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**AN APPLIED GENERAL EQUILIBRIUM MODEL
OF MOROCCAN TRADE LIBERALIZATION
FEATURING EXTERNAL ECONOMIES**

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Abstract

Since the 1920's economists have wrestled with the effects of external economies on trade liberalization. In this paper I show that under extreme conditions, externalities can reverse the gains from trade found in perfectly competitive trade models. However, the externalities needed to generate this result, even under the worst possible conditions (all expanding industries are subject to negative externalities, all contracting industries have positive externalities) are orders of magnitude larger than those estimated in Krizan (1997). This suggests that the presence of external economies of scale does not provide a credible argument for protectionism. On the other hand, the CGE model showed that external effects can increase the welfare gains from trade liberalization, but the combined effect is still small compared to other policy options. This finding contrasts sharply with many models featuring internal returns to scale that are able to generate large welfare benefits from trade liberalization.

KEYWORDS: External Economies, Spillovers, CGE Model, Developing Country.

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I. Introduction:

Over the past two decades, many analysts have attempted to quantify the effects of trade liberalization on welfare by using computable general equilibrium (CGE) models. Production technologies characterized by constant returns and by internal returns to scale have both been explored; and the static welfare gains appear to be surprisingly small.

The effects of external returns, by contrast, have not received much attention in the applied literature. This is a notable exception given that they have long been used in the theoretical literature, starting with Graham (1923), to justify protectionism. The goal of this paper is to incorporate industry-wide external economies, similar to those modeled by Helpman and Krugman (1985), into an applied general equilibrium model of Morocco based on Rutherford, Ruström, and Tarr (1993). The simulation qualifies the effects of external economies of scale, as estimated in Krizan (1997), on Moroccan national welfare when trade with the European Economic Community is liberalized.

The results indicate that the presence of the estimated external economies increases the benefits of free trade by up to 20 percent. While this is a large percentage increase, the magnitude of the welfare gains remains relatively small in

comparison with gains from other policy options, such as changes in the domestic tax regime. To generate significant positive welfare gains I inserted a series of ad-hoc positive externalities in key sectors. I also tried to use arbitrarily large negative externalities to generate welfare losses. I found that the externalities had to be at least an order of magnitude larger than my estimates to substantially alter the usual welfare effects of trade in either direction.

II. The CGE Literature:

Theoretical Work:

The modern literature on trade in the presence of external economies dates back to Graham's (1923) work. Graham argued that if trade liberalization causes a country's resources to shift from an increasing to decreasing returns to scale industry (resulting in a decline in gross domestic product), then that country suffers a welfare loss. This proposition touched off the famous Graham-Knight debate that raged throughout the 1920's. The debate revolved around both the existence and the effects of external economies, but focused especially on their effects on welfare during trade liberalization.

Although the debate died out many years ago, it has been reopened recently because of the important part external economies play in many modern theoretical trade models. The

consensus among theorists seems to be that the presence of external economies make prediction of the welfare effects of trade liberalization difficult because they represent a second source of gain (or loss) to the domestic economy (Helpman and Krugman 1985). In addition to the new price vector, trade also brings a productivity effect and the two forces don't necessarily act in the same direction. Graham's argument against trade liberalization rests on the productivity effect alone, he does not consider the benefits from the new price vector.

2. CGEs and Trade Policy: What Others Have Found

Until the mid 1980's, CGE trade models used constant returns to scale production technologies and most of these models show that trade policy has a disappointingly small impact on national welfare. The intuition for this result is that since trade is a small component of most economies and the existing distortions are relatively minor, significant changes in the trade regime often have small overall effects.

More recent work, based on the new trade theory, has generated larger welfare responses to policy changes. Harris (1984) analyzes the effects of Canadian/U.S. free trade in the presence of internal scale economies and finds that, for Canada, the effects of increased trade range from 8 to 10 percent. The expansion of Canadian industry because of increased access to U.S. markets leads to far more significant welfare gains than

most CGE models find in the U.S. economy, which does not have as great an opportunity for expansion. However, even for small countries, it is not clear how robust these large welfare changes are.

