frac{\partial Q_{s,e}}{\partial E}+\frac{\partial Q_{s,nt}}{\partial E}\right)\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D=0 \quad (82)$$

The term of "1_{nt}" in equation (82) tells us that raised funds are spent on non - tradables. In this part, we are aiming to estimate the total distortion costs arising in the external sector. Taking all the terms to right hand side:

$$\left[1_{nt}+\left(\frac{\partial Q_{d,i}}{\partial F^D}+\frac{\partial Q_{d,e}}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D+\left[\left(\frac{\partial Q_{d,nt}}{\partial E}-\frac{\partial Q_{s,nt}}{\partial E}\right)+\left(\left(\frac{\partial Q_{d,i}}{\partial E}-\frac{\partial Q_{s,i}}{\partial E}\right)-\left(\frac{\partial Q_{s,e}}{\partial E}-\frac{\partial Q_{d,e}}{\partial E}\right)\right)(E)\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D=0$$

For example, $\left[\left(\frac{\partial Q_{d,i}}{\partial F^D}+\frac{\partial Q_{d,e}}{\partial F^D}\right)(E)\right]$ is the amount of excess supply of tradables, but has just been broken into two parts. Expressing the feedback effects of a "gap" in the tradable sector on the external sector using the corresponding elasticities:

$$\left[1_{nt}+\left(\frac{\partial Q_{d,i}}{\partial F^D}+\frac{\partial Q_{d,e}}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D+\left[\begin{array}{l}\left(\frac{\partial Q_{d,nt}}{\partial E}\frac{E}{Q_{d,nt}}\frac{Q_{d,nt}}{E}-\frac{\partial Q_{s,nt}}{\partial E}\frac{E}{Q_{s,nt}}\frac{Q_{s,nt}}{E}\right)+\\ \left(\left(\frac{\partial Q_{d,i}}{\partial E}\frac{E}{Q_{d,i}}\frac{Q_{d,i}}{E}-\frac{\partial Q_{s,i}}{\partial E}\frac{E}{Q_{s,i}}\frac{Q_{s,i}}{E}\right)-\right.\\ \left.\left(\frac{\partial Q_{s,e}}{\partial E}\frac{E}{Q_{s,e}}\frac{Q_{s,e}}{E}-\frac{\partial Q_{d,e}}{\partial E}\frac{E}{Q_{d,e}}\frac{Q_{d,e}}{E}\right)\right)(E)\end{array}\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D=0$$

Remembering the definitions:

$$\eta_i^d=\frac{\partial Q_{d,i}}{\partial E}\frac{E}{Q_{d,i}},\ \eta_e^d=\frac{\partial Q_{d,e}}{\partial E}\frac{E}{Q_{d,e}}\text{ and }\eta_{nt}^d=\frac{\partial Q_{d,nt}}{\partial E}\frac{E}{Q_{d,nt}}$$

$$\varepsilon_i^s=\frac{\partial Q_{s,i}}{\partial E}\frac{E}{Q_{s,i}},\ \varepsilon_e^s=\frac{\partial Q_{s,e}}{\partial E}\frac{E}{Q_{s,e}}\text{ and }\varepsilon_{nt}^d=\frac{\partial Q_{s,nt}}{\partial E}\frac{E}{Q_{s,nt}}$$

Therefore,

$$\left[1_{nt}+\left(\frac{\partial Q_{d,i}}{\partial F^D}+\frac{\partial Q_{d,e}}{\partial F^D}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right]dF^D+\left[\begin{array}{l}\left(\eta_{nt}^d\frac{Q_{d,nt}}{E}-\varepsilon_{nt}^s\frac{Q_{s,nt}}{E}\right)+\\ \left(\left(\eta_i^d\frac{Q_{d,i}}{E}-\varepsilon_i^s\frac{Q_{s,i}}{E}\right)-\left(\varepsilon_e^s\frac{Q_{s,e}}{E}-\eta_e^d\frac{Q_{d,e}}{E}\right)\right)(E)\end{array}\right]\frac{\partial E}{\partial G}\frac{\partial G^T}{\partial F^D}dF^D=0$$

(83)

From the definition of $\varepsilon_T^s - \eta_T^d = \varepsilon_X^s - \eta_M^d$ and using the expressions in (18) and (72), equation (83) is simply:

$$\left[1_{nt} + \left(\frac{\partial Q_{d,i}}{\partial F^D} + \frac{\partial Q_{d,e}}{\partial F^D}\right)(E) + \left(\frac{\partial Q_{d,nt}}{\partial F^D}\right)\right] dF^D + \left[\frac{\left(\eta_{nt}^d \frac{Q_{d,nt}}{Q_{d,t}} - \varepsilon_{nt}^s \frac{Q_{s,nt}}{Q_{d,t}}\right) + \left(\eta_M^d - \varepsilon_X^s\right)(E)}{\varepsilon_X^s - \eta_M^d}\right] * \left(\frac{\partial Q_{d,t}}{\partial F^D}\right) dF^D = 0$$

(84)

It should be noted here that any reduction in demand for importables and exportables will automatically increase the demand for imports whereas will decrease supply of exports of a country, respectively. As these entire funds are spent on non-tradables, the excess supply of tradables equals the amount of decreased demand for importables and exportables. Total distortion costs in the external sector are determined as follows:

$$\left[1_{nt} + \left(t_m \frac{\partial Q_{d,i}}{\partial F^D} + t_e(1+t_m)(1-e_{is})\frac{\partial Q_{d,i}}{\partial F^D} + t_x \frac{\partial Q_{d,e}}{\partial F^D}\right)(E)\right] dF^D + \left[\frac{t_m \eta_M^d}{\varepsilon_X^s - \eta_M^d} + \frac{t_e(1+t_m)(1-e_{ia})\eta_M^d}{\varepsilon_X^s - \eta_M^d} - \frac{t_x \varepsilon_X^s}{\varepsilon_X^s - \eta_M^d}\right](E) * \left(\frac{\partial Q_{d,t}}{\partial F^D}\right) dF^D \neq 0$$

(85)

Defining:

$$\Delta WC_{10} = \left[\left(t_m \frac{\partial Q_{d,i}}{\partial F}\right) + \left(t_e(1+t_m)(1-e_{is})\frac{\partial Q_{d,i}}{\partial F^D}\right) + \left(t_x \frac{\partial Q_{d,e}}{\partial F^D}\right)\right](E) dF^D$$

$$\Delta WC_{11} = \left[\left(\frac{t_m \eta_M^d}{\varepsilon_X^s - \eta_M^d}\right) + \left(\frac{t_e(1+t_m)(1-e_{ia})\eta_M^d}{\varepsilon_X^s - \eta_M^d}\right) - \left(\frac{t_x \varepsilon_X^s}{\varepsilon_X^s - \eta_M^d}\right)\right](E)\left(\frac{\partial Q_{d,t}}{\partial F^D}\right) dF^D$$

Hence, using the above definitions, equation (85) is equal to non-zero, but particularly:

$$\left[(1_{mt})dF^{D} + (\Delta WC_{10} + \Delta WC_{11})\right] \tag{86}$$

The term of ΔWC_{11} is the change in the economic welfare being caused by a change in trade and excise taxes during the process of extraction of funds from the domestic capital market. The term ΔWC_{12} is the change in the economic welfare being caused by a change in trade and excise taxes because of a change in imports and exports with the change in the exchange rate.

3.5 Foreign capital market sourced funds are spent on non – tradables

Basically equations (11) and (12) hold whilst analyzing the impact of spending funds sourced through the foreign capital market. There is no displacement of any goods in the domestic market since project funds are sourced from abroad in the foreign exchange. Therefore, there will no distortion cost during the initial process. However, if these funds are used entirely to purchase non-tradable goods, these foreign exchanges must be first converted into a local currency as the prices of non-tradables are given in local currency. Without any doubt, the demand for tradables will increase and the supply of tradables will decrease as the relative price of non-tradable versus tradable increases.

