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The Euro-Mediterranean Free Trade Agreement An Inquiry into the Cost of Adjustment to Tariff Liberalization for the Egyptian Economy An Intertemporal General Equilibrium Analysis

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Introduction

Egypt' trade reform ,currently underway, represents conscious efforts to integrate the Egyptian economy, after decades of isolation and heavy reliance on tariff and non tariff barriers to promote import substitution, into world markets. These efforts which began in the mid 1980's and intensified in 1991 have resulted in the complete elimination of all non tariff barriers to trade (only ready made garments are still banned). A significant reduction in tariff dispersion and tariff rates also took place, though an average tariff rate of 27.4% in 1998, is still considered high by international standards. (Nathan Associates, 2000). Meanwhile, the ongoing efforts to negotiate a free trade agreement with Egypt's major trading partner ,the European union, represents one of main elements of this trade reform.

Some of the key aspects negotiated under the Euro-Med agreement include: abolishing all non-tariff barriers pertaining to exports of industrial products to EU (these products already enjoy duty free access to EU markets); gradual elimination over a period of 12 years of all tariffs on imported industrial products from the EU beginning with least affected products (raw materials and capital goods) over the first 4 years and progressively affecting all industrial products; and the harmonization of policies on competition, intellectual property rights and norms. Trade in agriculture and services has been excluded so far from the agreement, however liberalizing trade in agricultural products might be considered after the year 2000. (FEMISE, 1999)

Given ratios of exports to GDP and investment to GDP standing at 6.5% and 19.8% in 1999/2000 respectively, and given the current modest rate of growth of real GDP standing at 6.5% along with rates of unemployment as high as 7.5% in the same year, (Monthly Economic Digest, May 2001), the *expected* gains from the Euro-Med agreement either in terms of enhanced market access and export opportunities, increased investment flows and growth are in fact enormous. However, the validity of this contention can be questionable for two main reasons. For one thing, as has frequently been argued, there is the possibility that the welfare loses associated with trade diversion outweighs the welfare gains resulting from trade creation which renders preferential trade , in general, an inferior strategy to unilateral liberalization. (Hoekman, 1996). There is also the possibility , as has been recently emphasized else where (Elshennawy, 1998), that the transitional costs -if any- to trade liberalization outweighs the gains, at least over the shorts run.

Empirical studies of trade liberalization have demonstrated that the transitional costs to trade liberalization typically arise over the short run and are basically manifested in rising unemployment rates, balance of payment problems, declining industrial output, etc..On the other hand, the magnitude of these costs critically depends on initial conditions and the degree of consistency of other economic policies - macroeconomic policies in particular- with trade liberalization. In other words one would expect transitional costs to be higher the longer is the previous duration of protection so long as this contributes to chronic inefficiency in the industrial sector and reduces it competitiveness vis a vis imports. At the same time, a country that chooses

to maintain an overvalued exchange rate hampers the competitiveness of its exports industries. Broadly speaking, trade liberalization in a distorted environment undermines the ability of efficient import and export industries to quickly absorb resources from declining industries. This exacerbates problems of transitional unemployment and serves to increase pressure on the balance of payment, two of the main factors which jeopardizes the sustainability of trade liberalization attempts. (Michaely et al, 1991)

The adjustment process to trade liberalization, a process which is inherently dynamic in nature has not been adequately treated in the theoretical and empirical literature concerned with preferential trade liberalization. In particular, whether the transitional costs associated with preferential liberalization are *higher* or *lower* than those associated with unilateral liberalization remains a viable question without an answer. On first insight, since preferential trade can be - and is usually - considered as a gradual move towards freer trade, it could be the case that the transitional costs involved turn out to be smaller in magnitude compared to unilateral liberalization. This could in principle provide an important *nontraditional* reason for why countries should seek to engage in preferential trade liberalization as a preliminary stage that lays the ground for further unilateral liberalization.

Despite the importance of these issues, none has received much attention in any of the empirical studies which attempted to analyze the impact of the Euro- Med free trade agreement on the Egyptian economy. To date these studies lack any rigorous treatment of the Intertemporal effects of the agreement and none has managed to incorporate adjustment costs into the analysis. Ignoring the intertemporal effects is likely to underestimate the gains from freer trade while failing to account for adjustment costs can very well overestimate these gains, at least in the short run. Incorporating adjustment costs into the analysis highlights the importance of designing trade liberalization in a way that maximizes the gains from trade and minimizes any transitional cost. (Elshennawy, 1998)

In this setting, the primary concern of this research is to examine the likely impact of the Euro- Med agreement on trade and investment flows in addition to a number of macroeconomic variables including consumption, capital flows and unemployment, for the Egyptian economy with particular emphasis on the costs and benefits of adjustment within the framework of preferential *versus* unilateral trade liberalization. A thorough analysis of the impact of the agreement requires an investigation into both the sources of adjustment costs and the factors influencing their magnitude as they pertain to the Egyptian economy. Such an investigation is essential in order to provide policy makers with reliable estimates of adjustment costs which would in turn aid in the process of determining the optimal trade and adjustment policy mix necessary to minimize on these costs.

The remainder of this paper is organized as follows. Section two clarifys some conceptual issues related to adjustment to trade liberalization, section three describes a regional intertemporal general equilibrium model for Egypt, section four discusses the data and calibration, section five presents simulation results and finally, section six concludes.

Section two: Conceptual framework

Adjustment to Trade Liberalization, Adjustment costs, Efficiency and Sustainability

Before proceeding to discuss the methodology employed in this research, its necessary to elaborate on some conceptual issues. To begin with, it is important to define what is meant by adjustment in the context of this research. It is also imperative to understand why economies experience transitional costs i.e. why do problems of adjustment arise, what are the major repercussions of the these problems and how best they can be avoided or dealt with. (For a more detailed discussion see Elshennawy, 1998)[1].

Adjustment to trade liberalization can be defined from an economic point of view as the set of private and public decisions through which the reallocation of the economy's resources among its productive sectors - induced by increased competition from lower priced and higher quality imports - takes place. (ECC, 1988). Adjustment to trade liberalization - or to any other phenomenon - is necessary for the process of economic growth which involves the decline of certain activities and the expansion of more efficient ones to continue unhindered. *Adjustment occurs* as agents correctly anticipate changes in the relative profitablilty of various activities. Adjustment is thus essentially an "exercise in foresight". (Banks and Tumlir, 1986).

Most of the insights that can help explain why economies experience transitional costs during the course of adjustment to trade liberalization are drawn from a relatively underdevelped body of literature which consists mainly of qualitative case studies and is basically static in nature. The central argument underlying this body of literature revolves around the fact that the gains from trade , static and dynamic, occur in theory under a set of very restrictive assumptions ranging from perfect foresight to perfect product and factor markets. Given this set of assumptions, the argument so follows, market forces will always provide the most efficient adjustment mechanism through signals embedded in changing relative prices and job opportunities. Under such circumstances, the reallocation of resources will be frictionless and instantaneous as the economy adjusts - following a trade policy shock - to its new position. (Banks and Tumlir, 1986).

However, as we move to environments where markets are imperfect (labor, capital and product markets) uncertainty and risk increases and prices lose much of their informational content (Banks and Tumlir, 1986) creating distortions to the adjustment process. *An adjustment problem* occurs when distortions and presumably the lack of perfect foresight, create a divergence between the private and social perceptions of the costs and benefits of adjustment, preventing - in turn- the optimal allocation of resources. In this case, not only will the adjustment process be

[1]Τηισ σεχτιον ισ βασεδ εξτενσιωελψ ον χηαπτερ τηρεε ιν Ελσηενναωψ, Α. 1998. Τηε Τρανσιτιον αλ Χοστσ το Τραδε Λιβεραλιζατιον. Αν Ιντερτεμποραλ Γενεραλ Εθυιλιβριυμ Μοδελ φορ Εγψπτ. Υν πυβλισηεδ Πη.Δ Δισσερτατιον. Δεπαρτμεντ οφ Αππλιεδ Εχονομιχσ. Τηε Υνιωερσιτψ οφ Μιννεσοτ α. Υ.Σ.Α.

less than instantaneous, but instantaneous adjustment might not be the socially optimal policy. (Mussa, 1982).

Among the most common sources of labor market failures - that are especially relevent to the issue of adjustment to free trade - is the presence of externalities in the accumulation of human capital. This usually results in under- investment by both employer and employee in training and firm specific skills and therefore makes it intrinsincly difficult to reorient the skills of labor released from declining activities towards other uses. Other sources of market failure include congestion problems that lead to increasing costs of search by workers. (Trebilcock et al, 1990).

A number of restrictive practices can further inhibit the efficient working of the labor market. On the demand side these include wage rigidities (due to wage indexation or unionized labor) and social security regulations. Wages that are rigid downwards constrain expansion, while social security regulations constrain the ability of firms to alter the size of their labor force especially where adjustment requires downsizing of activities. Restrictive practices also include cumbersome administrative dismissal (and hiring) procedures that provide wide scope for government intervention. (Banks and Tumlir, 1986). Market failures also arise when pensions deter firms from hiring elderly workers. (Wonnacott and Hill, 1987). On the supply side, a number of studies have confirmed that unemployment insurance (especially for unskilled workers) and the subsidization of housing costs in certain regions can reduce the incentives for disallocated workers to seek reemployment in regions other than their home ones. (Banks and Tumlir, 1986).

Capital market imperfections do also impinge negatively on the adjustment process. Imperfections that arises due to excessive collateral requirements or credit rationing implies at the outset that some borrowers will be rationed out of the capital market. In particular, this will constrain the ability of already existing firms, to finance investment for expansion or restructuring. The credit constraint is even more likely to be binding for labor where funds are needed to cover the costs of retraining or reallocation. (Wonnacott and Hill, 1987).

Capital markets are not expected to function efficiently where a complex system of taxation prevails since normally, this renders the process of ranking alternative investment opportunities according to private and social profitability exceedingly difficult. In environments characterized by excessive inflationary pressures, a tax system where depreciation allowances are based on historical values of the capital stock reduces the after tax profitability of investment and tilts it in favor of short term projects. Investment demand can be also curtailed when regulations that restrict market entry in the financial sector, lead to collusive behavior on behalf of lending institutions and therefore contributes to high interest rates or when low administered interest rates reduce the volume of savings and thus available finance. The cumulative effect of these factors tends to reduce the sources of mobility in the capital stock, both the outflow (depreciation) and the inflow (new investment). (Banks and Tumlir, 1986).