Some of the CGE models featuring increasing returns may overstate the potential gains from trade. Tybout (1993) notes several ways that many CGE models with increasing returns differ from other empirical work. First, the returns to scale assumed in many CGE models are at least as large as those obtained from engineering estimates, and often much larger. Second, the returns-to-scale estimates are often not share-weighted averages of the returns to scale according to plant size. This means that large plants, presumably already operating at or near minimum efficient scale, experience the same rate of productivity enhancement due to increasing internal returns as much smaller plants. Finally, while most econometric studies show a negative correlation between heightened import penetration and plant size, many CGE models generate widespread increases in plant size with trade liberalization - even in import sectors.

While several authors have incorporated internal returns to scale into CGE models, only a few have incorporated external returns. One such paper is by Lopez-de-Sianes, Markusen, and Rutherford (1994). This paper builds an applied CGE model in the spirit of Eithier's (1982) or Markusen's (1990) theoretical

papers. The consumption goods sector is characterized by industry-level external returns which are directly correlated with the level of variety of intermediate inputs. In their model, as in several other theoretical trade models (Venables 1987), there is an initial underproduction of the intermediate inputs (due to monopolistic competition in that sector).

Tariffs can have beneficial effects in these types of models because of both a terms-of-trade effect and because they cause increased expenditure on, and production of, the domestic goods - which raises productivity through the externalities. In Lopez-de-Sianes, Markusen, and Rutherford's CGE model, there is an extra twist however. Because there is complementarity between the domestic and foreign intermediate inputs, protection has an additional cost: it reduces the quantity of complementary foreign inputs purchased. The model shows that, for the Mexican auto parts sector, protection reduces the output and exports of the auto sector. This results in negative externalities that are strong enough to out-weigh the positive terms-of-trade effects of protection. If, by contrast, all barriers are dropped for this sector, national welfare increases by as much as 0.9 percent which is a large contribution for a sector that accounts for less than 3 percent of Mexican GDP.

The goal of this paper also is to examine the effects of externalities on national welfare during trade liberalization.

My approach is different from Lopez-de-Sianes, Markusen, and Rutherford's in that I directly add estimated externalities obtained from Krizan (1997) to a modified version of the applied model found in Rutherford, Ruström and Tarr (1993).¹ The applied model is similar to theoretical models like Helpman (1984) and Helpman and Krugman (1985). It is a small, open economy model of Morocco with a large number of sectors with constant internal returns to scale and is designed to analyze the welfare effects of alternative trade liberalization schemes².

III. The External Economies:

The distinguishing characteristic of this paper is its use of a wide range of industry-wide and economy-wide externalities estimated from longitudinal, aggregate (2-digit SIC) and plant-level data from three developing countries. Although there are many forms of external-economies, in this paper, I mainly focus on industry-wide externalities. These have been in the literature the longest, are the best defined, and seem potentially the most important. I define industry-wide externalities as those externalities caused by a specific industry's activity, independent of geography. Many authors have used this type of spillover in their theoretical work. For example, Pigou (1928) and

¹I am very grateful to Tom Rutherford for developing this modified version of the model.

²For a detailed description of Morocco's tariff structure see Rutherford, Ruström, and Tarr (1993).

Romer (1986)³, use them to motivate their trade and growth analyzes . According to Marshall (1890), the three main sources of industry-wide economies are: the development, attraction, and retention of specialized labor; the genesis of intermediate input producers; and more fluid exchanges of ideas and technology.. One of the best-known empirical works on externalities was done by Caballero and Lyons (1990) using 2-digit SIC data. In that paper they focused on Economy-wide externalities. Economy-wide output produces externalities because workers and managers benefit from inter-industry skill and knowledge spillovers as the levels of output and employment rise (Romer 1986). That is, as the level of economic activity in a region (country) increases, workers gain experience that teaches them generic behaviors and skills valued by plants across industries (Hanson 1992). Likewise, managers benefit from cross-industry knowledge spillovers generated by higher levels of economic activity, which also enhances plant productivity. Given their prominence in the applied literature, and my desire to investigate the widest possible range of externalities, I also include a set of economy-wide externalities estimated from aggregated data in my CGE model.