3.5.1 Impacts on Demand for and Supply of Tradables and Non – Tradables

Substituting equation (11) and (12) into equation (13) and then taking the total differential in the foreign capital market $\left(dF^F\right)$, the following equation can be derived:

$$\left[\frac{\partial Q_t^d}{\partial F^F}(E)+\frac{\partial Q_{nt}^d}{\partial F^F}\right]dF^F+\left(\frac{\partial Q_{d,nt}^P}{\partial F^F}dF^F\right)+\left[\left(\frac{\partial Q_{d,t}}{\partial E}\frac{\partial E}{\partial F^F}\right)(E)+\left(\frac{\partial Q_{d,nt}}{\partial E}\frac{\partial E}{\partial F^F}\right)\right]dF^F$$
$$=$$
$$\left[\frac{\partial Q_{s,t}}{\partial F^F}(E)+\frac{\partial Q_{s,nt}}{\partial F^F}\right]dF^F+\left[\left(\frac{\partial Q_{s,t}}{\partial E}\frac{\partial E}{\partial F^F}\right)+\left(\frac{\partial Q_{s,nt}}{\partial E}\frac{\partial E}{\partial F^F}\right)\right]dF^F$$

(87)

Since project funds are used to purchase non-tradables:

$$\left(\frac{\partial Q_{d,nt}^P}{\partial F^F}\right)=1_{nt}^d \tag{88}$$

Together with facts expressed in both (7), (53)[14] and (88), taking the all the terms to the right hand side, equation (87) can be re-written as follows:

$$\left[\left(1_{nt}^d-\frac{\partial Q_{s,t}}{\partial F^F}E\right)\right]dF^F+\left[\left(\frac{\partial Q_{d,t}}{\partial E}-\frac{\partial Q_{s,t}}{\partial E}\right)E+\left(\frac{\partial Q_{d,nt}}{\partial E}-\frac{\partial Q_{s,nt}}{\partial E}\right)\right]\frac{\partial E}{\partial F^F}dF^F=0 \tag{89}$$

[14] Expression (7) : $\frac{\partial Q_{d,t}}{\partial F^F}=0$ and $\frac{\partial Q_{d,nt}}{\partial F^F}=0$, Expression (58): $\frac{\partial Q_{s,t}}{\partial F^F}=1_f^s$ but $\frac{\partial Q_{s,nt}}{\partial F^F}=0$

The first term in equation (89) indicates that if project funds are sourced abroad and spent entirely on non-tradables, it will create an excess supply of foreign exchange with an excess demand in the non-tradable sector. This excess demand for non-tradables is not same as the one observed in the second case (domestically sourced funds spent entirely on non-tradables) as now there is no initial displacement observed in either sectors.

Expressing equation (89) by using the corresponding elasticities already defined in equations (20), (21), (25) and (26) yields:

$$\left[\left(1_{nt}^{d}-\frac{\partial Q_{s,t}}{\partial F^{F}}E\right)\right]dF^{F}+\left[\left(\frac{\partial Q_{d,t}}{\partial E}\frac{E}{Q_{d,t}}\frac{Q_{d,t}}{E}-\frac{\partial Q_{s,t}}{\partial E}\frac{E}{Q_{s,t}}\frac{Q_{s,t}}{E}\right)E+\left(\frac{\partial Q_{d,nt}}{\partial E}\frac{E}{Q_{d,nt}}\frac{Q_{d,nt}}{E}-\frac{\partial Q_{s,nt}}{\partial E}\frac{E}{Q_{s,nt}}\frac{Q_{s,nt}}{E}\right)\right]\frac{\partial E}{\partial F^{F}}dF^{F}=0$$

Hence,

$$\left[\left(1_{nt}^{d}-\frac{\partial Q_{s,t}}{\partial F^{F}}E\right)\right]dF^{F}+\left[\left(\eta_{t}^{d}\frac{Q_{d,t}}{E}-\varepsilon_{t}^{s}\frac{Q_{s,t}}{E}\right)E+\left(\eta_{nt}^{d}\frac{Q_{d,nt}}{E}-\varepsilon_{nt}^{s}\frac{Q_{s,nt}}{E}\right)\right]\frac{\partial E}{\partial F^{F}}dF^{F}=0$$

(90)

Note that:

$$\frac{dG^{T}}{dF^{F}}=\left(\frac{\partial Q_{s,t}}{\partial F^{F}}\right)dF^{F} \qquad (91)$$

where the term $\left(\frac{\partial Q_{s,t}}{\partial F^{F}}\right)=1_{f}^{s}$ as defined in equation (58). Therefore, $\frac{dG^{T}}{dF^{F}}=dF^{F}$

Using equations (16) and (91), equation (90) can be re-expressed as follows:

$$\left[\left(1_{nt}^{d}-\frac{\partial Q_{s,t}}{\partial F^{F}}E\right)\right]dF^{F}+\left[\left(\eta_{t}^{d}\frac{Q_{d,t}}{E}-\varepsilon_{t}^{s}\frac{Q_{s,t}}{E}\right)E+\left(\eta_{nt}^{d}\frac{Q_{d,nt}}{E}-\varepsilon_{nt}^{s}\frac{Q_{s,nt}}{E}\right)\right]\left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right)\left(\frac{\partial Q_{s,t}}{\partial F^{F}}\right)dF^{F}=0$$

Rearranging the terms above yields:

$$\left[\left(1_{nt}^{d}-1_{f}^{s}E\right)\right]dF^{F}+\left[\frac{\left(\eta_{t}^{d}-\varepsilon_{t}^{s}\right)E+\left(\eta_{nt}^{d}-\varepsilon_{nt}^{s}\right)\frac{Q_{d,nt}}{Q_{d,t}}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right]\frac{\partial Q_{s,t}}{\partial F^{F}}dF^{F}=0 \qquad (92)$$

Finally, to estimate the total welfare costs associated with foreign exchange funding in the case of purchase of non-tradables, equation (93) can be modified as follows:

$$\left[\left(1_{nt}^{d}-\delta*1_{f}^{s}E\right)\right]dF^{F}+\left[\left(\frac{v_{t}\left(1-e_{ia}\right)\eta_{t}^{d}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}-\frac{k_{t}\varepsilon_{t}^{s}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right)E+\left(\frac{v_{nt}\left(1-e_{ia}\right)\eta_{nt}^{d}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}-\frac{k_{nt}\varepsilon_{nt}^{s}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right)\frac{Q_{d,nt}}{Q_{d,t}}\right]*\left(\frac{\partial Q_{s,t}}{\partial F^{F}}\right)dF^{F}\neq 0$$

(93)

Definining:

$$\Delta WC_{12}=-\left(\delta*1_{f}^{s}E\right)dF^{F}$$

$$\Delta WC_{13}=\left[\left(\frac{v_{t}\left(1-e_{ia}\right)\eta_{t}^{d}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}-\frac{k_{t}\varepsilon_{t}^{s}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right)E+\left(\frac{v_{nt}\left(1-e_{ia}\right)\eta_{nt}^{d}}{\varepsilon_{t}^{d}-\eta_{t}^{d}}-\frac{k_{nt}\varepsilon_{nt}^{s}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right)\left(\frac{Q_{d,nt}}{Q_{d,t}}\right)\right]\left(\frac{\partial Q_{t}}{\partial F^{F}}\right)dF^{F}$$

Therefore, equation (93) is non-zero and it is equal to:

$$\left[\left(1_{nt}\right)dF^{F}+\left(\Delta WC_{12}+\Delta WC_{13}\right)\right] \qquad (94)$$

WC_{12} is the economic welfare cost rise due to the distortion on inflow of foreign exchange supply (assuming that δ is per cent tax of foreign exchange supply). On the other hand, the term WC_{13} is the change in taxes collected -from domestic indirect taxation and production subsidies- from changes in demand and the supply of tradables and non-tradables caused by a change in the exchange rate.

3.5.2 Impacts on Imports and Exports

Note that as previously mentioned, there will be an excess demand for non-tradables and to cover this excess demand, foreign exchanges are converted into domestic currency which in turn will stimulate the imports while displacing the exports by certain amounts. Moreover, if these foreign funds are used to purchase non-tradable items for the use of the project, we must add the term $\frac{\partial Q^{P}_{d,nt}}{\partial F^{F}} = 1^{d}_{nt}$ into the model.