When the mobility of factors of production is reduced, as a result of market failures, adjustment to changing economic circumstances -at least in the short run- can lead to excessive costs. (Wonnacott and Hill, 1987). As outlined earlier these costs are basically manifested in rising unemployment, balance of payment problems, declining industrial output, etc..
At this stage it is worthwhile to point out, that the list of factors that lead to adjustment costs along the transitional path to free trade is not confined to those analyzed above, but rather extends to a range of other factors from the institutional to macroeconomic and policy environment within which both consumers and firms are going to adjust to free trade. The emphasis here has been on factor mobility since this aspect is central to the methodology applied in this research.

In light of the preceding analysis, it becomes inevitably clear that a frictionless and instantaneous adjustment to free trade - as implicit in the theoretical literature on the gains from trade - is hard to visualize in practice, given empirical evidence. While the analysis has not in any sense questioned the very existence of gains to free trade - a premise so well founded on both theoretical and empirical grounds - it did serve to bring into light not a very old, but apparently a marginalized dimension to the process of trade liberalization. This dimension - that of the possibility of existence of adjustment costs - is highly relevant to policy making in the area of implementation. Efficient implementation of trade liberalization , goes beyond simply removing trade barriers to identifying the nature of adjustment costs, the sources of adjustment costs and hetherto, to identifying a *socially optimal* adjustment path.

The adjustment path to trade liberalization can be considered socially optimal only if it balances the social cost and benefit of adjustment for the economy. Only when the adjustment of sectors of the economy in response to trade liberalization is proceeding at a speed sufficient to bring about a more efficient reallocation of resources would the path be considered *efficient*. A more efficient reallocation occurs when any resources released from declining activities are absorbed by expanding activities in a fashion that maximizes transitional GDP. An efficient adjustment path is precisely one that maximizes the gains from trade, minimizes any transitional costs of adjustment and one where GDP does not *initially* decline. (Elshennawy, 1998)

While its desirable from a social point of view that the adjustment path to trade liberalization be efficient, it is certainly desirable also that this path be sustainable. A *sustainable* adjustment path is one where efficient export and import substituting industries are expanding at a rate sufficient to reduce any pressure on the balance of payment. That is a sustainable adjustment path would be associated with a reasonable path of debt to GDP ratio. (Elshennawy, 1998). The issue of sustainablility is in fact crucial since the gains from trade liberalization typically arise over the medium to long run, whereas, the loses are immediately felt. (Lawrence, 1997).

For many of the reasons cited above, it has commonly been the case in many economies and throughout numerous trade liberalization attempts that recourse to *adjustment policies* took place. In general, adjustment policies are called upon whenever the likelihood of market failures

,or any other distortion, lead to an inefficient or unsustainable adjustment path, one that is characterized by excessively high costs. Nevertheless, the primary objective of these policies is to minimize the magnitude of any costs by facilitating the adjustment process through modifying rather than replacing market forces and through inducing positive adjustment rather than retarding it. (Wonnacott and Hill, 1987).

Adjustment policies that fall into this category, encompasse subsidies to labor (wages, training or relocation etc..), to exports and to investment. Gradual phasing out of tariffs (temporary protection) has been also widely used a form of adjustment assistance. The main purpose of subsidies and temporary protection is to provide breathing space for firms to restructure, modernize etc.. in the process of adjusting to free trade. (Wonnacott and Hill, 1987: Trebilcock et al, 1990: Mussa, 1980). A third policy entails the implementation of a separate stage of export promotion prior to removing trade barriers in order to reduce pressure on the balance of payment. (Michaely et al, 1991). How successful where these policies, the literature is full with mixed evidence. However, one observation stands clear, if not carefully designed and if their costs are not weighed against their benefits these policies can fail to attain their objectives. (Elshennawy,1998)

In a recent study (Elshennawy,1998), an intertemporal dynamic general equilibrium model was used to assess the costs and benefits of implementing adjustment policies. Within the context of imperfect labor markets and gradual adjustment of the capital stock, this study confirmed the findings of earlier theoretical and empirical studies; economies *do* incur costs along the adjustment path to free trade. The analysis also confirmed that adjustment policies *do* involve costs as well as benefits. Beside their budgetary costs and distortive effects, ironically, some of these policies were found to impede adjustment and contribute to rising adjustment cost. Compared to all the policies investigated, the study ranked the policy of implementing a separate stage of export promotion prior to the removal of trade barriers as the most effective in increasing the efficiency and sustainability of the adjustment path to free trade.

Finally, an adjustment policy that has often been recommended but has not been extensively evaluated, involves removing tariffs conditional on the trading partner providing reciprocal concessions. This policy reduces adjustment costs - especially pressure on the balance of payment - by making possible increased specialization in exports through improving market access conditions. (Trebilcock et al, 1990). Analyzing this policy option is therefore pertinent to the current research because such arrangements can take place within the framework of preferential trade liberalization. The following section elaborates on the methodology that will be utilized to evaluate the costs and benefits of this policy option.

Section three: Methodology

The Model

The process of adjustment to trade liberalization will be studied in the context of this research using a multi sector regional intertemporal Computable General Equilibrium model (DCGE). These models have recently emerged as the leading tool implemented in studies of trade liberalization and have been used extensively within the framework of the neoclassical theory of growth to analyze the impact of trade policy on short run growth rates. The model is designed with the primary objective of analyzing the impact the Euro-Med trade agreement on growth, investment, capital flows and consumer welfare.

On line of the neoclassical theory of growth, growth along the transition occurs in the model as a result of factor accumulation. Assuming exogenous technical change and population growth to be zero, both the growth of variables and per capita variables will be zero in the steady state. The model is composed of two parts: a dynamic part - in which both households and firms decision to consume and invest is a result of dynamic optimization- and a within period static CGE model.

There are two institutions, a representative households and the rest of the world. The model differentiates between six sectors of economic activity; agriculture, oil, industry, construction, electricity and services. At the same time, the model also differentiates between three regions, Egypt; the EU and Rest of the World. For simplicity, the role of government is ignored and is only confined to tax collection which becomes part of household income. The representative household is an aggregate domestic non government institution covering both households and enterprises. Markets are perfectly competitive . What follows is a description of the dynamic components of the model. A detailed description of model equations will be provided in the appendix.

The consumer problem:

The representative consumer receives all labor, land and dividend income and owns the firm, however the decision to allocate income between consumption and savings is separate from the decision to borrow and invest as firms. The representative household chooses the path of consumption that maximizes the discrete intertemporal utility function :

0Yo= ΣYM ΣYB τ (1/1+ ρηο) ΣΥΠ τ λν(TX ΣYB τ)

Where ρ is positive rate of time preference,

TC(t) is aggregate instantaneous consumption which is a Cobb Douglas aggregation of S final goods CD, $0<a<1$ and $\Sigma_s a(s)=1$.

0TX(τ)=ΠΙ συβ σ ΧΔ(Σ.τ) ΣΥΠ {α(σ)}

The intertemporal budget constraint is

0ΣΥΜ ΣΥΒ {τ=0}P(τ)Πτχ (τ) ΤΧ (τ) ΠΡΕΧ ΕΘ ΣΥΜ ΣΥΒ {τ=0} P (τ) (ωλ ΣΥΒ π (τ) ΛΣ ΥΠ συβ π (τ) + ωλ συβ ΝΠ (τ) ΛΣΥΠ συβ ΝΠ (τ) + ωN(τ) N (τ) +ΤΗΓ (τ))+ ομεγα

That is the consumer maximizes utility subject to the constraint that the discounted sum of total consumption is less than or equal to the discounted sum of after tax income in addition to the household initial financial wealth ω. The household receives all income from Labor which is t $LSUP_P$ and $LSUP_{NP}$ are supply of production and non production labor , while wl_p and wl_{NP} represent wages for the two skill categories respectively. In addition, the household also receives income from land where wN is rent and N is the supply of land. THG is a lumpsum transfer of government revenue from net indirect taxes (indirect taxes less subsidies) and custom duties. R is the discount factor and r is the world interest rate

0P (τ)= ΠΙ συβ {τ=0} 1 οωερ {1+ ρ (τ)}

Savings SAV in period t is determined from the current period budget constraint as the difference between total income flows, consumption and interest rate on debt D.

0ΣΑς(τ) = ωλ συΒ π (τ) ΛΣΥΠ συΒ π (τ) + ωλ συΒ ΝΠ (τ) ΛΣΥΠ ΣΥΒ ΝΠ (τ) +ΣΥΜ Σ ΥΒ Σ Δ Ι ς (Σ) + ωN συβ τ N συβ τ +ΤΗΓ – ρ ΣΥΒ τ Δ ΣΥΒ {τ–1} – Πτχ ΣΥΒ τ ΤΧ ΣΥΒ τ

In each period total income flows consists of labor income, land income, the transfer of government revenue THG and income flows from financial wealth which in turn consists of income from dividends less interest payment on debt.

First order (Euler conditions) imply

0{ΤΧ (τ+1) } ΟςΕΡ {ΤΧ (τ)} (1+ρηο) = {Πτ χ (τ)} ΟςΕΡ {Πτχ (τ+1)} (1+ρ (τ))

The Firm Problem

In each sector firms are aggregated into one representative firm which finances all of its investment through retained earnings and thus the number of equities issued is constant. Managers seek to maximize the value of the firm. Assuming perfect capital markets, asset market equilibrium requires equal rates of returns (adjusted for risk) on all assets. This implies that firm's equity must earn an expected rate of return equal to that of a safe asset as reflected in the following condition

0ρ = {Δ Ι ς(Σ) } οωερ {ς (Σ)} + {ΔΕΛΤΑ ς (Σ)} οωερ {ς (Σ)}

where div is dividends, V is the value of the firm. In addition, the following terminal condition is imposed to rule out Ponzi schemes

0λιμ συβ {τ ινφ} P (τ)ς (Σ,τ) = 0

solving the above difference equation yields

0ς (Σ,1) = ΣΥΜ ΣΥΒ {τ=1} ΣΥΠ ΙΝΦ P(τ) Δ Ι ς(Σ,τ)

The market value of the firm is defined as the sum of discounted stream of future dividends. Dividends are defined as

0ΠςΑ (Σ,τ) ϕ ⌊ (Λ(Σ,τ), Κ (Σ,τ)⌋ – ωλ συβ Π (τ) ΛΣΥΠ συβ Π (τ)

where, f (.) is the production function, L is labor (aggregation of production and nonproduction labor), K is capital, PI(S) is the price of per unit quantity of investment, I is quantity of investment, ADC is the adjustment cost of investment PVA is value

–ωλ συβ ΝΠ (τ) ΛΣΥΠ συβ ΝΠ (τ) – ΑΔΧ (Σ,τ) – Π Ι (Σ,τ) Ι (Σ,τ)

0ΑΔΧ(Σ,τ) = πηι(Σ) ΠςΑ (Σ,τ) {{Ι (Σ,τ) }συ π 2 } οωερ {Κ (Σ,τ)}

added price and ϕ is a positive constant.