IV. The CGE Model:

1. The Basic Model:

To describe the model it is convenient to begin with a variant that does not have external economies (This is exactly the specification in Rutherford et al, 1993). Domestic output is

³Although this model uses economy-wide, aggregate knowledge spillovers, I believe it captures the spirit of many of the own-industry models of externalities.

produced with labor, capital, and intermediate inputs according to a constant internal returns to scale technology. Labor is fully mobile across sectors, but some capital is sector-specific.

Producers equate prices to marginal cost and profits are driven to zero. The total cost of supply in these sectors is:

$$c_i Y_i = \sum_j \pi_j x_{ij} + (1+v_i) \sum_k w_k (f_{ik}^V + f_{ik}^K),$$

where c_i is average cost for good i , Y_i is domestic production of good i , \mathbf{B}_j is the price of the j th domestic-import good composite⁴, x_{ij} is intermediate inputs of good j for sector i , v_i is the tax rate on primary factor inputs for good i , w_k is factor prices for factor k , while f_{ik}^V and f_{ik}^K are, respectively, the variable and fixed inputs of primary factor k in the production of good i . The zero profit condition can be written as:

$$(1 + s_i^P)(p_i D_i + p_i^E E_i) + p_i^E E_i s_i^E = c_i Y_i,$$

where s_i^P is the rate of the production subsidy for good i , p_i is the domestic price of good i , p_i^E is the export price of good i , E_i is exports of good i , and s_i^E is the export subsidy rate for good i . The left hand side of the equation represents total revenue inclusive of the production subsidy for the i^{th} sector, and the right hand side is total costs.

⁴That is, the Armington good.

Domestically-produced final goods are produced by combining intermediate input goods and primary factors of production in a linearly homogeneous, nested Leontief-CES production function. Defining a_{ij} as the intermediate input requirements for one unit of good i in sector j , x_{ij} as total intermediate goods for good j in industry i , f_i as the primary factor inputs to variable cost in sector i , f_{ik} as the variable input of primary factor k in sector i , f_{ik}^F as the exogenous requirements for fixed costs in sector i , and \mathbf{F} as the elasticity of substitution between domestic consumption and aggregate imports in sector i , the CES-Leontief form can be written as:

$$Y_i = \min \left[\frac{x_{i1}}{a_{i1}}, \frac{x_{i2}}{a_{i2}}, \dots, \frac{x_{in}}{a_{in}}, \frac{V_i(f_i) + \sum_k f_{ik}^F}{a_{VA}} \right],$$

where:

$$V_i(f_i) = \left(\sum_k \delta_{ik} f_{ik}^{(\sigma-1)/\sigma} \right)^{\sigma/\sigma-1}.$$

Factor markets always clear with flexible prices:

$$\sum_i f_{ik} + f_{ik}^F = N_k,$$

where N_k is the economy-wide endowment of factor k .

Production is divided between domestic and export goods, and

export goods are differentiated according to destination (The European Community (EC) or the rest of the world), Technology is such that export and domestic consumption goods have a constant elasticity of transformation (\mathbf{D}):

$$Y_i = \phi(D_i, E_i) = (\alpha_{D_i} D_i^{(\rho_i-1)/\rho_i} + \alpha_{E_i} E_i^{(\rho_i-1)/\rho_i})^{(\rho_i-1)/\rho_i},$$

where D is goods for domestic consumption and \mathbf{D} is the elasticity of transformation between domestic production and exports. Letting r index regions, the export aggregate E_i , can be written as:

$$E_i = \left(\sum_r \beta_{ir} E_{ir}^{(\rho_i-1)/\rho_i} \right)^{\rho_i/(\rho_i-1)}.$$

This model, like many CGE models, features "Armington" goods which are goods that are similar in all respects except country of origin.⁵ Denoting imports as M , the Armington aggregate of domestic supply and imports can be expressed as a CES function of domestic and imported goods:

$$S_i = \psi(D_i, M_i) = (\alpha_{D_i} D_i^{(\rho_i-1)/\rho_i} + \alpha_{M_i} M_i^{(\rho_i-1)/\rho_i})^{(\rho_i-1)/\rho_i}.$$

Imports are further differentiated according to region of origin

⁵Except in the meat, dairy, and sugar sectors where imports and domestic production are perfect substitutes.