To analyze the impacts on the external sector in the case of foreign capital market sourcing, equation (31) and (34) will be substituted into equation (13) again, but it will be differentiated with respect to a change in dF^{F} such that:

$$\left[1_{nt} + \left(\frac{\partial Q_{d,i}}{\partial F^{F}} + \frac{\partial Q_{d,e}}{\partial F^{F}}\right)(E) + \frac{\partial Q_{d,nt}}{\partial F^{F}}\right] dF^{F} + \left[\left(\frac{\partial Q_{d,i}}{\partial E} + \frac{\partial Q_{d,e}}{\partial E}\right)(E) + \frac{\partial Q_{d,nt}}{\partial E}\right] \frac{\partial E}{\partial G}\frac{\partial G^{T}}{\partial F^{F}} dF^{F} = \left(\frac{\partial Q_{s,i}}{\partial E} + \frac{\partial Q_{s,e}}{\partial E} + \frac{\partial Q_{s,nt}}{\partial E}\right) \frac{\partial E}{\partial G}\frac{\partial G^{T}}{\partial F^{F}} dF^{F} = 0 \quad (95)$$

By using the facts expressed in both (5) and (53), taking the all the terms to the right hand side, equation (95) can be re-written as follows:

$$\left[\left(1_{nt}^{d}-\frac{\partial Q_{s,t}}{\partial F^{F}}E\right)\right]dF^{F}+\left[\left(\frac{\partial Q_{d,nt}}{\partial E}-\frac{\partial Q_{s,nt}}{\partial E}\right)+\left(\left(\frac{\partial Q_{d,i}}{\partial E}-\frac{\partial Q_{s,i}}{\partial E}\right)-\left(\frac{\partial Q_{s,e}}{\partial E}\frac{\partial Q_{d,e}}{\partial E}\right)\right)(E)\right]\frac{\partial E}{\partial G}\frac{\partial G^{T}}{\partial F^{F}}dF^{F}=0$$

This equation can be expressed in terms of elasticities as follows:

$$\left[\left(1_{nt}^{d}-\frac{\partial Q_{s,t}}{\partial F^{F}}E\right)\right]dF^{F}+\left[\begin{array}{l}\left(\frac{\partial Q_{d,nt}}{\partial E}\frac{E}{Q_{d,nt}}\frac{Q_{d,nt}}{E}-\frac{\partial Q_{s,nt}}{\partial E}\frac{E}{Q_{s,nt}}\frac{Q_{s,nt}}{E}\right)+\\ \left(\left(\frac{\partial Q_{d,i}}{\partial E}\frac{E}{Q_{d,i}}\frac{Q_{d,i}}{E}-\frac{\partial Q_{s,i}}{\partial E}\frac{E}{Q_{s,i}}\frac{Q_{s,i}}{E}\right)-\right.\\ \left.\left(\frac{\partial Q_{s,e}}{\partial E}\frac{E}{Q_{s,e}}\frac{Q_{s,e}}{E}-\frac{\partial Q_{d,e}}{\partial E}\frac{E}{Q_{d,e}}\frac{Q_{d,e}}{E}\right)\right)(E)\end{array}\right]\frac{\partial E}{\partial G}\frac{\partial G^{T}}{\partial F^{F}}dF^{F}=0$$

From the definitions of elasticities (39) to (42):

$$\left[\left(1_{nt}^{d}-\frac{\partial Q_{s,t}}{\partial F^{F}}E\right)\right]dF^{F}+\left[\left(\eta_{nt}^{d}\frac{Q_{d,nt}}{E}-\varepsilon_{nt}^{s}\frac{Q_{s,nt}}{E}\right)+\left(\left(\eta_{i}^{d}\frac{Q_{d,i}}{E}-\varepsilon_{i}^{s}\frac{Q_{s,i}}{E}\right)-\left(\varepsilon_{e}^{s}\frac{Q_{s,e}}{E}-\eta_{e}^{d}\frac{Q_{d,e}}{E}\right)\right)(E)\right]\frac{\partial E}{\partial G}\frac{\partial G^{T}}{\partial F^{F}}dF^{F}=0$$

Then using the definition of both (16) and (91):

$$\left[\left(1_{nt}^{d}-\frac{\partial Q_{s,t}}{\partial F^{F}}E\right)\right]dF^{F}+\left[\left(\eta_{nt}^{d}\frac{Q_{d,nt}}{E}-\varepsilon_{nt}^{s}\frac{Q_{s,nt}}{E}\right)+\left(\left(\eta_{i}^{d}\frac{Q_{d,i}}{E}-\varepsilon_{i}^{s}\frac{Q_{s,i}}{E}\right)-\left(\varepsilon_{e}^{s}\frac{Q_{s,e}}{E}-\eta_{e}^{d}\frac{Q_{d,e}}{E}\right)\right)(E)\right]\left(\frac{\frac{\partial Q_{d,t}}{\partial G}\frac{E}{Q_{d,t}}}{\varepsilon_{t}^{s}-\eta_{t}^{d}}\right)\left(\frac{\partial Q_{s,t}}{\partial F^{F}}\right)dF^{F}=0$$

Simplifying the above equation gives us:

$$\left[\left(1_{nt}^{d}-1_{f}^{s}E\right)\right]dF^{F}+\left[\frac{\left(\eta_{nt}^{d}\frac{Q_{d,nt}}{Q_{d,t}}-\varepsilon_{nt}^{s}\frac{Q_{s,nt}}{Q_{d,t}}\right)+\left(\left(\eta_{i}^{d}\frac{Q_{d,i}}{Q_{d,t}}-\varepsilon_{i}^{s}\frac{Q_{s,i}}{Q_{d,t}}\right)-\left(\varepsilon_{e}^{s}\frac{Q_{s,e}}{Q_{d,t}}-\eta_{e}^{d}\frac{Q_{d,e}}{Q_{d,t}}\right)\right)(E)}{\varepsilon_{X}^{s}-\eta_{M}^{d}}\right]*\left(\frac{\partial Q_{d,t}}{\partial F^{F}}\right)dF^{F}=0 \qquad (96)$$

Again, one should be careful about the welfare cost calculations in this section. In equation (93), the economic welfare cost calculation from the imposition of tax on the supply of foreign exchange is already estimated, shown by the term (ΔWC_{12}). Therefore, in order to avoid an overestimation of welfare cost, using the definition in (58); the left hand side of equation (96) is zero.

$$0+\left[\frac{\left(\eta_{nt}^{d}\frac{Q_{d,nt}}{Q_{d,t}}-\varepsilon_{nt}^{s}\frac{Q_{s,nt}}{Q_{d,t}}\right)+\left(\left(\eta_{i}^{d}\frac{Q_{d,i}}{Q_{d,t}}-\varepsilon_{i}^{s}\frac{Q_{s,i}}{Q_{d,t}}\right)-\left(\varepsilon_{e}^{s}\frac{Q_{s,e}}{Q_{d,t}}-\eta_{e}^{d}\frac{Q_{d,e}}{Q_{d,t}}\right)\right)(E)}{\varepsilon_{X}^{s}-\eta_{M}^{d}}\right]*\left(\frac{\partial Q_{d,t}}{\partial F^{F}}\right)dF^{F}=0$$

Finally, to estimate the total welfare cost arises due to changes in demand and the supply of importables and exportables can be expressed by the following equation:

$$0+\left[\frac{t_m\eta_M^d}{\varepsilon_X^s-\eta_M^d}+\frac{t_e(1+t_m)(1-e_{ia})\eta_M^d}{\varepsilon_X^s-\eta_M^d}-\frac{t_x\varepsilon_X^s}{\varepsilon_X^s-\eta_M^d}\right](E)*\left(\frac{\partial Q_{s,t}}{\partial F^{F}}\right)dF^{F}\neq 0 \qquad (97)$$

Defining

$$\Delta WC_{14}=\left[\left(\frac{t_m\eta_M^d}{\varepsilon_X^s-\eta_M^d}\right)+\left(\frac{t_e(1+t_m)(1-e_{ia})\eta_M^d}{\varepsilon_X^s-\eta_M^d}\right)-\left(\frac{t_x\varepsilon_X^s}{\varepsilon_X^s-\eta_M^d}\right)\right](E)\left(\frac{\partial Q_{s,t}}{\partial F^{F}}\right)dF^{F}$$

To put it in a simple form, equation (97) equals to:

$$\Delta WC_{14} \qquad (98)$$

The term WC_{16} in equation (98) is the change in taxes collected –only from trade taxes on both imports and exports as well as the excise tax on imports- from changes

in demand and supply of tradables and non-tradables caused by the change in the exchange rate.