The model incorporates the impact of a number of distortions that are conceived to impede instantaneous and uncostly adjustment of the economy and its industrial sector to trade liberalization. Firms incur costs due to the installation of new capital. These costs arise because production is disrupted during installation, labor has to be retained , or because of managerial diseconomies that often take place as the firm expands etc., (Alvarez, 1993) all of which constrains the ability of firms -especially small scale enterprises- to adjust the capital stock in the short run. This mimics a distinctive characteristic of the adjustment process in real economies where the capital stock does not adjust instantaneously to its new level following a policy shock and is basically captured through introducing adjustment costs to investment (ADC).

Adjustment costs to investment (ADC) are assumed to be internal to the firm and separable. According to this specification adjustment costs are measured in terms of foregone output as resources are devoted to the capital installation process. For any given level of the capital stock these costs are strictly increasing in investment and decreasing in the capital stock for any given level of investment. As a result, firms will find optimal to increase the capital stock gradually over time in order to reach the optimal long run capital intensity. The larger the magnitude of the constant parameter ϕ, the larger will be the change in the adjustment costs in response to any change in its arguments. Finally, the adjustment cost function is assumed to be linearly homogeneous in both investment and capital. Along with the assumption of constant returns to scale in production, the linear homogeneity of the adjustment cost function allows us to equate marginal q with Tobin's q. (Hayashi, 1982).

In each specific sector producers maximize the value of the firm subject to the capital accumulation constraint

0K (Σ, (τ+1)) = (1−δελτα(Σ))K(Σ, τ) + I(Σ,τ) where δ is the rate of depreciation

The lagrangian for this problem is

L(s,t) = SUM sub {t=1} sup inf R(t) [PVA (S, t) f [(K(S,t), L(S,t)]-wl sub P(t) LSUP sub P - wl sub NP(t) LSUP sub NP(t)

(13)– πηι(Σ) ΠςA(Σ,τ) {{ I (Σ,τ)}συπ 2} ο ωερ {K (Σ, τ) }– Π I(Σ,T) I(Σ,T) + ΣΥΜ συβ {τ=1} συπ ινφ θ (Σ, τ) [(1–δελτα(Σ) K (Σ, τ) +I(Σ,τ)– K (Σ,(τ+1))]

Differentiating with respect to the control variable I yields

(14)θ(Σ,τ) = Π I (Σ,τ) + 2 ΠςA (Σ,τ) πηι(Σ){ I (Σ,τ)} οωερ {K (Σ,τ)}

which determines the shadow price of capital (Tobin q).

Differentiating with respect to the state variable K yields the no arbitrage condition

(15)ωκ (Σ,τ) + ΠςA (Σ,τ) πηι(Σ) { I (Σ,τ) συπ 2 } οωερ {K (Σ,τ) συπ 2} + (1–δελτα(Σ)) θ (Σ,τ) – (1+ρ) θ (Σ,τ–1)=0

which is the same as the asset equilibrium condition since V=q K and wk is the capital rental rate.

For simplicity, there is no differentiation between government and private investment in the model. I(t) is a composite good produced from all final goods - with fixed share θ - using a constant returns technology,

(16)

$$I(\Sigma,\tau) = AK(\Sigma).\Pi\, \sigma\upsilon\beta\, \{\sigma\vartheta\}IN\varsigma\Delta(\Sigma\vartheta,\Sigma)\, \sigma\upsilon\pi\, \{\tau\eta\varepsilon\tau\alpha(\Sigma\vartheta,\Sigma)\}$$

where INVD(S',S) is investment demand by sector of origin while AK(S) is shift parameter in the investment function. This implies that the unit cost of producing a new capital good is determined by the composite prices of the final goods. In equilibrium, producing a positive quantity of the investment good requires that the price of the investment good, PI(S,T), be equal to the unit cost where this price is different from the value of investment VI(S,t).

Current Account Dynamics

The pattern by which the dynamics of consumption -hence savings- and investment translate into a certain pattern of current account dynamics is anther important feature of the model. In an open economy, investment is not constrained by the availability of domestic savings and any discrepancy is financed through foreign borrowing and current account equilibrium is described by

(17)

$$\Delta(\tau) - \Delta(\tau-1) = \rho\, \Delta(\tau-1) + TB(\tau)$$

According to the above equation, the change in foreign debt between two consecutive periods is equal to the trade deficit TB(t) plus the interest payment on foreign debt.

Embedded in this dynamic structure is a standard within period general equilibrium model. (a detailed outline of model equations is presented in the Appendix to this paper). As is common to most static CGE models, the Armington assumption - according to which domestic and foreign goods are imperfect substitutes - is employed. As a result, the domestic price system becomes independent of world prices despite the small country assumption. This specification is useful since it allows for the analysis of two way trade.

Output is produced using intermediate inputs and primary factors of production which include labor, capital and land. To better capture the effect of different policy scenarios on the labor market, two skill categories of labor are differentiated, production and nonproduction labor. Both production labor and capital are sector specific in the short run while each of the two categories of labor and capital are sectorally mobile in the long run. In addition, distortions due to labor market imperfections will be incorporated through introducing wage rigidities. Any transitional unemployment resulting from import penetration can thus be readily estimated.

There are several advantages to the above approach. Unlike existing qualitative approaches to the adjustment problem, the one developed here can provide significant information on the *relative* magnitude of adjustment costs. Because they capture the intertemporal effects of trade liberalization, dynamic CGE models allow for a more realistic exposition of the adjustment process and in contrast to static CGE models - which ignore such intertemporal effects - are therefore less likely to overestimate the gains from trade or

underestimate adjustment costs. A dynamic general equilibrium approach is capable of capturing the repercussion of trade liberalization on key macroeconomic variables including consumption, savings, investment, growth, trade and capital flows tracing out the transition from a less to a more efficient economy. An intertemporal analysis will also yield valuable insights as to the properties of the adjustment path to trade liberalization pertaining to efficiency and sustainability.

Equilibrium

Intra temporal equilibrium requires that for each time period, (I) demand for each factor of production equal supply, (ii) demand for each sectoral good equal its supply. In addition to these within period equilibrium conditions, steady state equilibrium conditions must be satisfied

(18) $\delta\varepsilon\lambda\tau\alpha\ K(\Sigma\Sigma) = I(\Sigma\Sigma)$

(19) $\rho(\Sigma\Sigma) = \rho\eta o$

(20) $\rho(\Sigma\Sigma)\ \Delta EBT(\Sigma\Sigma) + TB(\Sigma\Sigma) = 0$

(21) $\rho(\Sigma\Sigma)\ \varsigma(\Sigma\Sigma)\ \sigma\upsilon\beta\ \sigma = \delta\ \iota\varpi(\Sigma\Sigma)\ \sigma\upsilon\beta\ \sigma$

Equation (18) states that investment in the steady state is equal to the depreciated capital and thus the stock of capital per labor is constant. Equation (19) is derived from the Euler condition evaluated in the steady state. Equation (20) implies that if debt is positive in the steady state then a country has to run a trade surplus to pay interest payment on debt i.e. negative trade deficit TB. Finally, equation (21) is the same as equation (1) evaluated in the steady state and states that the average rate of return on capital is constant and equal to the interest rate in the steady state.

Section Four: Data and Calibration

The model is calibrated using the 1991/92 Social Accounting Matrix for Egypt. Assuming that the initial data represents an economy evolving along a steady state path, parameters are calibrated so that the model generates a path that replicates the benchmark data. Any policy shock will give rise to a new path that reflects deviations from the benchmark steady state run.

Calibration of all parameters of the intra temporal part of the model follow the methods used in static CGE models. Following (Diao, X. and Agapi, S., 1997) the dynamic calibration proceeds as follows: Starting from the Euler equation for consumption, the assumption of steady state equilibrium implies that the rate of time preference ρ must be equal to the interest rate r, the value of which can be chosen from outside data . Total dividend payments are calculated as the difference between the value of capital flows and the value of total investment. The aggregate value of the firm can be derived from the asset market equilibrium condition evaluated in the steady state upon which the value to Tobin's q can be calculated using the condition that q = V/K.

By choosing the value of either the rate of depreciation or the coefficient in the capital adjustment cost function from outside data, the other can be calculated from the no arbitrage equation evaluated in the steady state. That is value of these parameters can be calculated using the following equation

delta(S) = {q(s)} over {2 PVA(s) } -{ [{r . q(s) - wk(s)} over {PVA(s) phi(s)} + {q(s)} over {2PVA(s)phi(s)}]} sup {1 over 2}

The capital accumulation equation in the steady state $I(S) = \delta (S) K(S)$ can be used to determine the quantity of total investment after which both the capital adjustment cost ADC(S) and the price of investment PI(S) can be calculated.

Section Five: Simulation Results

Trade liberalization often takes place within the framework of Preferential trade agreements for a variety of reasons. Traditionally, these agreements were used as a means to increase market size to promote import substitution, were mostly led by governments in economies where resource allocation is governed by political consideration rather than market forces and were mainly concerned with the removal of trade barriers for industrial goods. Past experience, however, proved that the success of these agreements has been very limited and increasingly associated with rising inefficiency. More recently, the objectives underlying preferential trade liberalization along with their scope has changed. These agreements are now concluded to promote export orientation, are largely led by the private sector in economies where the process of resource allocation is governed by the market and Liberalization is extended to all goods, services and investment. In addition, aspects related to deeper integration is usually on top of the issues negotiated. (Lawerence, 1997).

A potentially viable *nontraditional* reason why a country should pursue preferential trade liberalization rather than Unilateral Liberalization is related to the issue of adjustment costs. Empirical evidence reveals that Unilateral trade liberalization is often unsustainable if associated with high adjustment costs over the short run. One of the questions that arises then, is whether taking the preferential route instead might lead to lower adjustment costs, increases the chances of sustainability of trade liberalization and thus pave the route for further unilateral liberalization in the future.