(r) so that M_i is the composite:

$$M_i = \left(\sum_r \beta_{ir} M_{ir}^{(\rho_i-1)/\rho_i} \right)^{\rho_i} .$$

The market clearing condition balances output from the Armington aggregation function with investment, intermediate and final demand:

$$S_i = \sum_j a_{ij} Y_j + G_i + I_i + C_i ,$$

where G_i is government demand for good i .

The purpose of the model is to compare domestic welfare under a set of different trade policies. For tractability, welfare is determined solely by the consumption level of the final goods, C_i :

$$W = U(C_1, \dots, C_n) .$$

Consumer income is the sum of earnings from primary sales and foreign capital flows, minus transfers. Demand for finished goods is determined through the maximization of a budget constrained utility function of a representative agent. Defining T as lump-sum transfers from households, B as the foreign exchange earnings and N_k as the endowment of factor k , the consumer budget constraint is:

$$\sum_i \pi_i C_i = \sum_k w_k N_k + B - T.$$

Government expenditure is exogenous and its consumption is held constant throughout the exercise by using the budget constraint to scale the three tax instruments so that revenues match expenditures. Government income comes from: lump-sum transfers from households T , import tariffs t_{ir} , value-added taxes on factor inputs to production and imports v_i , employment and corporation taxes on factor employment t_{ik} , minus production subsidies net of excise taxes s_i^P , minus export

subsidies s_i^E . The government budget is:

$$\begin{aligned} \sum_i \pi_i G_i &= T + \sum_{ik} t_{ik} f_{ik} + \sum_{ik} v_i w_k f_{ki} + \\ &\sum_{ir} p_{ir}^M t_{ir} m_{ir} - \sum_i s_i^P (p_i D_i + p_i^X X_i) - \sum_i s_i^X p_i^X X_i. \end{aligned}$$

2. *Incorporating the External Economies Into the CGE Model:*

To modify the model for external economies, let Y_i now be the index of the inputs to production, and $Y_i^{1+\theta_i}$ be the output index where θ_i is the elasticity of scale estimated in (Krizan

1997). Then excess output due to the scale economies DY_i , is:

$$DY_i = Y_i^{1+\eta_i} - Y_i .$$

The producers cannot individually influence DY_i because they are small, so they view the excess output as a result of an exogenous output subsidy from consumers. If Y_i is defined as the output good, then the rate of output subsidy SY_i , satisfies:

$$SY_i = Y_i^{\eta_i} - 1 .$$

.
For increasing returns sectors, the constant-returns output level is produced by combining intermediate inputs and primary inputs according to (3) and (4), then it is scaled up by the degree of the external returns. The consumption goods are, as in the traditional sectors, divided between export and domestic goods. The export and domestic goods are subdivided into sectors with and without comparable import varieties.

To represent increased factor productivity and higher factor payments due to the externality, each consumer is endowed with an identical quantity of the increasing returns good through an endogenous rationing variable. The rationing variable fluctuates

with the level of excess output, DY_i (a function of the returns to scale, $\mathbf{0}_i$), and equates consumer endowment with excess output. The new consumer budget constraint is:

$$\sum_i \pi_i C_i = \sum_k w_k N_k + B - \tau_T T + \sum_i DY_i .$$

If the externalities are positive, then factor productivity and payments are higher, DY_i is positive, and consumer welfare increases.

3. *Estimating the Externalities to be Included in the Modified CGE Model:*

A) The Externality Estimation Model:

My point of departure for the estimation of the externalities to be included in the CGE model is the basic model developed in Caballero and Lyons (1990). My general estimation equations are⁶:

$$dy_{ijt} = \gamma_j dx_{ijt} + de_{jt} + d\epsilon_{ijt}$$

Here d's indicate first differences, lower-case letters indicate logs, y is value added, k is capital, l is labor, γ_j is the cost share of labor for industry j, e is an external economy index, v is an unobserved productivity index, and ϵ_{ijt} is noise. Also,

⁶I adopt the following notation: "i" denotes plants, "j" is for industry, and "t" is time.