In summary, the shadow price of foreign exchange is computed as 1_{nt} (one unit of domestic currency) plus the premium on non-tradable outlays (NTP). In order to calculate the NTP, there is a need to obtain the welfare cost per $ of fund as done identically in the case of FEP calculation for the EOCFX. (Once again all welfare cost calculations from 8 to 14 are calculated with the actual change as they represent the changes in the equilibrium amounts by capital market extraction and changes due to a shift in the tradable sector – either surplus or shortage). Welfare Cost per unit of funds is calculated as the change in the welfare cost divided by the total available funds. Algebraically:

$$NTP_{1,2} = \frac{\sum \Delta WC_{8,9,10,11}}{dF} + \frac{\sum \Delta WC_{12,13,14}}{dF} \tag{99}$$

Finally, using the proportion of funds sourced from the domestic capital market$\left(\frac{\partial F^{D}}{\partial F}\right)$ and foreign capital market$\left(\frac{\partial F^{F}}{\partial F}\right)$, the SPNTO is to be estimated.

$$SPNTO = 1_{nt} + \left(\frac{\partial F^{D}}{\partial F} * NTP_{1}\right) + \left(\frac{\partial F^{F}}{\partial F} NTP_{2}\right) \tag{100}$$

General Expression for the Estimation of Shadow Price of Non – Tradable Outlays (SPNTO)

$$SPNTO = \left[1_{nt} + \frac{\partial F^D}{\partial F}\left(\left(\frac{v_t(1-e_{is})\frac{\partial Q_{d,t}}{\partial F^D}}{dF}\right)(E) + \left(\frac{v_{nt}(1-e_{is})\frac{\partial Q_{d,nt}}{\partial F^D}}{dF}\right)\right) + \frac{\partial F^F}{\partial F}\left(1_f - \frac{\delta\frac{\partial Q_s}{\partial F}}{dF}\right)\right] + \left[\frac{\left(\frac{v_t(1-e_{ia})\eta_t^d}{\varepsilon_t^s-\eta_t^d} - \frac{k_t\varepsilon_t^s}{\varepsilon_t^s-\eta_t^d}\right)}{dF}(E) + \frac{\left(\frac{v_{nt}(1-e_{ia})\eta_{nt}^d}{\varepsilon_t^s-\eta_t^d} - \frac{k_{nt}\varepsilon_{nt}^s}{\varepsilon_t^s-\eta_t^d}\right)\frac{Q_{d,nt}}{Q_{d,t}}}{dF}\right] * \left[\frac{\partial F^D}{\partial F}\left(\frac{\partial Q_t}{\partial F^D}\right) + \frac{\partial F^F}{\partial F}\left(\frac{\partial Q_s}{\partial F^F}\right)\right]$$

$$+$$

$$\left[\frac{\partial F^D}{\partial F}\left[\left(\frac{t_m\frac{\partial Q_{d,i}}{\partial F} + \left(t_e(1+t_m)(1-e_{ia})\right)\frac{\partial Q_{d,i}}{\partial F}}{dF}\right) + \frac{t_x\frac{\partial Q_{d,e}}{\partial F}}{dF}\right](E)\right] + \left[\frac{\frac{t_m\eta_M^d}{\varepsilon_X^d-\eta_M^d} + \frac{\left(t_e(1+t_m)(1-e_{is})\right)\eta_M^d}{\varepsilon_X^s-\eta_M^d} - \frac{t_x\varepsilon_X^s}{\varepsilon_X^s-\eta_M^d}}{dF}\right](E)\left[\frac{\partial F^D}{\partial F}\left(\frac{\partial Q_{d,t}}{\partial F^D}\right) + \frac{\partial F^F}{\partial F}\left(\frac{\partial Q_s}{\partial F^F}\right)\right]$$

[101]

CHAPTER 4

AN ECONOMIC REVIEW ON WEST AFRICAN ECONOMIC & MONETARY UNION (WAEMU)

4.1 Overview[15]

The African Financial Community (CFA Franc Zone) comprises 14 different African states, which are formed into two monetary areas; the West African Economic and Monetary Union and the Union of the Central African State. WAEMU Member States are Benin, Burkina Faso, Guinea-Bissau, Ivory Coast, Mali, Niger, Senegal and Togo. Each of the monetary areas are operated by a different Central Bank, completely independent from each other. Each Central Bank issues its own currency, commonly called the CFA Franc.[16] These two Central Banks issue the only legal currency in each monetary area. It is noteworthy that foreign currencies are not accepted as a unit of account or medium of exchange in these two monetary areas, including the CFA Franc issued by each of the Central Banks. Moreover, Commercial Banks in both areas do not accept savings in foreign currency which in

[15] Summarized from studies conducted by Fielding and Shields, (2005), Fielding and Shields (2001), Strauss-Kahn (2003), Claeys and Sindzingre (2003). For more information about the WAEMU and CFA Franc Zone, also see the studies conducted by Kose and Riezman (2001), Dore and Masson (2002), Wane (2003), Rogoff and Reinhart (2003), Masson and Pattitilo (2004), Boogaerde and Tsangarides (2005)

[16] The Central Bank of West African States (BCEAO) operates the West African Economic and Monetary Union whereas the Bank of Central African States (BEAC) operates the Union of Central African States.

turn ensures that only a small amount of foreign deposits are available at the commercial banks compared to local currency savings. The Central Banks are the only institutions providing foreign exchanges in the union which are subject to taxation. The Central Banks hold the power to place restrictions on the re-financing facilities available to the commercial banks and also on their ability to lend to the private sector in each member state. Between the member states and France, there are no financial transfer constraints. The French Treasury is the responsible institution to exchange CFA Francs for Euros at a fixed exchange on demand. This suggests that short – run monetary policy in the CFA is not constrained by the need to maintain the currency peg, but Monetary Policy in the CFA is constrained by various regulations which limit credit creation. Furthermore, there are certain rules set for CFA currency users of African governments to protect the French Treasury's guarantee of convertibility.[17] Also, the French Treasury holds at least 65 per cent of the pooled reserves of each area. However, each country has its own share of foreign assets and this share is determined by the national economic and financial parameters of each country.

Figure 1: Map of WAEMU

Source(s): The World Bank (WB) and the WAEMU Commision

[17] See Dearden (1999)

Since 1994 when the CFA Franc was devalued against other foreign currencies, the users of the CFA Franc have agreed to strengthen their monetary union and to boost regional integration through the formation of a customs union and a common economic market.[18] To maintain the macroeconomic stability as well as the currency peg within the union, a system of multilateral surveillance of macroeconomic policy is established which in fact ensures a convergence of key aggregates in the fiscal area. As mentioned above, under this arrangement, the CFA Franc is pegged to the Euro at a fixed rate so that any movement of the Euro against the US$ or other international currencies directly affects trade patterns of the CFA Franc economies. For instance, the recent appreciation of the Euro against the US$ caused the trade balance of the CFA Franc economies to deteriorate. In addition to the appreciation of the Euro, the increase in oil prices and a decrease in profitability of major export commodities resulted in an increase in the trade deficit within the WAEMU. The WAEMU's share of world trade is still small, so it is not able to influence the world prices of its tradable goods and services. Furthermore, the WAEMU member states have signed an agreement on the free movement of goods and services within the union. Besides, United Nation statistics reveal that this has been increasing the trade complementarities within the union. Initially this agreement increased the intra-union trade volume.

A greater level of integration was achieved in 2000 via the implementation of a Common External Tariff (CET) such that the same external tariff rules apply to all non-WAEMU member states. This common tariff rate (CET) is applied to products entering the WAEMU with the revenue shared by agreement amongst the countries.

[18] It is based on a "Transit System"; so collection of custom duties by the country of final destination.