This question is relevant not only because it has not been yet explored, but also in light of the growing trend towards regionalism that has been sweeping the world, challenging in its path a well established line of thought which has for long favoured unilateral over preferential trade liberalization and suggesting - in the mean time - that there might be after all some hidden virtue to these arrangements. The same question becomes also particulary relevant as Egypt is currently negotiating a free trade agreement with its major trading partner, the European Union.

As mentioned earlier, negotiations of the free trade agreement between Egypt and the European Union so far have excluded liberalization of trade in agricultural goods, an aspect that is

to be considered later in the future together with liberalization of trade in services. Several important questions becomes of interest with regards to the former matter. In general, what are the costs and benefits of excluding Liberalization of trade in agricultural goods?. When is the ideal time to introduce liberalization of trade in agricultural goods; immediately or sometime in the future?. These among others, are some of the questions that will be analyzed below in this section.

5.1 Unilateral Versus Preferential Trade Liberalization: The costs of adjustment

To settle on the issue of unilateral versus preferential trade liberalization, two simulation runs will be performed in the context of the intertemporal general equilibrium model developed in the last section. Simulation one (SIMU1) involves instantaneous unilateral trade liberalization. Simulation two (SIMU2) involves - except for agricultural goods - instantaneous removal of all tariffs on goods imported from the EU, while retaining those imposed on imports from the rest of the world. Both experiments are conducted under the assumption of rigid production wages for Electricity. [2] In general aside from (SIMU1), all simulation runs involve improved market access to industrial exports to EU markets through reduction in nontariff barriers to trade (which is modelled as a 1% increase in the price of industrial exports). Following Maskus and Konan, 1997, the assumption is that the EU will accept Egyptian inspection practices and recognize Egyptian standards of production. All simulation results are presented in table one (in the appendix to this paper) and all percentage changes are changes from the base run scenario.[3]

For both (SIMU1) and (SIMU2), aggregate investment as well as aggregate exports increase over the base run value throughout the transition to the new steady state. The results of the simulations indicate that aggregate investment is dramatically higher under (SIMU1) compared to (SIMU2) over the entire adjustment path. This is reasonable to expect since investment is a composite of imported and domestically produced goods. Trade liberalization renders imports cheaper and therefore stimulates investment more. That is, investment will be larger the wider is the scope of liberalization.

In the case of aggregate exports, except for period one, the adjustment path for (SIMU1) lies above that of (SIMU2). In period one, aggregate exports increased by 0.04% under the former scenario versus 0.3% under the latter. Export expansion is affected by trade liberalization through three channels. First, improved market access provides incentives for increasing exports. Second, cheaper intermediate inputs stimulates expansion in output given fixed capital stock. Third,

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[2] Ωηεν τηε μοδελ ωασ ρυν υνδερ τηε ασσυμπτιον οφ φλεξιβλε ωαγεσ φορ βοτη χατεγοριεσ οφ λαβ ορ, σιμυλατιον ρεσυλτσ σηοωεδ δεχρεασινγ ρεαλ ωαγεσ – οωερ τηε φιρστ φεω περιοδσ οφ τηε τρα νσιτιον – φορ προδυχτιον λαβορ ιν Ελεχτριχιτψ υνδερ τηε τωο σιμυλατιονσ.

[3] Απαρτ φρομ υνεμπλοψμεντ ωηιχη αρισεσ υνδερ τηε ασσυμπτιον οφ ριγιδ ωαγεσ, τηερε αρε νο σι γνιφιχαντ διφφερενχεσ βετωεεν τηε σιμυλατιον ρεσυλτσ χονδυχτεδ ιν τηισ παπερ υνδερ φλεξιβλ ε ωερσυσ ριγιδ ωαγεσ. Το χονσερωε ον σπαχε, ρεσυλτσ υνδερ τηε ριγιδ ωαγε ασσυμπτιον ωιλλ β ε αναλψζεδ ωηιλε τηοσε περταινινγ το τηε φλεξιβλε ωαγε χασε ωιλλ βε πρεσεντεδ ιν ταβλε τωο ιν τηε αππενδιξ.

cheaper inputs stimulates investment which translates into higher capital stock permitting the expansion in productive capacity and therefore exports. Thus once again, the volume of exports will be larger the wider is the scope of trade liberalization. The first effect dominates over the first period whereby significant trade creation takes place as exports to EU increases by 1.67% and those to the rest of the world decline by 0.52% under (SIMU2). However, the second and third effects dominate in the steady state.

Under (SIMU1), real GDP increases over the base run all along the adjustment path, increasing by 0.05% in period one. Contrary to prior expectations, real GDP declines by 0.24% in the first period under (SIMU2), but the path remains above that of the base run and lower than its counterpart under unilateral liberalization later. A major factor that can help explain this result is related to the behavior of sectoral output. Initially, the contraction of agriculture, oil, electricity and services is not compensated by enough expansion in industry and construction. One reason this occurs is the fact that expansion in any sector - given fixed capital stock - is affected by the prices of imported inputs which are relatively higher under preferential liberalization (SIMU2) since all goods imported from the rest of the world are still subject to tariffs.

Real income on the other hand, sharply declines below the base run value for both simulations, rising above that value roughly after period twenty. In period one, real income falls by 5.68% under (SIMU1) and falls by only 2.71% under (SIMU2). The adjustment path for (SIMU2) lies above that of (SIMU1) until period 22 and lies below that path afterwards. In the steady state real income increases by 3.76% under (SIMU1) in contrast to just 1.69% under (SIMU2).

The trade deficit surpasses the base run value during the first few periods (1-9) of the transition under both scenarios, which implies that the rate at which efficient import substituting and export industries is expanding is not sufficient to reduce pressure on the balance of payment. Such a trend is, however, reversed later. The adjustment path for (SIMU1) remains above that of (SIMU2) over the first ten periods, but this result is reversed over the rest of the transition. This stems from the fact that the scope of trade liberalization is wider under (SIMU1) which - as mentioned before - leads to a higher rate of investment and in turn partially contributes to a larger volume of imports. On the other hand, the path falls below that of (SIMU2) thereafter since the higher rate of investment under (SIMU1) and the build up of capital makes possible a faster expansion in import substituting and export industries.

With increasing trade deficits, Debt/GDP rises monotonically above the base run value under the two scenarios until the new steady state. (SIMU1) gives rise to an adjustment path associated throughout with a higher debt to GDP ratio relative to (SIMU2). In period two, Debt/GDP increases by 3.28% and 101.79% in the steady state under (SIMU1). The figures for (SIMU2) are 1.33% and 35.46% respectively. Transitional unemployment (as percent of labor supply) arises in only one sector (Electricity) for the two simulations, accounting for 3.7% under (SIMU1) and 2.22% under (SIMU2).

Consumer welfare measured by using equivalent variation method increases by 3.10% compared to the base run under (SIMU1) and increases by only 1.41% under (SIMU2). Clearly the welfare gains from trade liberalization are significantly larger under the former scenario. Nevertheless, the results of the simulations asserts that welfare improves as a result of preferential trade liberalization despite the trade diversion which takes place as imports of Oil and Industrial goods from the EU increases while those from the rest of the world declines relative to the base run. This result is contrary to what the static (CGE) models developed to analyze the impact of the Euro- Med agreement on the Egyptian economy predicted.

While the impact of liberalization on consumer welfare clearly tilts policy choices in favor of unilateral liberalization, the same conclusion cannot be firmly asserted once the efficiency and sustainability of the adjustment path to trade liberalization are both considered. In terms of efficiency, adjustment under (SIMU1) outperforms (SIMU2) since real GDP declines in the first period under the latter scenario. However, in terms of sustainability, adjustment under (SIMU2) outperforms (SIMU1) since the former scenario is associated with lower trade deficit over the first ten periods, a lower debt to GDP path over the entire transition and lower unemployment. Consequently, the subsequent analysis implies that the chances of survival of liberalization within a preferential trade agreement are much higher than under a more comprehensive program of liberalization.

5.2 The Euro-Med Agreement: The cost of excluding Trade Liberalization in Agriculture

To assess the cost of excluding trade liberalization of agricultural goods, (SIMU2) will be compared to four alternative scenarios of the agreement. Simulation three (SIMU3) and simulation four (SIMU4) entail removal of tariffs on all goods imported from the EU starting period one with the exception of agricultural goods where liberalization takes place in period 4. Simulation seven (SIMU7) and simulation eight (SIMU8) entail instantanous removal of tariffs on all goods imported from the EU. Under the five scenarios, tariffs on goods imported from the rest of the world remain in effect.

The difference between [(SIMU3),(SIMU8)] and [(SIMU4),(SIMU7)] lies in the assumptions regarding the conditions of improved market access to agricultural goods to the EU. Under the two conservative simulations [(SIMU3),(SIMU8)], improved market access is modelled as a 2% increase in the export price of agricultural goods where as this percentage rises to 8% under the less conservative simulations [(SIMU4),(SIMU7)]. This is to test the sensitivity of the simulation results to conditions of improved market access. The percentage increase in prices of agricultural exports is higher than the 1% assumed for industrial goods above since Egyptian agricultural exports to EU face higher nontariff barriers than those facing industrial products. (SIMU3), (SIMU4), (SIMU7) are conducted under the assumption of rigid production

wages for Electricity. (SIMU8) is conducted under the assumption of rigid production wages for Agriculture and Electricity. [4]

For the these four variants of the agreement , both aggregate investment and aggregate exports increase over the base run value everywhere along the adjustment path. Broadly speaking, the adjustment paths under these four scenarios almost coincide for the two variables, and all four lie above that of (SIMU2) throughout. Compared to (SIMU3,4,8) , aggregate investment records the highest percentage increase over the base run in period one and in the steady state under (SIMU7). Aggregate exports also record the highest percentage increase ,in period, one under (SIMU7), but the figures for (SIMU7) and (SIMU8) converge in the steady state.

In period one, real GDP falls by only 0.24% in period one under (SIMU2), (SIMU3) and (SIMU4) versus 0.25% for (SIMU7) and 0.29% for (SIMU8). In general, real GDP increases above the base run value for all simulations afterwards. The adjustment paths roughly overlapp over the early stages of the transition (periods 1-15) until later on when the path of (SIMU2) falls below all the rest. In the steady state, real GDP is highest for (SIMU7) increasing by 9.37%. Real income also falls below the base run value in period one for the five scenarios, decreasing by 2.71% under (SIMU2), 1.72% under (SIMU3) and 1.73% under (SIMU4). The figures for (SIMU7) and (SIMU8) are 2.83% and 2.87% respectively. While the adjustment paths for (SIMU2,3,4) nearly coincide, they nonetheless lie above those of (SIMU7, 8) which also nearly coincide. As a new steady state is approached, real income registers the highest percentage increase under (SIMU4) accounting for 1.75% followed by 1.73% under (SIMU3).