$$dx_{ijpt} = \alpha_{jt} dl_{ijpt} + (1 - \alpha_{jt}) dk_{ijpt} ,$$

and:

$$de_{jt} = \beta_1 dz_{jt} + d\epsilon_{ijt} ,$$

where z_{jt} is output⁷ of the j^{th} industry during year t . Finally,

$$\epsilon_{ijt} = \mu_{ij} + \tau_{jt} + \xi_{ijt} .$$

the error component μ_{ij} is a plant-specific effect reflecting heterogeneous technologies and management; τ_{jt} is a time effect, common to all plants that reflects general changes in capacity utilization and technological innovation; and ξ_{ijt} is noise.

Caballero and Lyons estimate this model using seemingly unrelated regressions (SUR) on 2-digit SIC European data. Although I also report (and incorporate into the CGE model) results obtained from using SUR on aggregate data, my work is distinct from that of Caballero and Lyons (1990) in three respects. First, I use plant-level data that allow me to examine

⁷Potential misspecification because of the simultaneity between industry-wide output and plant-specific productivity shocks: $\text{corr}(dy_{jt}, d:_{ijt}) \dots 0$, could bias the external returns to scale coefficients based on output. Using 2-digit SIC data, Caballero and Lyons (1990) show an analogous problem can be reduced by expressing aggregate output growth in terms of factor growth and productivity growth (of course y_{jt} and x_{jt} are still simultaneously determined to the extent that the firms are affected by business cycles). In the same spirit, I substitute industry factor growth plus industry productivity growth for industry output growth.

external effects at the level that most theories predict they occur. Specifically, I estimate the effects of externalities from employment and output on individual plants. Second, I construct proxies for industry-wide externalities. A variety stressed by theory but not estimated by Caballero and Lyons. The final difference between my work and most other studies is that my data are from developing countries while most previous studies have featured developed countries.

B. Plant-Level Estimators:

Recall from equation (20) that the error term of the production function, ϵ_{ijt} , has three components that are unobservable to the econometrician:

$$\epsilon_{ijt} = \mu_{ij} + \tau_{jt} + \xi_{ijt}.$$

Here μ_{ij} is a plant-specific effect, τ_{jt} is a region and industry-specific time effect, and ξ_{ijt} is assumed to be identically independently distributed across plants and time and uncorrelated with the exogenous variables. The plant-specific effect, μ_{ij} , can be removed with either a within or difference estimator. I include coefficients from both estimators in the CGE model.

A common problem plaguing econometric work of this type is the obvious correlation between output and employment with demand: $\text{corr}(dy_{ijt}, dJ_{jt}) \dots 0$. Because of this, there is always a concern that the estimated "externalities" may actually be

capturing capacity utilization effects. That is, because plants cannot costlessly adjust capital during business cycles, they often have excess capacity. Variables such as industry output that are correlated with demand, could appear to affect productivity by capturing these business cycle effects. Unfortunately, there is little that can be done to mitigate this problem. Although it is theoretically possible to reduce time effects, J_{jt} , by including year dummies in the models, because several of the externality proxies vary by year only, year dummies are not included, and the externality proxies can be expected to capture some of the time effects, J_{jt} .

C. The Externality Estimation Data:

Three plant-level panel data sets from Chile, Mexico, and Morocco, spanning 7, 6, and 5 years respectively, are used to estimate the externalities. The Chilean data cover virtually all manufacturing plants with at least 10 workers observed at least once during 1979-1986. Outputs are deflated using price indices constructed from sectoral output prices using the 1977 Chilean input-output table. Capital stocks are imputed by applying the perpetual inventory method to deflated investment figures for each of four capital goods categories.⁸

The Mexican data also comprise plant-level panels for several industries. They come from Mexico's Annual Industrial Survey and cover the period from 1984 through 1990. For an average industry, the data span approximately 80 percent of total output (the excluded plants are the

⁸Base-year capital stocks are taken from 1980 financial statements and should reflect replacement costs.

smallest ones) and include information on: output, employment, location, input usage, costs, investment and inventories. Mexico's Secretary of Commerce and Industrial Development (SECOFI) provided industry-level deflators for output and intermediate inputs and sector-level deflators for machinery and equipment, buildings, and land.⁹ A more detailed description of the data can be found in Tybout and Westbrook (1995).