Although the WAEMU is a customs union, the existence of non-tariff barriers and other institutional barriers in some countries still prevent the movement of goods without cost. Divergence between costs such as transportation costs and many other distortions in prices caused by the differences in taxes rather than tariff and VAT play an important role in terms of explaining the existence of non – tariff barriers. These policies in fact contradict the common policy of the WAEMU custom union. Under the WAEMU, the CFA currencies are pegged to the Euro at a fixed rate and the French Treasury is the authorized institution to convert CFA Francs into Euros on demand. The French Treasury also provides "overdraft facilities" to the central banks of the CFA countries, which allow them to pursue a short run stabilization policy inside the zone independent from that of France. It also attempts to insulate monetary growth shocks due to the change in public debt. Some institutional restrictions are agreed with the Central Banks of the union in order to avoid free riding actions of individual governments and to manage the satisfactorily the 'operations account'. For instance, the credits issued to a government from Central Bank cannot exceed 20 per cent of the government's fiscal receipts for the previous year. Another limitation is on the amount of private credits issued by the Central Banks via rediscount activities. While there is not complete financial market integration between the CFA countries and France, the non-existence of foreign exchange rationing and easy access to international capital markets is an encouragement to foreign investors.[19] The low inflation rate due to currency pegging to the Euro and the stable monetary policy in the zone also create a positive economic climate for investors. One of the main indicators is the relatively low cost of borrowing as measured by the interest rate and

[19] It should be stated that there is a 0.25 per cent tax plus national surtax in case of assets exported outside the CFA and also there is a 0.10 per cent on export of assets from one CFA zone to another CFA zone. In addition to these, each government within the zone applies some administrative rules in order to keep assets within the country.

is controlled directly by the Central Bank. The Central Banks also follow an interest rate policy to maintain a positive real rate of interest in order to promote long term domestic savings. On the other hand, investments in the zone are negatively affected by unstable capital goods prices that in turn increase the variability of rate of return on investments. One of the main measurements of international competitiveness is the value of the real exchange rate over time. For the WAEMU zone, the nominal exchange rate is fixed; so the relative price level is the variable that determines the RER.

In addition to the all above, the liberalization process in West Africa continues with the enlargement of a customs union zone with the formation of ECOWAS. ECOWAS includes all the WAEMU states and also Caper Verde, Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone that are all non – CFA Franc users. Today, trade between the WAEMU and other ECOWAS states is distorted by tariffs and administrative restrictions. As the WAEMU and other ECOWAS states are using different currencies, the currency transaction costs associated with them have to be considered while analyzing the impact of ECOWAS union on trade.[20]

The EU and ECOWAS have been working on an economic partnership agreement which will help both unions to expand their markets. However, completion of the customs union is a 'must condition' imposed by the EU – WAEP agreement for negotiations. A Critique of this possible EU – WAEP was done by Goretti and Weisfeld (2008). Goretti and Weisfeld (2008) identify three areas where problems arise starting that 'tariff revenues of the WAEMU countries from trade with Europe

[20] Also see the discussion paper by Hefeker (2003)

will be completely removed through the customs union agreement which in turn reduces the tariff revenues substantially as the import share of WAEMU countries with the EU is high. Secondly, this agreement may divert trade if imports from the EU replace cheaper imports from other countries. Finally, the weak business environment and limited access to funds for investments could slow the re-allocation of capital and labor from import substitution industries that are affected by cheaper imports from the EU.'[21]

4.2 The WAEMU CET[22]

Through a combination of unilateral and regional modalities, import liberalization has progressed quite rapidly in many African countries, particularly during the 1990s. The WAEMU implemented its common external tariff (CET) as it transformed itself from a free trade area (FTA) into a higher level of integration within the union in 1994 and 1998. As a result of the customs union, its member-countries currently impose average import tariffs of 12 per cent within the range of 0-20 per cent. Implementation of a common external tariff was scheduled to take place on 1 January 2000, but in some countries, it became effective after the designated date. However, any of the WAEMU member states producing industrial goods and exporting them to another WAEMU member state are also subject to taxation if the product is not certified as eligible for duty free treatment as part of the WAEMU internal free trade. Thus, only the approved industrial products of any WAEMU enterprises can move inside the WAEMU market freely. The prevention of trade diversion, a danger since the lack of uniform tariffs among the WAEMU

[21] Also see Lang (2002) and Alaba (2006)
[22] More detailed information is available at *Les Great Cahiers* by Massa and Plunkett (2006)

member states adversely affected their ability to compete favorably in their own markets, given the possibility for third country exporters to export their products into the WAEMU customs territory through those countries where import duties were lowest, for re-export to those countries with higher import duties.

4.3 Estimation of Externalities for the WAEMU

The project spends money on either tradable or non-tradable items some of which are subject to various taxes, subsidies, direct and indirect taxes. Hence, estimation of the tax distortions (externalities) involved in the spending of these project funds is a must. That is how we estimate the changes in welfare cost. In other words, one must estimate the foreign exchange premium in case of tradable purchases and the premium on non-tradables in case of non-tradable purchases for the estimation of the EOCFX and SPNTO.

4.3.1 Externalities created by Import Tariff

The first set of externalities arises in the importable goods market due to the effect of the import tariff. The effective rate of import tariff is measured by the ratio of the amount of tariff revenues collected in a given year to the market value of imports for the same period. The value of imports to the consumer of these goods importers is measured by its world price expressed as the domestic price plus the tariff rate. The value of this distortion can be calculated by multiplying the rate of the distortion (t_m) by the initial displacement of importables due to the funds extracted from the capital

market plus the net changes in the demand for and supply of importables as a result of a change in the relative price.

The average effective tariff rate (t_m) for the WAEMU is calculated by dividing the total customs duty collections by the total amount of imports excluding importation within the union for the same period of time. The calculation reveals that it is 13.4 per cent excluding all other import taxes. There is a 1 per cent Statistical Tax applied to all imports entering the WAEMU custom zone from non – WAEMU member states, 1 per cent rate WAEMU Community Solidarity Levy apply all imports except petroleum products, goods in transit or goods under bonded warehouse arrangements, 0.5 per cent ECOWAS levy applied to goods of non-ECOWAS countries and a charge for the inspection and verification of imported goods ranging between 0.75 per cent – 1 per cent. Accordingly, applying 16 per cent of an average effective import tariff is believed to be consistent.

4.3.2 Externalities created by Export Tax

The second externality is the export tax. When there is an export tax, the national benefits received from exporting are greater than the domestic resource cost if producing exportable goods. Export taxes are imposed in order to increase government revenue and to protect domestic consumers by lowering the prices of them and also cause the national benefits from exporting to be greater than the domestic resource costs. In order to calculate the effective export tax rate (t_x), simply taking the total export tax revenue of the union for the particular year and divide it by

the total value of exports in the same period without excluding the countries which do not impose export taxation.

In order to calculate the effective export tax rate (t_x), simply taking the total export tax revenues of the countries for the year of 2002 and divide it by the total value of exports in the same period without excluding those do not impose export taxation.

It is noteworthy that the Ivory Coast is the country that collects a considerable amount of export tax revenues, but for consistency, all other countries that impose export taxes are considered as well. Then, the effective export tax (t_x) for the WAEMU is calculated about at 8.5 per cent.

Table 4.1: Effective Rate of Export Tax for the WAEMU Region (values are in current FCFA, year of 2002)

	Export Taxes	Exports
Benin	1,771,000,000	313,645,500,000
Burkina Faso	-	172,156,530,000
Ivory Coast	503,300,000,000	3,676,622,250,000
Mali	9,800,000,000	607,775,280,000
Niger	-	194,640,210,000
Senegal	-	743,688,330,000
Togo	-	297,614,730,000
Guinea Bissau	1,623,000,000	37,637,460,000
Total Volume	516,494,000,000	6,043,600,290,000
Effective Rate of Export Tax	**8.5%**	

Source(s): International Monetary Fund (IMF)

Table 4.2: Effective Rate of Import Tariff for the WAEMU Region

(values are in $, current prices of 2005)

	Senegal	Ivory Coast	Benin	Mali	Togo	Niger	Burkina Faso
Total Imports	3,497,700,592	5,864,962,365	898,695,761	1,543,598,939	592,615,810	735,563,160	1,264,039,402
Imports within WAEMU	125,078,692	44,599,234	121,504,657	588,165,319	57,939,344	160,158,923	268,277,102
Imports outside WAEMU	3,372,621,900	5,820,363,131	777,191,104	955,433,620	534,676,466	575,404,237	995,762,300
Total Imports outside WAEMU	13,031,452,758						
GDP at Current Prices	8,355,906,497	16,172,426,868	4,377,689,726	5,117,352,646	2,174,019,376	3,024,532,201	5,697,385,633
Tariff Revenue (% of GDP)*	5.52%	3.87%	3.31%	1.17%	8.41%	3.87%	2.75%
Tariff Revenue	461,246,039	625,872,920	144,901,530	59,873,026	182,835,030	117,049,396	156,678,105
Total Tariff Revenue	1,748,456,044.89						
Average Tariff Rate	**13.4%**						