Under (SIMU3), the trade deficit increases the least, by 36% in period one, and the same observation holds for Debt/GDP which increases by 1.28% in period two. After period one, the trade deficit steadily declines under all simulations falling below the base run value starting period 10, but the Debt/GDP continues to increase above that value until the new steady state is reached. In the steady state, the trade deficit is lowest under (SIMU8) falling by 125.69% and Debt/GDP is lowest under (SIMU2) increasing by only 35.46%. During the first few periods of the transition, the adjustment paths for (SIMU3) and (SIMU4) - which roughly converge -lie below that of the other simulations for the trade deficit and Debt/GDP. However, the situation is quite different later on as the adjustment path for (SIMU7) and (SIMU8) - which also roughly converge - fall below the rest in the case of the trade deficit after period 3 ,while that for (SIMU2) falls below the rest for Debt/GDP after period 6. In period one, unemployment in Electricity increases the least, by only 2.22% in period one under (SIMU2) while unemployment in Agriculture arises only under (SIMU8) increasing by 1.66% over the base run.

[4] Ωηεν τηε μοδελ ωασ ρυν υνδερ τηε ασσυμπτιον οφ φλεξιβλε ωαγεσ φορ βοτη χατεγοριεσ οφ λαβο ρ, σιμυλατιον ρεσυλτσ σηοωεδ δεχρεασινγ ρεαλ ωαγεσ – οπερ τηε φιρστ φεω περιοδσ οφ τηε τραν σιτιον – φορ προδυχτιον λαβορ ιν Ελεχτριχιτψ υνδερ τηε φουρ σιμυλατιονσ ιν αδδιτιον το ρεαλ ω αγεσ φορ προδυχτιον λαβορ ιν αγριχυλτυρε.

The above simulation results reveal that adjustment costs along the early stages of the transition (Periods 1-15) are lowest under are (SIMU3) which introduces trade liberalization in agricultural goods in period 4 relative to (SIMU2), (SIMU4), (SIMU7) and (SIMU8) on account of lower trade deficit - up to period 3 - and lower Debt/GDP - up to period 6 - . On account of real GDP (SIMU3) and (SIMU2) coincide, both outperforming (SIMU4), (SIMU7) and (SIMU8). However, on account of unemployment, (SIMU2) outperforms them all.

Thus there *are* costs to excluding agriculture from the agreement. This becomes even a more valid argument, if one does not consider unemployment in Electricity as a vital issue in favouring one simulation over the other. Moreover, excluding liberalization of agriculture from the agreement reduces consumer welfare. Equivalent variation reaches highest percentage increase under (SIMU4) standing at 1.49% followed by a 1.47% increase for (SIMU3) in contrast to just 1.41% under (SIMU2). There is only one benefit , however, to excluding agriculture from the agreement, the ratio of Debt/GDP is lower for (SIMU2) than for the rest of the simulations approximately starting period 7, but the difference becomes pronounced after the first phase of the transition. Never the less, since adjustment costs are typically of concern over the first phase of the transition to trade liberalization, the so mentioned benefit is not quite important.

The simulation results also reveal that (SIMU7) and (SIMU8) where liberalization of agriculture takes place in period one are associated with the highest percentage increase in adjustment costs in contrast to (SIMU2), (SIMU3) and (SIMU4). Lowest real GDP in period one, largest trade deficit up to period three, highest Debt/GDP through out and highest rates of unemployment. At the same time, these two simulations are also associated with the lowest percentage increase in equivalent variation standing at 1.44% for (SIMU7) and 1.42% for (SIMU8) - which is not significantly larger than the 1.41% increase under (SIMU2) - . All together, this indicates that the suitable timing for introducing trade liberalization in agricultural goods is not immediately but rather sometime in the future, that is the results favor the gradual implementation of the agreement.

As to the sensitivity of simulation results to the percentage increase in the export price of agricultural goods, in the case of (SIMU3), in period one, both the trade deficit and Debt/GDP are lower compared to (SIMU4) while the two simulation coincide for real GDP. The rate of unemployment in Electricity is higher for (SIMU3). In other words, when liberalization of trade in agricultural goods takes place in period 4, adjustment costs (trade deficit and Debt/GDP) over the first phase of the transition are higher the larger is the percentage increase in the export price of agricultural goods to the EU.

Striking as it may seem, this can be explained by the fact that firms will start expanding their productive capacity by accumlating capital to take advantage of the new export opportunities materializing as conditions of market access improve in period 4. Investment which is a composite of both domestic and imported goods will therefore start to increase early on putting pressure on the balance of payment. At the same time exports of agricultural goods will not start to respond except in period 4. For these reasons, pressure on the balance of payment

will be more intense the larger is the percentage increase in export price since this leads to a higher rate of investment in period one. As is evident from the data, in period one aggregate investment increases by 4.87% under (SIMU3) and increases by 4.91% under (SIMU4).

In contrast, the trade deficit - up to period 5- and Debt/GDP are lower under (SIMU7) versus (SIMU8). Real GDP falls be less under (SIMU7) than under (SIMU8). Unemployment in Electricity is also lower under (SIMU7). Unemployment in Agriculture is zero for (SIMU7) and accounts for 1.66% under (SIMU8). That is, when liberalization of trade in agricultural goods takes place in period one, adjustment costs are higher, the smaller is the percentage increase in the export price of agricultural goods to the EU which is exactly opposite to the previous results. Here, unlike the situation above, as investment starts to increase in period one to take advantage of enhanced export opportunities, exports of agricultural goods will also start responding which reduces the pressure on the balance of payment. Nonetheless, with respect to consumer welfare, the percent increase in equivalent variation is consistently higher the larger is the percent increase in the export price of agricultural goods to the EU.

Similar to the case under (SIMU2), these four different scenarios of the agreement give rise to transitional paths that are less efficient - since real GDP falls below the base run value in period one - but more sustainable - since adjustment costs (trade deficit -up to period 10- , Debt/GDP, unemployment in Electicity) are much lower - relative to (SIMU1). Consequently, despite a positive rate of unemployment in agriculture under (SIMU8) versus zero under (SIMU1) and the higher percentage increase in equivalent variation under unilateral liberalization, one cannot postulate that this latter strategy is *absolutely* superior to preferential trade liberalization.

5.3 A New Approach to Trade Liberalization; Preferential Trade Liberalization Followed by Unilateral Trade Liberalization.

To test the merits of this approach, unilateral trade liberalization is introduced in period 10 following the implementation of the agreement for both of the cases where liberalization of agricultural goods takes place in period 4 [(SIMU5) and (SIMU6)] and in period 1 [(SIMU9), (SIMU10)]. Once more, the difference between [(SIMU5), (SIMU9)] and [(SIMU6), (SIMU7)] lies in the assumption of improved market access to agricultural goods to the EU. Under the two conservative simulations [(SIMU5),(SIMU9)] improved market access is modelled as a 2% increase in the export price of agricultural goods while this percentage rises to 8% under the less conservative simulations [(SIMU6),(SIMU10)]. The four simulations are conducted under the assumption of rigid production wages in Electricity. In addition, (SIMU9) and (SIMU10) are conducted under the assumption of rigid production wages in agriculture.[5]

[5]Ωηεν τηε μοδελ ωασ ρυν υνδερ τηε ασσυμπτιον οφ φλεξιβλε ωαγεσ φορ βοτη χατεγοριεσ οφ λαβο ρ, σιμυλατιον ρεσυλτσ σηοωεδ δεχρεασινγ ρεαλ ωαγεσ – οπερ τηε φιρστ φεω περιοδσ οφ τηε τραν σιτιον – φορ προδυχτιον λαβορ ιν Ελεχτριχιτψ υνδερ τηε φουρ σιμυλατιονσ ιν αδδιτιον το ρεαλ ω αγεσ φορ προδυχτιον λαβορ ιν αγριχυλτυρε υνδερ (ΣΙΜΥ9) ανδ (ΣΙΜΥ10).

Both aggregate investment and aggregate exports increase over the base run value along the entire adjustment path. Among (SIMU5,6,9, 10), (SIMU10) registers the highest levels of aggregate investment and aggregate exports in period one as well as the new steady state, followed consecutively by (SIMU9, 6,5). Generally speaking, the adjustment paths for these two variables under the four simulations approximately converge, lying above those of the remaining simulations of the agreement.

In period one, real GDP falls by only 0.26% for (SIMU5) and (SIMU6), versus 0.32% for (SIMU9) and 0.3% for (SIMU10), which apart from (SIMU8) does not compare favourably to the results for real GDP under all the rest of the other versions of the agreement. Real GDP increases over the base run for the four simulations thereafter. In the steady state real GDP increases by 26.82% for (SIMU9) and (SIMU10), increases by 26.76% for (SIMU5) and 26.77% for (SIMU6). These figures are the highest among all the other simulations examined in the previous section. The adjustment paths for the fours simulations approximately converge and following the first few periods, these paths do lie above all others corresponding to the agreement. Real income decreases by 2.92% in period one under (SIMU5), by 2.93% under (SIMU6), decreases even more, by 3.08% under (SIMU9) and further by 3.06% under (SIMU10). The adjustment paths for the four simulations overlapp, falling below those of (SIMU2,3,4,7,8) early on and then lying above them after period 25. In the steady state real income increases the most, by 4.71% under (SIMU6) followed by 4.69% under (SIMU5).

The trade deficit initially increases over the base run value under the four simulations, but start decreasing below this value immediately after the first phase of the transition. On the other hand, Debt/GDP increases above the base run value all along the transition for the four simulations. Both the trade deficit - in period one- and Debt/GDP ratio - in period two- are lowest in the case of (SIMU5) and (SIMU6) in contrast to all other scenarios of the agreement. The trade deficit increases by 33.45% for (SIMU5) and by 33.7% for (SIMU6) while Debt/GDP ratio increases by 1.19% for (SIMU5) and 1.20% for (SIMU6).

In the steady state, the trade deficit is lowest under (SIMU9) falling by 357.57% and by 357.10% for (SIMU10), followed by 355.46% for (SIMU5) and 355.29% for (SIMU6). Debt/GDP records the highest percentage increase for these four simulations increasing by 95.33% for (SIMU9), 95.20% for (SIMU10), 94.79% for (SIMU5) and 94.74% for (SIMU6). The adjustment paths for the trade deficit and Debt/GDP for the four simulations do not diverge much from all the rest over the early phase of the transition, but starting period 10 - when unilateral liberalization is introduced- the paths do lie above the rest, only to fall beneath them starting period 20, for the trade deficit.