The Moroccan data cover most manufacturing firms and span the years 1984-1989. Nominal variables are deflated using a set of sectoral price indices obtained from The World Bank. As with the Chilean data, capital stocks are imputed using the perpetual inventory method on deflated investment figures. The capital stock for the base year, 1985, is established by multiplying sectoral capital/labor rates for firms with 10 or more employees by the number of employees. A perpetual inventory technique is used for the remaining years and a 5 percent depreciation rate of capital is assumed.

The data sets are too large to check the reliability of each observation. To eliminate outrageous values, the data are subject to a set of exclusion criteria. Valid observations require values greater than zero for: gross value of output, the capital stock, the number of employees, and the cost of labor. Additionally, observations with total costs (or gross value of output) per worker less than one twentieth or greater than twenty times the industry average are excluded. Also eliminated are observations showing either rates of growth of total cost (gross value of output) per worker greater than 300 percent per year or rates of decline of total cost (gross value of output) per worker greater than 75 percent per year.

⁹Maquiladora plants (plants that assemble components for export only) were excluded from the analysis because they do not report values for gross output or intermediate inputs.

Finally, studentized residuals, the ratio of the residual to its standard error, are used to identify additional outliers. For each regression, observations that yield studentized residuals with absolute values greater than three are omitted and the regression is run again. The results remain qualitatively unchanged between the two stages in all of the plant-level regressions and the results incorporated into the CGE model are from the second stage regressions.

V. The CGE Results:

1. Scenarios:

The CGE model (equations 1-16) simulates four different trade-liberalization scenarios. To establish base cases to compare to the results from including various sets of externalities, I run begin by running each CGE scenario without externalities ($\mathbf{0} = 0$). Next, I include each of the 5 sets of externalities obtained from the previously described externality estimation model (equations 17-20). Finally I develop an arbitrarily large and dispersed vector of external economies and diseconomies. Comparing national welfare with and without the externality proxy vectors allows me to quantify the impact of the external economies on national welfare during trade liberalization.

As in Rutherford et al. (1993), four trade liberalization scenarios were run for each set of externalities (including the base model where they are set equal to zero). Most of these scenarios were designed to examine various facets of the 1992

Reciprocal Free Trade Agreement between Morocco and the EC. The EC is Morocco's most important trading partner and Morocco already had relatively free access to EC markets for its industrial goods, but there were some significant only increased access to EC fruit and vegetable markets with an 8 percent increase in price. The barriers against Moroccan fruit and vegetable exports. The trade agreement increased Moroccan access to EC markets, notably in the Fruit and Vegetable industries. The agreement obligates Morocco, in turn, to lower its tariffs against EC manufactured goods.

The ASSOC scenario most closely approximates the effects of the Morocco/EC trade agreement. ASSOC eliminates all tariff and non-tariff barriers to EC imports and simulates increased access to EC fruit and vegetable markets with an 8 percent export price increase. ACCESS simulates only increased access to EC fruit and vegetable markets with an 8 percent increase in price. The ECLIB scenario captures the other half of the agreement by eliminating protection against EC imports. Finally, the LIBALL scheme eliminates import protection against all imports, EC and non-EC. Although this scenario is the least likely to occur, it provides the best opportunity to examine many of the arguments for and against trade liberalization in the presence of external economies.

2. *The Estimated Externalities Incorporated in the CGE Model:*

Table 1 lists the estimated externalities that were included in the model and their sources. The first set of externalities is found in column 2 and comes from the SUR estimates using the combined, sector-level data. These data spanned the manufacturing sector. The next two sets use the within and first difference estimates respectively on the Moroccan plant-level data. The last two sets of estimates come from within and difference estimation of the externality proxies on the combined

Table 1: Externality Inputs (Obtained from Estimations of Eqs. 17 - 20; *= significant at approximately 95%):