Source(s): *(*)International Monetary Fund (IMF) Staff Estimations*
United Nations (UN) Comtrade Database

4.3.3 Externalities created by the Value Added Tax (VAT)

The third externality is the Value Added Tax (VAT). Even though VAT is not a border tax, VAT collections from imports are higher than that of VAT collections from domestic sales. This way of measuring VAT revenue tends to overstate the VAT revenue from imports because the tax paid on imported inputs can be used as a credit against the VAT owed on the sales of goods and services in the economy that use these imported inputs as intermediate goods. Moreover, the reduction in government revenues due to a decrease in customs duties is offset through an increase in internal taxes such as VAT and excise taxes in the union. It is an indirect tax and a fully implemented VAT is equivalent to a single stage tax at the retail level. Also, VAT is applied to consumption items, so that only consumption goods represent a portion of the changes in the demand for tradable and non-tradable goods. In order to calculate the effective VAT for tradable and non-tradables, one must separate VAT collections from imports and domestic sales and divide them by the value of imports and private consumption, respectively.

All the WAEMU member countries have replaced their turnover and sales tax with VAT, except Guinea Bissau. They have been applying a common and a single rate of VAT of 18 per cent since 2000, except that of Niger with 19 per cent rate. Therefore, a VAT policy within the union preserves “neutrality” since the members apply the same rate to domestic production and imports. Moreover, the reduction in government revenues due to a decrease in customs duties is offset through an increase in internal taxes such as VAT and excise taxes in the union. Even though VAT is not a border tax, two-thirds of VAT revenue is collected from the imported

commodities as foreign produced goods are subject to taxation. It is an indirect tax and a fully implemented VAT is equivalent to a single stage tax at the retail level.

Hence, it is calculated that the effective VAT rates are approximately 10 per cent and 3 per cent for tradable (v_t) and non-tradables (v_{nt}), respectively. However, in our analysis, we will be using the value added tax rates as 12 per cent and 5 per cent for tradables and non – taradables, respectively.

Table 4.3: Effective Rates of VAT Tax for the WAEMU Region
(values are in current FCFA, year of 2002)

	Collection of VAT Taxes (Domestic)	Total Private Consumption Expenditures	Collection of VAT Taxes (Imports)	Value of Imports
Benin	41,454,000,000	1,532,978,100,000	86,606,000,000	505,325,000,000
Burkina Faso	54,800,000,000	1,623,976,800,000	32,100,000,000	385,441,000,000
Ivory Coast	129,000,000,000	4,857,930,600,000	175,000,000,000	1,711,832,000,000
Mali	42,900,000,000	1,553,997,800,000	82,800,000,000	646,119,000,000
Niger	28,600,000,000	1,035,985,200,000	18,400,000,000*	326,196,000,000
Senegal	90,500,000,000	2,988,957,300,000	112,700,000,000	1,415,607,000,000
Togo	24,600,000,000	888,987,300,000	16,400,000,000	403,563,000,000
Total Volume	411,854,000,000	14,482,793,100,00	524,006,000,000	5,394,083,000,000
Effective Rate of VAT (Non - Tradables)	**2.8%**			
Effective Rate of VAT (Tradables)	**9.7%**			

Source: *International Monetary Fund (IMF)*

(*) Data for the collection of VAT taxes on imports obtained from article published Zafar, A. (2005)

4.3.4 Externalities created by Excise Tax

Finally, the effective excise tax rate is included in externality in measure as part of the total externalities. It should be stated that excise tax also changes the structure of the economy if the goods are subject to excise tax; demand for goods decreases and during the process of decrease, consumers who consume the good release resources from that industry to the others. While measuring the change in the welfare cost due to excise tax, one should be careful with the treatment of this distortion. For instance, the excise tax is applicable to importable goods within the union, so it is imposed including the import tariff. Furthermore, if businesses purchase an input that is subject to excise tax, it is excluded from tax payment if it is for investment purpose. This necessitates adjustment of the externalites arising due to excise tax to the exclusions of tax distortions in order not to overstate the changes in the economic welfare.

Within the union, there is a set of excise duties levied on specific commodities with specific rates. The WAEMU excise tax base includes two lists. “Mandatory” refers to all member countries must tax beverages (except water) and tobacco products. Another one is “Elective” in which the member country is free to choose a maximum of four groups of products from the list of seven determined by the commission. In order to estimate the externalities created by the excise tax rate, one should recognize the fact that the excise tax is domestically applied to tradables, and particularly to importables. Then, effective excise duty rates are calculated as $(t_{e,t})$ is 1 per cent and $(t_{e,nt})$ is 0 per cent for traded and non-traded goods, respectively.

Table 4.4: Effective Rate of Excise Tax for the WAEMU Region (values are in current FCFA, year of 2002)

	Collection of Excise Taxes	Value of Domestic Production[23]
Benin	4,000,000,000	942,509,333,000
Burkina Faso	24,000,000,000	1,143,067,710,540
Ivory Coast	33,000,000,000	3,827,119,275,353
Mali	7,000,000,000	1,079,043,195,678
Niger	3,000,000,000	717,155,733,300
Senegal	13,000,000,000	1,739,081,664,518
Togo	11,000,000,000	505,866,666,667
Total Volume	95,000,000,000	9,953,843,579,422
Effective Rate of Excise Tax	**0.95%**	

Source(s): WAEMU Commission and United Nations (UN) Comtrade Database

To be brief, based on the sourcing of funds – used to spend on either tradables or non – tradable goods for the project, one must combine all the cases and determine in a consistent manner the total externalities (total distortion costs) arising in the economy for the estimation of EOCFX and the SPNTO.

[23] Total tradables goods and services account for 2/3 of the total domestic production such that importable goods account for 80% of the total tradables while the remaining 20% represents the share of exportables.

CHAPTER 5

EMPIRICAL ESTIMATION

Firstly, there is a need to estimate and assume the various coefficients to be used in the model and then replicating the in order to estimate the foreign exchange premium and non – tradable outlays for the West African Economic and Monetary Union.

5.1 Tradable versus Non – Tradable Goods and Sources of Funds[24]

The goods and services in an economy are classified as tradable and non – tradable where tradable goods and services consist of importables and exportables. What is more, it is shown that raising a certain amount of funds (dF) in the domestic capital market requires a certain fraction of displacement of tradables and non – tradables. Here, it is assumed that the share of domestic project funds sourced by displacing the demand for tradables $\left(\partial Q_{d,t} / \partial F^{D}\right) dF^{D}$ is 2/3 while displacement of the demand for non-tradables $\left(\partial Q_{d,nt} / \partial F^{D}\right) dF^{D}$ is 1/3.

It should be noted here that a reduction in demand for tradables is broken down into a portion such as the demand for importables and the supply of exportables. As exportable goods and services produced within the WAEMU are very limited, the

[24] Assumed coefficients in this section belong to Harberger and Jenkins. Their assumptions are also used in this study.

share of exportables is much below that of importables. Additionally, due to the lack of detailed data set, again it is assumed here that the importable demand $\left(\partial Q_{d,i}/\partial F^D\right)dF^D$ constitutes 80 per cent of the total tradables while the exportable demand $\left(\partial Q_{d,e}/\partial F^D\right)dF^D$ accounts for only 20 per cent of the total tradables demand. Therefore, demand for importables and exportables as a share of the total demand for tradables are 0.8 and 0.2, respectively.

The coefficients just described above imply that funds borrowed in the capital market displace other demands for capital and consumption expenditure that would otherwise have been made on these three composite goods in the economy. However, it does not apply in the case of external capital market borrowing since they flow into the country without altering the consumption of any type of goods and services. In the case of foreign capital market borrowing, the definitions are already presented in (6).