Rates of unemployment in Electricty increases by 2.98% for (SIMU5), 2.96% for (SIMU6), 3.07% for (SIMU9) and 3.03% for (SIMU10). Unemployment in Agriculture increases by 1.98% for (SIMU9) and 1.85% for (SIMU10). The results for unemployment are generally higher than those reported for all simulations involving the implementation of agreement. Meanwhile, consumer welfare improves by 4.05% under (SIMU5) and by 4.07%

under (SIMU6) - ranking highest among all other simulations - followed by 4.01% for (SIMU10) and 3.98% for (SIMU9).

The preceding analysis shows that over the first stage of the transition, adjustment costs (trade deficit - up to period 3 - , Debt/GDP - up to period 10) are lowest under (SIMU5), the scenario which entails the gradual implementation of the agreement followed by the introduction of unilateral liberalization in period 10. This result holds given that the data for real GDP is not significantly lower under this scenario than under the other scenarios of the agreement and if - as mentioned before- unemployment in Electricity is not considered as a vital issue for favouring one scenario over the other. This conclusion becomes even more plausable in light of the fact that consumer welfare improves by more under (SIMU5) and (SIMU6) than under all other simulations.

The only advantages of the scenarios confined only to the agreement over those were unilateral liberalization is introduced in period 10 are related to the lower trade deficit taking place between period 10 and 19 and the lower Debt/GDP after period 10. As argued before, these changes are of little importance in relation to the question of adjustment costs since the lower Debt/GDP becomes pronounced after the first phase of the transition. With regards to the sensitivity of simulation results to conditions of market access, the conclusion is the same as before. It remains, however, to compare these four scenarios to (SIMU1).

Apart from real GDP which falls in period one under (SIMU5,6,9,10) while increases under (SIMU1), adjustment costs (trade deficit, Debt/GDP) are generally lower for all simulations where preferential trade liberalization is followed by unilateral trade liberalization relative to (SIMU1). This is true for period one and - except for the path for the trade deficit which lies above that of (SIMU1) after period 10 - is also true along the transition and in the steady state. Unemployment in Electricity is lower among all these simulation than under (SIMU1), but unemployment in Agricutlure which is zero under (SIMU1) is positive under both (SIMU9) and (SIMU10). Consumer welfare improves by more under (SIMU5,6,9,10) than under (SIMU1).

This is perhaps the most interesting of all results. Preferential trade liberalization is *not* an inferior strategy compared to instantaneous unilateral liberalization provided the former is followed by Unilateral trade liberalization. Because of the forward looking behavoir of the dynamic CGE model implemented here, introducing unilateral trade liberalization sometime in the future following preferential trade liberalization means that consumers and firms will anticipate these changes and are going to start adjusting to them earlier even before unilateral liberalization is implemented. Under these circumstances, the adjustment path is such that adjustment costs - especially over the early phase of the transitions - are generally lower and consumer welfare improves by more under this strategy relative to instantaneous unilateral trade liberalization or a strategy that is confined to the agreement only.

A brief note with regards to adjustment policies needs to be discussed before concluding. As is clear from the simulation results, an economy experiences growth - as capital accumulates - along the adjustment path within the context of preferential trade liberalization. It takes time, nevertheless, for these gains to materialize while the economy starts to experience transitional costs immediately. Despite, the lower adjustment costs under preferential versus unilateral liberalization, these costs are still sizable relative to the base run and thus continue to pose problems related to the efficiency and sustainability of the transitional path.

On a first best basis, ofcourse the ideal way to proceed is to eliminate the distortions that are responsible for rising adjustment costs. In other words, remove the sources of imperfections in labor and capital markets. Because first best policies sometimes can only be implemented with a lag, adjustment policies can be used to reduce the extent of these problems. One policy that has proven very successful in this respect, is implementing a separate stage of export promotion prior to the removal of trade barriers.

Section Six: Concluding Remarks

In this research, a regional intertemporal general equilibrium model was utilized to study the nature of the adjustment path to trade liberalization within the framework of the free trade agreement - currently being negotiated - between Egypt and the European Union. Besides dynamic optimization on behalf of consumers and firms, some of the intrinsic features of the model include imperfect labor markets and gradual adjustment of the capital stock.

Simulation results reveal that the Egyptian economy experiences gains as well as costs along the adjustment path to freer trade. As tariffs on goods imported from the EU are removed, and market access condition to EU markets improve, investment and exports increase while growth slowly picks up. Consumer welfare increases despite the significant trade diversion taking place as imports from the rest of the world fall relative to the EU. Initially, however, output falls, unemployment rises and the trade deficits sores over the early phase of the transition. In terms of higher growth and welfare, the Egyptian economy stands to gain more under unilateral trade liberalization versus preferential trade liberalization, but only at the expense of higher adjustment costs. Consequently, trade liberalization is likely to be more sustainable under the latter scenario, especially if some form of adjustment assistance can be provided for producers.

Excluding liberalization of trade in agricultural goods from the agreement, as has been so far the case, reduces the gains from trade and increases the costs of adjustment to preferential trade liberalization. Moreover, the gains from trade were found to be larger and adjustment costs lower when trade liberalization in agricultural goods takes place instantaneously along with the liberalization of all other sectors compared to a scenario where liberalization of this sector takes place sometime in the future.

Finally, one new approach to trade liberalization examined in this research, involves preferential trade liberalization followed - after a considerable period of time - by unilateral trade

liberalization. On account of higher consumer welfare and lower adjustment costs, preferential trade liberalization *was not* found to be inferior to a strategy confined exclusively to unilateral liberalization. The strength of this approach stems from the fact that it is possible to minimize the cost of adjustment to *both* preferential and unilateral trade liberalization altogether. Exploiting all potential benefits from the agreement at the least possible costs therefore requires Egypt to be keen and committed to widen the scope of liberalization further in the future and to announce these intentions immediately given that the agreement has been signed.

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Appendix

Table One: Simulation Results under the assumption of rigid wages (percent change from base run)

	SIMU 1	SIMU 2	SIMU 3	SIMU 4	SIMU 5	SIMU 6	SIMU 7	SIMU 8	SIMU 9	SIMU 10
	Period1	Period1	Period1	Period1	Period1	Period1	Period1	Period 1	Period 1	Period 1
Trade Deficit	91.63	37.44	36.00	36.26	33.45	33.70	39.66	39.96	37.45	37.22
Debt	377.98	154.43	148.50	149.56	138.01	139.02	163.60	164.86	154.48	153.54
Debt/GDP	3.28	1.33	1.28	1.29	1.19	1.20	1.41	1.42	1.34	1.33
TINVEST	12.05	4.96	4.87	4.91	5.17	5.20	5.04	4.97	5.26	5.30
EEXP	0.04	0.30	0.34	0.33	0.42	0.41	0.45	0.39	0.46	0.53
RCONS	-1.31	-0.95	-1.03	-1.02	-1.35	-1.34	-0.96	-0.99	-1.31	-1.30
GDP	-2.69	-1.60	-1.70	-1.69	-1.89	-1.88	-1.81	-1.87	-2.06	-2.02
RGDP	0.05	-0.24	-0.24	-0.24	-0.26	-0.26	-0.25	-0.29	-0.32	-0.30
RINC	-5.68	-2.71	-2.72	-2.73	-2.92	-2.93	-2.83	-2.87	-3.08	-3.06
TEXP to EU	0.04	1.67	1.72	1.71	1.80	1.79	2.42	1.90	1.98	2.50
TEXP to ROW	0.04	-0.52	-0.48	-0.49	-0.40	-0.41	-0.73	-0.52	-0.44	-0.65
Unemp.AGR								1.66	1.98	1.85
Unemp.ELE	3.70	2.22	2.40	2.38	2.98	2.96	2.45	2.49	3.07	3.03
	S.S	S.S	S.S	S.S	S.S	S.S	S.S	S.S	S.S	S.S
Trade Deficit	-382.73	-118.41	-124.12	-124.14	-355.46	-355.29	-125.44	-125.69	-357.57	-357.10
Debt	14096.70	4361.16	4571.53	4572.40	13092.29	13086.19	4620.25	4629.28	13169.92	13152.85
Debt/GDP	101.79	35.46	37.11	37.11	94.79	94.74	37.49	37.58	95.33	95.20
TINVEST	26.57	7.95	8.31	8.32	26.00	26.00	8.34	8.32	26.05	26.05
EEXP	66.12	21.38	22.69	22.71	63.39	63.38	22.83	22.83	63.61	63.57
RCONS	3.76	1.69	1.73	1.75	4.69	4.71	1.71	1.68	4.63	4.66
GDP	17.81	4.63	4.80	4.83	17.50	17.51	4.83	4.81	17.53	17.54
RGDP	27.35	8.91	9.33	9.35	26.76	26.77	9.37	9.36	26.82	26.82
RINC	3.76	1.69	1.73	1.75	4.69	4.71	1.71	1.68	4.63	4.66
TEXP to EU	66.12	22.87	24.33	24.83	65.21	65.70	24.95	24.47	65.43	65.90
TEXP to ROW	66.12	20.49	21.71	21.44	62.30	61.99	21.56	21.85	62.52	62.19
E.V.	3.10	1.41	1.47	1.49	4.05	4.07	1.44	1.42	3.98	4.01

All the following experiments are conducted under the assumption of rigid production wages for electricity since this is the only sector which experiences falling real wages after trade liberalization with flexible production wages.

SIMU1:Unilateral trade liberalization

SIMU2:Preferential trade liberalization excluding agriculture and with improved market access to Industrial exports to the EU market (modelled as a 1% increase in the world price of industrial exports).

SIMU3:Preferential trade liberalization including agriculture and with improved market access to agricultural exports to the EU market (modelled as a 2% increase in the world price of agricultural exports), in addition to improved market access to Industrial exports to the EU market (modelled as a 1% increase in the world price of industrial exports). Liberalization of agriculture takes place in period 4.

SIMU4:Preferential trade liberailzation including agriculture and with improved market access to agricultural exports to the EU market (modelled as a 8% increase in the world price of agricultural exports), in addition to improved market access to Industrial exports to the

EU market (modelled as a 1% increase in the world price of industrial exports). Liberalization of agriculture takes place in period 4.

SIMU5:Preferential trade liberalization including agriculture and with improved market access to agricultural exports to the EU market (modelled as a 2% increase in the world price of agricultural exports), in addition to improved market access to Industrial exports to the EU market (modelled as a 1% increase in the world price of industrial exports). Liberalization of agriculture takes place in period 4. Unilateral Liberalization takes place in
period 10, where tariffs on imports from the rest of the world are set equal to zero.

SIMU6:Preferential trade liberailzation including agriculture and with improved market access to agricultural exports to the EU market (modelled as a 8% increase in the world price of agricultural exports), in addition to improved market access to Industrial exports to the EU market (modelled as a 1% increase in the world price of industrial exports). Liberalization of agriculture takes place in period 4. Unilateral Liberalization takes place in
period 10, where tariffs on imports from the rest of the world are set equal to zero.

SIMU7:Preferential trade liberalization including agriculture and with improved market access to agricultural exports to the EU market (modelled as a 8% increase in the world price of agricultural exports), in addition to improved market access to Industrial exports to the EU market (modelled as a 1% increase in the world price of industrial exports). Liberalization of agriculture takes place in period 1.

All the following experiments are conducted under the assumption of rigid production wages for electricity and agriculture since these are the only sector which experience falling real wages after trade liberalization with flexible production wages.

SIMU8:Preferential trade liberalization including agriculture and with improved market access to agricultural exports to the EU market (modelled as a 2% increase in the world price of agricultural exports), in addition to improved market access to Industrial exports to the EU market (modelled as a 1% increase in the world price of industrial exports). Liberalization of agriculture takes place in period 1.

SIMU9:Preferential trade liberalization including agriculture and with improved market access to agricultural exports to the EU market (modelled as a 2% increase in the world price of agricultural exports), in addition to improved market access to Industrial exports to the EU market (modelled as a 1% increase in the world price of industrial exports). Liberalization of agriculture takes place in period 1. Unilateral Liberalization takes place in period 10, where tariffs on imports from the rest of the world are set equal to zero.

SIMU10:Preferential trade liberalization including agriculture and with improved market access to agricultural exports to the EU market (modelled as a 2% increase in the world price of agricultural exports), in addition to improved market access to Industrial exports to the EU market (modelled as a 1% increase in the world price of industrial exports). Liberalization of agriculture takes place in period 1. Unilateral Liberalization takes place in period 10, where tariffs on imports from the rest of the world are set equal to zero.

Abbreviations

TINVEST :Total Investment
EEXP :Total Exports
RCONS :Real Consumption
RGDP :Real GDP
RINC :Real Income
TEXP to EU :Total Exports to EU market
TEXP to ROW:Total Exports to the Rest of the World
E.V. :Equivalent Variation

For table two below, the description of the simulations is exactly as above except that SIMU1.1 through SIMU10.1 are all conducted under the assumption of flexible wages for production and nonproduction labor.

Table Two: Simulation results under the assumption of flexible wages (percent change from base run).

	SIMU1.1	SIMU2.1	SIMU3.1	SIMU4.1	SIMU5.1	SIMU6.1	SIMU7.1	SIMU8.1	SIMU9.1	SIMU10.1
	Period 1	Period 1	Period 1	Period 1	Period 1	Period 1	Period 1	Period 1	Period 1	
Trade Deficit	91.64	37.44	36.01	36.26	33.46	33.71	39.67	39.87	37.34	37.12
Debt	378.02	154.45	148.53	149.59	138.04	139.06	163.63	164.48	154.04	153.11
Debt/GDP	3.28	1.33	1.28	1.29	1.19	1.20	1.41	1.42	1.33	1.32
TINVEST	12.05	4.96	4.87	4.90	5.16	5.20	5.04	5.00	5.29	5.33
EEXP	0.04	0.30	0.34	0.34	0.42	0.41	0.45	0.39	0.46	0.53
RCONS	-1.30	-0.95	-1.02	-1.02	-1.34	-1.33	-0.95	-0.96	-1.27	-1.27
GDP	-2.70	-1.60	-1.71	-1.69	-1.90	-1.88	-1.81	-1.86	-2.04	-2.00
RGDP	0.06	-0.23	-0.24	-0.24	-0.26	-0.26	-0.24	-0.26	-0.27	-0.26
RINC	-5.67	-2.71	-2.72	-2.72	-2.92	-2.92	-2.82	-2.84	-3.04	-3.03
TEXP to EU	0.04	1.67	1.72	1.71	1.80	1.79	2.42	1.90	1.98	2.51
TEXP to ROW	0.04	-0.52	-0.48	-0.48	-0.40	-0.41	-0.73	-0.52	-0.44	-0.65
	S.S	S.S	S.S	S.S	S.S	S.S	S.S	S.S	S.S	S.S
Trade Deficit	-382.74	-118.41	-124.12	-124.15	-355.47	-355.30	-125.45	-125.64	-357.49	-357.03
Debt	14097.05	4361.30	4571.69	4572.56	13092.57	13086.47	4620.42	4627.56	13167.13	13150.23
Debt/GDP	101.79	35.46	37.11	37.11	94.80	94.74	37.50	37.56	95.31	95.18
TINVEST	26.57	7.95	8.31	8.32	26.00	26.00	8.34	8.32	26.05	26.04
EEXP	66.12	21.38	22.69	22.71	63.39	63.38	22.83	22.83	63.60	63.57
RCONS	3.75	1.69	1.73	1.75	4.69	4.71	1.71	1.68	4.63	4.66
GDP	17.81	4.63	4.80	4.83	17.50	17.51	4.83	4.81	17.53	17.54
RGDP	27.35	8.91	9.33	9.35	26.76	26.77	9.37	9.36	26.82	26.82
RINC	3.75	1.69	1.73	1.75	4.69	4.71	1.71	1.68	4.63	4.66
TEXP to EU	66.12	22.87	24.33	24.83	65.21	65.71	24.95	24.47	65.43	65.89
TEXP to ROW	66.12	20.49	21.71	21.45	62.30	62.00	21.56	21.85	62.52	62.18
E.V.	3.10	1.41	1.47	1.49	4.04	4.07	1.44	1.42	3.98	4.02

Model Equations

The consumer problem:

The representative household chooses the path of consumption that maximizes the discrete intertemporal utility function :

Uo= SUM SUB t (1/1+ rho) SUP t ln(TC SUB t)

TC(t)=PI sub s CD(S.t) SUP {a(s)}

The intertemporal budget constraint is

SUM SUB {t=0}R(t)Ptc (t) TC (t) PRECEQ SUM SUB {t=0} R (t) (wl SUB p (t) LSUP sub p (t) + wl sub NP (t) LSUP sub NP (t) + wN(t) N (t) +THG (t))+ omega

Variables and Parameters

R (t)= PI sub {t=0} 1 over {1+ r (t)}

TC(t) = Aggregate consumption

CD(S,t) = private consumption of good s

R(t) = discount factor from time t to time zero

Ptc(t) = the price of total consumption

$wl_P(t)$ = wage rate of production labor

$wl_{NP}(t)$ = wage rate of nonproduction labor

$LSUP_P(t)$ = labor supply of production labor

$LSUP_{NP}(t)$ = labor supply of nonproduction labor

THG(t) = transfer of government revenue to household

r(t) = instantaneous interest rate

ω = value of the household initial financial wealth

SAV(t) = wl suB p (t) LSUP suB p (t) + wl suB NP (t) LSUP SUB NP (t) +SUM SUB S D I V (S) + wN sub t N sub t +THG - r SUB t D SUB {t-1} - Ptc SUB t TC SUB t

First order (Euler conditions) imply

{TC (t+1) } OVER {TC (t)} (1+rho) = {Ptc (t)} OVER {Ptc (t+1)} (1+r (t))

The Firm Problem

Asset market equilibrium condition

r = {D I V(S) } over {V (S)} + {DELTA V (S)} over {V (S)}

where r is the world interest rate, div is dividends, V is the value of the firm. In addition, the following terminal condition is imposed to rule out Ponzi schemes

lim sub {t inf} R (t)V (S,t) = 0

solving the above difference equation yields

V (S,1) = SUM SUB {t=1} SUP INF R(t) D I V(S,t)

The market value of the firm is defined as the sum of discounted stream of future dividends. Dividends are defined as

PVA (S,t) f [(L(S,t), K (S,t)] - wl sub P (t) LSUP sub P (t)

-wl sub NP (t) LSUP sub NP (t) - ADC (S,t) - P I (S,t) I (S,t)

and ADC is the adjustment cost of investment while PVA is value added price.

Capital accumulation constraint

K (S, (t+1)) = (1-delta(S))K(S, t) + I(S,t)

ADC(S,t) = phi(S) PVA (S,t) {{I (S,t) }sup 2 } over {K (S,t)}

Differentiating with respect to the control variable I yields

q(S,t) = P I (S,t) + 2 PVA (S,t) phi(S){ I (S,t)} over {K (S,t)}

which determines the shadow price of capital (Tobin q).

Differentiating with respect to the state variable K yields the no arbitrage condition

wk (S,t) + PVA (S,t) phi(S) { I (S,t) sup 2} over {K (S,t)} + (1-delta(S)) q (S,t) - (1+r) q (S,t-1)=0

which is the same as the asset equilibrium condition since V=q K.

Variables and Parameters

wk(S,t)=capital rental rate

PVA(S,t)=value added price

K(S,t)=capital stock

δ(S)=depreciation rate

I(S,t)=new physical capital good

I(t) is a composite good produced from all final goods - with fixed share θ - using a constant returns technology,

I (S,t) = AK(S).PI sub {s'}INVD(S',S) sup {theta(S',S)}

Variables and Parameters

AK(S)=shift parameter in the investment function
INVD(S',S)=investment demand by sector of origin
vI(S,t)=value of investment.
PI(S,t)=price of new capital good

Current Account Dynamics

In open economy, investment is not constrained by the availability of domestic savings and any discrepancy is financed through foreign borrowing. Current account equilibrium is described by

D (t) - D (t-1) = r D (t-1)+TB(t)

The above equation shows that the increase in foreign debt is composed of the trade deficit TB(t) and the interest payment on foreign debt.