5.2 Demand and Supply Elasticities[25]

Both tradable sector goods and non-tradable sector goods are functions of the real exchange rate. An increase in demand for one sector due to initial capital extraction is somehow offset by a change in its relative price with respect to the other sector, which results from a change in the real exchange rate. This process of substitution effects of a change in the relative price stimulates the economy. For instance, if funds are spent entirely on tradables, there will be an excess demand for tradables and an

[25] Elasticities used in this study (except the compensated own price elasticity demand for imports (η_M^d) and the price supply elasticity of exports (ε_X^s)) are assumed by Harberger and Jenkins and their assumptions are used in this study too.

excess supply of non-tradables which in turn increases the relative price of tradables as the real exchange rate tends to decrease and vice versa.

In fact, in the model developed in chapter 3, any changes in quantities due to a real exchange rate adjustment is analyzed using the 'gap' in the traded sector between the demand for and supply of tradable goods due to spending domestically borrowed funds spent entirely either on tradables or non-tradables. Later, in order to estimate the change due to relative price change, one needs to use "corresponding elasticities".[26] In this analysis, the compensated own price demand elasticity of tradables $\left(\eta_t^d\right)$is assumed to be -1.5, own price supply elasticity of tradables $\left(\varepsilon_t^s\right)$ is 1, the compensated cross – price elasticity of demand for non - tradable goods times the demand for non -tradables as a share of total aggregate demand $\left(\eta_{nt}^d \frac{\partial Q_{d,nt}}{\partial Q_D}\right)$ is 1.5 and finally the cross price elasticity of supply of non-tradables times the supply of non -tradables as a share of total aggregate production $\left(\varepsilon_{nt}^s \frac{\partial Q_{s,nt}}{\partial Q_S}\right)$ is assumed to be -1. This indicates that based on sourcing of funds – for funds used to spend on either tradables or non-tradables, the demand for tradables will change 1.5 times more than that of a change in supply of tradables due to the relative price change. It is necessary to state here again that this change in demand and supply of tradables will move the tradables sector into a new equilibrium and under the assumption of producing on the same PPF, equilibrium in one sector leads also equilibrium in another sector. Hence, equilibrium in the traded sector implies equilibrium in the non-tradable goods market as well.

[26] Detailed information about the determination of elasticities is discussed and provided in chapter 3.

Furthermore, impact of the 'gap' in the tradable sector on demand for imports is measured by dividing the compensated own – price elasticity of demand for imports to the difference between the price elasticity of supply of exports and compensated own – price elasticity of demand for imports. Similarly, the impact of a change in the 'size' of tradable sector on supply of exports is measured by dividing the price elasticity of supply of exports to the difference between the price elasticity of supply exports and compensated own – price elasticity demand for imports. In the analysis, compensated own price elasticity demand for imports $\left(\eta_M^d\right)$and the price supply elasticity of exports $\left(\varepsilon_X^s\right)$ are assumed to be 0.9 and -1.6, respectively.[27]

Apart from all these, various assumptions are considered due to a lack of data for the region other than elasticities. The proportion of the capital market extraction that is exclusive creating a less in VAT and excise taxes (businesses do not pay excise tax when they purchase inputs for investment purposes) is assumed to be 0.85 and the proportion of the changes in demand that are excluded from VAT and excise tax because it affects an investment during the process of exchange rate adjustment is assumed to be 0.50. There is a strong statement of the Harberger and Jenkins (2002) as:

> *"...with the realistic assumption that investment goods will represent a higher fraction of the spending that is displaced by sourcing in the capital market than they will of spending that is displaced or added via price- induced substitution effect."*

[27] ε_X^s = (Price Elasticity of Supply of Exportables *Supply of Exportables as a share of the Total Supply of Tradables) – (Compensated Own - Price Elasticity of Demand for Exportables*Demand for Exportables as a share of Total Demand For Tradables)

η_M^d = Compensated Own - Price Elasticity of Demand for Importables*Demand for Importables as a share of Total Demand For Tradables – (Price Elasticity of Supply of Importables *Supply of importables as a share of the Total Supply of Tradables)

5.3 Empirical Results for the WAEMU Region

Using all the coefficients and the assumpions made for the West African economy defined in part 5.1 and 5.2 and the effective rate of distortions already estimated in chapter 4, one can easily compute the distortion costs (benefits) for the estimation of EOCFX and SPNTO in the case of the West African Economic and Monetary Union. Table 3 provides all the necessary variables to compute the changes in welfare costs in the economy when project funds sourced in the domestic capital market and spent entirely on tradables (table 4), project funds sourced in the foreign capital market and spent entirely on tradables (table 5), project funds sourced in domestic capital market and spent entirely on non - tradables (table 6), project funds sourced in foreign capital market and spent entirely on non - tradables (table 7). Moreover, the welfare costs calculated in tables 4 and 5 are used to estimate the EOCFX whereas welfare costs measured in table 6 and 7 are used to estimate the SPNTO.

Table 5.1: Parameters Used in the Empirical Estimation of EOCFX and SPNTO

Fixed Coefficients	
Amount of Funds Raised:	1
Displaced Demand for Tradables by Borrowing Domestically:	-0.667
Displaced Demand for Non -Tradables by Borrowing Domestically:	-0.333
Displaced Demand for Tradables by Borrowing Abroad:	0
Displaced Demand for Non -Tradables by Borrowing Abroad:	0
Effective Rates of Distortions	
Effective VAT Rate on Tradables (vt):	12%
Effective VAT Rate on Non - Tradables (vnt):	5%
Effective Import Tariff Rate on Imports (tm):	16%
Effective Excise Tax Rate on Tradables - Importables-(te,t):	1 %
Effective Excise Tax Rate on Non - Tradables (te,nt)	0.0%
Effective Export Tax Rate (tx):	8.5%
Subsidy Rate on Tradable Production (Kt):	0%
Subsidy Rate on Non - Tradable Production (Knt):	0%
Investment Credits Due To	
Exclusion from VAT and Excise Tax for Investment Purpose: (During the Initial Process of Capital Market Extraction)	0.85
Exclusion from VAT and Excise Tax for Investment Purpose: (During the Exchange Rate Effect)	0.50
Demand and Supply Shares	
Demand for Importables as a share of Total Demand For Tradables:	0.8
Demand for Exportables as a share of Total Demand For Tradables:	0.2
Demand for Tradables as a share of Total Aggregate Demand:	0.7
Supply of Importables as a share of the Total Supply of Tradables:	0.4
Supply of Exportables as a share of the Total Supply of Tradables:	0.6
Supply of Tradables as a share of Total Aggregate Production:	0.7

cont'd

Supply and Demand Elasticities of Imports and Exportables	
Compensated Own - Price Elasticity of Demand for Importables:	-1.5
Compensated Own - Price Elasticity of Demand for Exportables:	-1.5
Price Elasticity of Supply of Importables:	1
Price Elasticity of Supply of Exportables:	1
Standard Capital Market Sourcing of Funds	
Proportion of Funds Sourced from Domestic Capital Market:	0.60
Proportion of Funds Sourced from Foreign Capital Market:	0.40

The following variables are part of table 3, but they are estimated by using the relevant parameters defined above. All the necessary formulae are provided in chapter 3.