Within period equations (the time subscript is omitted to simplify notation)

Price block

Domestic price of imports

PM(S,R) = [1 + tau m(S,R)]ER .PIWM(S,R)

Domestic price of exports

PE(S,R) = [1+ sigma e(S,R)]ER. PIWE(S,R)

Composite import price

PMM(S) = 1 over ACM [{delta sub m}sup {1 over {1+rho sub m}} PM(S,W) sup {rho sub m over {1+rho sub m}} +
{(1-delta) sub m}sup {1 over {1+rho sub m}} PM(S,EU) sup {rho sub m over {1+rho sub m}}] sup {{1+rho sub m} over rho sub m}

Composite export price

Domestic supply price

Domestic output price

PEE(S,R) = 1 over ATE [{gamma sub E} sup {-1 over { rho sub E -1}} PE(S,W) sup { rho sub E over {rho sub E -1}}+{(1-gamma sub E)} sup {-1 over { rho sub E -1}} PE(S,EU) sup { rho sub E over {rho sub E -1}}]sup {{rho sub E -1} over rho sub E}

Value added price

PC(S) = PD(S) {D(S)}OVER {C(S)} + PMM(S) { MM(S)}OVER{C(S)}

Price of investment (unit cost function for producing investment good)

PX(S) = PD(S) { D(S)}OVER {X(S)} + PEE(S) {EE(S)} OVER{X(S)}

PVA(S) = [1- tau i(S)] PX(S) - SUM SUB SP IO(SP,S) PC(SP)

P I (S) = {PI SUB {S' }PC(S) SUP{ theta(S',S)}} over {AK(S) .PI sub {s'}theta (s',s) sup {theta (s',s)}}

Variables and Paramters:

PD(S) = domestic good price (sold domestically)
PM(S,R) = domestic price of imports from region R
PMM(S) = composite price of imports
PE(S,R) = domestic price of exports to region R

PEE(S) = composite price of exports
PC(S) = domestic supply price
PX(S) = domestic output price
ER = exchange rate
PVA(S) = value added price
D(S) = quantity of domestic output sold domestically
M(S,R) = quantity of imports from region R
MM(S) = composite quantity of imports
E(S,R) = quantity of exports to region R
EE(S) = composite quantity of exports
C(S) = quantity of good supplied domestically
X(S) = quantity of domestic output

Parameters

τm(S)= import tariff rate
σe(S)= export subsidy rate
τi(S)= input output coefficient
PIWM(S)= world price of imports
PIWE(S) = world price of exports
θ(S',S) = share of good s' in sector s investment
AK(S)= shift parameter in the investment production function

Output supply and demand block

AX(S)[K(S) SUP{ beta(S)} SUB K L(S) SUP {beta(S)} SUB L N(S) SUP{ beta(S)} SUB N

Labor is a Cobb Douglas aggregation of two skill categories; production and nonproduction labor
L(S)= L(S) sub{p} sup {alpha (s) sub p} L(S)sub{NP} sup {alpha (s) sub NP}

Profit maximization by producers lead to the following factor demand equations

Factor demand
LD(S) sub p = {PVA(S) X(S) beta(S) SUB L alpha(S) SUB P} OVER wl SUB P

The rental rate of capital is determçned from the following equation
K(S) ={PVA(S) beta SUB K X } OVER {wk(S)}

ND(S) = {PVA(S) beta SUB N(S)} OVER wN

LD(S) SUB NP = {PVA(S)X(S)beta(S) SUB L alpha(S) SUB NP} OVER wl SUB NP

I NTD(S) = SUM SUB {S' }IO(S,S')X(S')

Demand for Land
Intermediate demand

Intermediate demand is determined according to leontif technology and is therefore equal to the sum of fixed input output coefficients IO(S,S') multiplied by domestic output X(S')

Armington Functions
C(S) = AC(S) [delta (S)MM(S) SUP { - rho C(S) } +(1- delta (S))D(S) SUP { - rho C(S) }] SUP { -1/ rho C(S)}

Import demand

MM(S) = D(S) [{ PD(S) } OVER { PMM(S) } { delta(S) } OVER { 1- delta (S)}] SUP {1/(1+ rho C(S)) }

MM(S) = AC sub m [delta sub m M(S,W) sup {- rho sub m}+ (1- delta sub m)M(S, EU) sup {- rho sub m}] sup {-1 over {rho sub m}}

M(S,W) = M(S,EU) [{PM(S, EU) }over {PM(S, W)} delta sub m over {(1-delta sub m)}] sup {1 over {1+ rho sub m}}

X(S) = AT(S) [gamma (S)EE(S) SUP { rho T(S)} +(1-gamma (S))D(S) SUP{rho T(S)}] SUP {1/ rho X(S)}

EE(S)= D(S)[{PEE(S)} OVER{PD(S)} {1-gamma(S)} OVER {gamma(S)}]SUP{1/(rho(S)-1)}

CET Functions

Export supply

EE(S) = ATE [gamma sub E {E(S, W)} sup {rho sub E}+ (1-gamma sub E){E(S,EU)} sup {rho sub E}] sup {1 over {rho sub E}}

E(S,W) = E(S, EU) [{PE(S,W)} over {PE(S, EU)} {gamma sub E} over {(1-gamma sub E)}] sup {1 over {(rho sub E-1)}}

X(S) = D(S)

Finally, two condition must be satisfied for the nontradables goods in the model:
Domestic production for nontradables
For nontradables, domestic output is equal to domestic use

Domestic supply for nontradables

C(S) = D(S) Since there are no imports in the case of nontradables, supply consists only of output sold domestically.

Variables and Parameters:

Variables

wl_P = production labor wage rate

wl_{NP} = non production labor wage rate

wk(S)= capital wage rate

wN=land wage rate

K(S)= capital stock in sector s

$LD_P(S)$=demand for production labor by sector s

$LD_{NP}(S)$= demand for non production labor by sector s

ND(S)= demand for land

INTD(S)=intermediate demand of good S

Parameters

AX(S) = production function shift parameter

$\beta_K(S)$ = share of capital in value added of sector s

$\beta_L(S)$ = share of labor in value added of sector s

$\beta_N(S)$ = share of land in value added of sector s

$\alpha_P(S)$ =share of production labor in total labor input

$\alpha_{NP}(S)$=share of non production labor in total labor input

AC(S) = shift parameter in Armington

ACM(S) = shift parameter in Regional Armington elasticity

$\delta(S)$ = share parameter in Armington

$\delta_m(S)$ = share parameter in Regional Armington

$\rho C(S)$ = Armington exponent

$\rho_m(S)$ = Armington exponent

AT (S) = shift parameter in CET

ATE (S) = shift parameter in Regional CET

γ (S) = share parameter in CET

γ_E (S) = share parameter in Regional CET
X(S) = CET exponent
ρ_E(S) = Regional CET exponent
σC(S) = elasticity of substitution between domestic goods and imports
σX(S) = elasticity of substitution between domestic use and exports

Factor and institution block

Household flow income

YH (t)= wl sub P (t) LSUP sub P (t) + wl sub NP (t) LSUP sub NP (t) + wN. NSUP + SUM sub S D I V (S,t) + wN (t)N (t) + THG (t)- ER.r (t)DEBT (t-1)

Household demand

Demand for each good is a fixed share a(S) of total expenditure on goods

PC(S)CD(S) = a(S) (YH - SAV)

Sectoral investment demand (by sector of origin)

PC(S')INVD(S',S) = theta(S',S) P I(S) . I(S)

Variables and Parameters

Variables

YH= household income
DEBT= foreign debt
SAV= household saving
CD(S)=HH demand for good S
INVD(S',S)= sector S investment demand for good S' (investment demand by sector of origin)
I(S) = new investment

Parameters

a(S) = spending share for HH on good S
AK(S) = shift parameter in investment equation
θ(S',S) = share of good s' in sector s investment

Government transfers

tau i(S)PX(S) X(S) + sum sub R sum sub s tau m(S,R) .ER.PIWM(S,R) M(S,R)- sum sub R SUM sub s sigma e(s).ER.PIWE(S,R).E(S,R)

Government transfers to household

THG is a transfer of net government revenue which consists of government income that is revenue from indirect taxes and tariffs less subsidies. Government consumption and government deficit is ignored. Consequently, household savings is equal to national savings.

Equilibrium conditions

Factor market equilibrium

Labor

sum sub s beta sub L (S). alpha(S) sub p.PVA(S). X(S) =LSUP sub p. wL sub p

Demand for labor of each skill category equal its supply.

sum sub s beta(S) sub L .alpha(S) sub NP. PVA(S). X(S) = LSUP sub NP .wl sub NP

Capital

sum sub s beta(S) sub k .PVA(S).X(S) = K(S). wk(S)
Land
demand for land equal supply of land

SUM SUB S beta SUB N (S) . PVA(S). X(S) =wN . NSUP
Commodity market equilibrium
Supply of output for good S, C(S) must equal consumption demand, investment demand and intermediated demand.

C(S) =CD(S) + INVD(S) + I NTD(S)
Current account

current account equilibrium requires imports less exports must equal foreign savings

SUM SUB S PWIM(S) M(S)-SUM SUB S PWE(S) E(S) =SW

Variables and Parameters

Variables

K(S)=capital supply (capital stock)
SW= Foreign savings

Parameters

$LSUP_P$= supply of production labor
$LSUP_{NP}$= supply of non production labor
NSUP = land supply
τd = direct tax rate

Dynamic equations

Euler equation for consumption
{YH(t+1) - SAV(t+1)} OVER {YH(t) - SAV(t)} = {1+r(t+1)} OVER {1+rho}
No Arbitrage condition for investment
q(S,t) = P I (S,t) + 2 PVA (S,t) phi(S){ I (S,t)} over {K (S,t)}
Capital accumulation

wk (S,t) + PVA (S,t) phi(S) { I (S,t) sup 2} over {K (S,t)} + (1-delta(S)) q (S,t) - (1+r) q (S,t-1)=0
Foreign debt

K(t+1) = (1-delta)K(t) + I(t)
Terminal condition (last period is T)

DEBT(t+1) = (1+r(t)) DEBT(t) + SW(t)
The first condition indicates that in the steady state investment is equal todepreciated capital.

delta K(S,T) = I(S,T)
The second condition follows form the Euler equation evaluated in the steady state and states that the interest rate must be equal to the rate of time preference. Assuming that the world economy is in a steady state and therefore (r)is constant implies in turn that the rate of time preference is also constant.

r(T) = rho

r(T) DEBT(S,T) + SW(S,T) = 0 Debt is constant in the steady state. If D is positive then foreign savings (the trade deficit) must be negative. That is the country must run a trade surplus in order to pay the interest rate on debt. If the above equation holds then domestic savings must be equal to investment.

r(T) V(S,T) = D IV(S,T) Since the condition for asset market equilibrium and the no arbitrage condition are equivalent, the above equation must hold in the steady state implying that the average return to capital is constant.

Variables and Parameters:

Variables:

SW= foreign savings (trade deficit)

Parameters

r= interest rate