Corresponding Elasticities	
Compensated Own – Price Elasticity of Demand for Tradables:	-1.5
Own Price Supply Elasticity of Tradables:	1
Compensated Cross Price Demand Elasticity of Non-Tradables:	5
Compensated Cross – Price Elasticity of Demand for Non – Tradables times the Demand for Non- Tradables as a share of Total Aggregate Demand:	1.5
Compensated Cross Price Supply Elasticity of Non – Tradables:	-3.3
Cross Price Supply Elasticity of Non – Tradables times the Supply of Non – Tradables as a share of Total Aggregate Production:	-1
Own Price Supply Elasticity of Exports:	0.9
Compensated Own Price Elasticity Demand for Imports:	-1.6
Gap in the Traded Sector Due To:	
Spending Domestically Borrowed Funds Entirely on Tradable:	0.333
Spending Domestically Borrowed Funds Entirely on Non – Tradables:	-0.667
Gap in the Foreign Exchange Market Due To	
Spending Foreign Sourced Funds on Tradables:	0
Spending Foreign Sourced Funds on Non - Tradables:	1

Table 5.2: Calculation of Welfare Costs When Project Funds Sourced in Domestic Capital Market & Spent on Tradables

Change Due To Capital Market Sourcing

(Exclusion for investment – eis: 0.85)

		Rate of Distortion	Distortion Cost
Tradable Demand	-0.667	vt = 0.12	(0.012)
		tm = 0.16	(0.085)
Import Demand	-0.533	te,t = 0.01	(0.001)
Export Supply	+0.133	tx = 0.085	0.011
Non – Tradable Demand	-0.333	vnt = 0.05	(0.003)
		te,nt = 0.00	0.000

Change Due To Real Exchange Rate Adjustment

(Exclusion for investment – eia: 0.50)

		Rate of Distortion	Distortion Cost
Tradable Demand	-0.200	vt = 0.12	(0.012)
Tradable Supply	+0.133	Kt = 0.00	0.000
		tm = 0.16	(0.034)
Import Demand	-0.213	te,t = 0.01	(0.001)
Export Supply	+0.120	tx = 0.045	0.010
Non – Tradable Demand	+0.200	vnt = 0.05	0.005
		te, nt = 0.00	0.00
Non – Tradable Supply	-0.133	Knt = 0.00	0.00

Total Distortion Costs – Benefits: **(0.122)**

Table 5.3: Calculation of Welfare Costs When Project Funds Sourced in Foreign Capital Market & Spent on Tradables

Change Due To Capital Market Sourcing

(Exclusion for investment – eis: 0.85)

		Rate of Distortion	Distortion Cost
Tradable Demand	0.00	vt = 0.12	0.00
		tm = 0.16	0.00
Import Demand	0.00	te,t = 0.01	0.00
Export Supply	0.00	tx = 0.085	0.00
Non – Tradable Demand	0.00	vnt = 0.05	0.00
		te,nt = 0.00	0.00

Change Due To Real Exchange Rate Adjustment

(Exclusion for investment – eia: 0.50)

		Rate of Distortion	Distortion Cost
Tradable Demand	0.00	vt = 0.12	0.00
Tradable Supply	0.00	Kt = 0.00	0.00
		tm = 0.16	0.00
Import Demand	0.00	te,t = 0.01	0.00
Export Supply	0.00	tx = 0.085	0.00
Non – Tradable Demand	0.00	vnt = 0.05	0.00
		te, nt = 0.00	0.00
Non – Tradable Supply	0.00	Knt = 0.00	0.00
Total Distortion Costs – Benefits:			**0.00**

Table 5.4: Calculation of Welfare Costs When Project Funds Sourced in Domestic Capital Market & Spent on Non - Tradables

Change Due To Capital Market Sourcing

(Exclusion for investment – eis: 0.85)

		Rate of Distortion	Distortion Cost
Tradable Demand	-0.667	vt = 0.12	(0.012)
		tm = 0.16	(0.085)
Import Demand	-0.533	te,t = 0.01	(0.001)
Export Supply	+0.133	tx = 0.085	0.011
Non – Tradable Demand	-0.333	vnt = 0.05	(0.003)
		te,nt = 0.00	0.000

Change Due To Real Exchange Rate Adjustment

(Exclusion for investment – eia: 0.50)

		Rate of Distortion	Distortion Cost
Tradable Demand	+0.400	vt = 0.12	0.024
Tradable Supply	-0.267	Kt = 0.00	0.000
		tm = 0.16	0.068
Import Demand	+0.427	te,t = 0.01	0.002
Export Supply	-0.420	tx = 0.085	(0.020)
Non – Tradable Demand	-0.400	vnt = 0.05	(0.010)
		te, nt = 0.00	0.000
Non – Tradable Supply	+0.267	Knt = 0.00	0.000
Total Distortion Costs – Benefits:			**(0.025)**

Table 5.5: Calculation of Welfare Costs When Project Funds Sourced in Foreign Capital Market & Spent on Non - Tradables

Change Due To Capital Market Sourcing

(Exclusion for investment – eis: 0.85)

		Rate of Distortion	Distortion Cost
Tradable Demand	0.00	vt = 0.12	0.000
		tm = 0.16	0.000
Import Demand	0.00	te,t = 0.01	0.000
Export Supply	0.00	tx = 0.085	0.000
Non – Tradable Demand	0.00	vnt = 0.05	0.000
		te,nt = 0.00	0.000

Change Due To Real Exchange Rate Adjustment

(Exclusion for investment – eia: 0.50)

		Rate of Distortion	Distortion Cost
Tradable Demand	+0.60	vt = 0.12	0.036
Tradable Supply	-0.40	Kt = 0.00	0.000
		tm = 0.16	0.102
Import Demand	+0.64	te,t = 0.01	0.004
Export Supply	-0.36	tx = 0.085	(0.031)
Non – Tradable Demand	-0.60	vnt = 0.05	(0.015)
		te, nt = 0.00	0.000
Non – Tradable Supply	+0.40	Knt = 0.00	0.000
Total Distortion Costs – Benefits:			**0.097**

5.4 Weighted Average Premiums with Standard Capital Market Sourcing[28]

By using the methodology developed for the estimation of EOCFX and the SPNTO in chapter 3 together with the variables summarized in table 3; tables 4 to 7 can be produced easily. Tables 4 and 5 are particularly used to estimate the FEP while tables 6 and 7 are used to estimate the NTP[29]. The only distortion not accounted for in the above table is the tax on supply of foreign exchange. Within the WAEMU region, there is no such tax, so there is no distortion cost. Eventually, empirical estimation for the WAEMU region reveals the EOCFX to be approximately 7.3 per cent whereas the corresponding SPNTO to be 2.4 per cent.

If fractions of funds are changed as 75 per cent and 25 per cent for domestic and foreign sourcing, respectively, then the EOCFX increases as to be approximately 9.1 per cent whereas the corresponding SPNTO decreases and is close to 0,5 per cent. Hence, the fraction of the foreign sourcing is significant in the estimation of both the EOCFX and the SPNTO.

Table 5.6: The EOCFX and the SPNTO for the WAEMU

	Domestic Capital Market	Foreign Capital Market	Both Markets
Foreign Exchange Premium (FEP)	0.122	0.000	**0.073**
Premium on Non - Tradable Outlays (NTP)	0.025	-0.097	**-0.024**

[28] For the related discussion on capital market sourcing, see the study conducted by Harberger and Jenkins (2002)
[29] See the both equations (68) and (100)

CHAPTER 6

CONCLUSION

This thesis provides an analytical framework and a practical approach to the measurement of the economic cost of foreign exchange and the shadow price of non-tradable outlays for any economy. In this thesis, impacts of both the capital market extraction required to finance the purchase of the project and as well as the substitution effects due to a change in the 'size' of tradables is taken into account in a general equilibrium setting.

Due to the existence of indirect taxes on both domestic and external transactions, the economic value of foreign exchange differs from the market exchange rate. This difference is known as 'foreign exchange premium' and is used to convert financial values into their real economic worth where a project uses foreign exchange to purchase or to sell. One should make sure that to get the economic worth of financial costs and benefits of a development or an investment project, foreign exchange premium applies to all tradable items of the project in question.

Furthermore, the non-tradable sector includes a set of distortions which necessitates adjusting the costs and benefits flows related to non-tradables when moving from financial to the economic flows of costs and benefits of a project and 'premium on non – tradable outlays' is used in this case to convert the financial values of non-traded items into their economic worth.

While estimating the EOCFX and the SPNTO, a three sector general equilibrium model is used. Firstly, the impact of a capital market extraction is analyzed. While analyzing the capital market action of raising the project funds, domestic versus foreign capital market sourcing is separated as their consequences are quite different while estimating the EOCFX as well as the SPNTO. Later on, depending on purchase of tradables or non-tradables by the project (which determines the change in the relative prices of tradables to non-tradables), the changes in the demand for tradables (including the external sector such as volume of imports and exports of a country) and non – tradables are estimated using the related elasticities. These two will change the equilibrium quantities in the economy and so therefore the welfare costs. Finally, using the effective rate of distortions in the economy, the change in the economic welfare cost is estimated for each case in order to estimate the EOCFX and the SPNTO.

The empirical results for the WAEMU region advocate that the additional cost of the use of foreign exchange within the WAEMU is approximately 7.4 per cent of the market value of tradable goods. Similarly, there is approximately a 2.5 per cent premium on the expenditures or receipts of non-tradable goods.

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