Industry	Sector-Level Economy-Wide Externalities From Combined Data	Plant-level Industry-Wide Output Externalities From Moroccan Data		Plant-level Industry-Wide Output Externalities from Combined Data	
	SUR	Within	1st Diff	Within	1st Diff
Bev & Tobacco	0.0050				
Chemicals	0.2630*	-3.4833	-0.0069	0.0024	0.0687*
Citrus Fruits		0.0211*	-0.0167	0.0136*	0.0376
Clothing		-0.0038*	-0.0104*	-0.0026*	0.0165*
Electrical Equip	-0.0210				
Industrial Machines	0.0480*				
Iron and Steel	0.3880				
Metals Mining	0.3620				
Office Machinery	-0.0210*				
Paper and Print	-0.0040				
Rubber and Plastic	0.0340				
Textiles	-1.8410	0.0014	0.0768	0.0307	0.1605
Trans Equip	0.1100*	0.0146	0.0002	0.0083*	0.0123*
Vegetables		0.0211*	-0.0167	0.0136*	0.0376
Wooden Prods		0.0017	-0.0090	0.0104*	0.0281*

plant-level data. The plant-level data estimates are for selected industries only. Notably, there is a good mixture of positive and negative coefficients which will allow me to test the spirit of Graham's argument. For a more detailed analysis of these and other externalities, see Krizan (1997).

3. *The results of the CGE Simulations:*

The results of the CGE simulations are reported in Table 2. Column 1 describes the externality included (if any) in the model and columns 2 through 4 report the welfare effects of each liberalization scheme. Columns 5 to 8 describe the percentage change in the VAT needed to

Table 2: CGE Simulation Results (Running of Eqs. 1 - 16 with Externalities from Table 1)

Type of Externality Included	% Change in Welfare				% Change in VAT Rate			
	ASSOC	ECLIB	LIBALL	ACCESS	ASSOC	ECLIB	LIBALL	ACCESS
None	0.249	0.029	0.892	0.230	1.533	1.540	1.806	0.993
SUR - Comb	0.458	0.211	1.120	0.267	1.535	1.541	1.808	0.993
Within - Mor	0.350	0.080	0.899	0.287	1.532	1.539	1.806	0.993
Diff - Mor	0.211	0.008	0.861	0.213	1.533	1.539	1.805	0.993
Within- Comb	0.254	0.022	0.883	0.241	1.533	1.539	1.805	0.993
Diff - Comb	0.222	-0.026	0.824	0.253	1.532	1.539	1.805	0.992

Source of Estimate	% of Labor that Change Jobs				% of Capital that Adjusts			
	ASSOC	ECLIB	LIBALL	ACCESS	ASSOC	ECLIB	LIBALL	ACCESS
No Ext	0.879	0.900	1.385	0.395	0.922	1.077	1.646	0.536
SUR - Comb	0.774	0.787	1.224	0.402	0.813	0.939	1.458	0.551
Within - Mor	0.856	0.878	1.386	0.412	0.896	1.039	1.644	0.563
Diff - Mor	0.892	0.914	1.407	0.385	0.930	1.093	1.669	0.521
Within-Comb	0.886	0.905	1.394	0.405	0.929	1.083	1.654	0.548
Diff -Comb	0.919	0.937	1.437	0.422	0.965	1.121	1.699	0.570

keep government revenue unchanged under each scenario. Columns 9 through 12 show the percentage of labor that changes jobs and columns 13 to 16 report the percent of capital that adjusts. Columns 9 through 12 show the percentage of labor that changes jobs while 13 to 16 show the percent of capital that adjusts. The first row shows the base case when the externalities are set equal to zero and the remaining rows show the results generated by each set of externalities.

A) Welfare Gains:

The most obvious result in columns 2 to 8 of Table 2 is that my welfare gains are generally smaller than those obtained in Rutherford, Ruström, and Tarr (1993) and about the same size as those found by Lopez-de-Sianes, Markusen, and Rutherford (1994). The most dramatic results come from including the SUR estimates in the LIBALL scenario. Entering these externalities into the model results in an increase in welfare under a complete liberalization scenario (LIBALL, column 4 of Table 2) from 0.892 without the externalities to 1.120 when the SUR externalities are included. This is an increase of a little over 20 percent. While this is a sizable percentage increase, the absolute magnitude of this welfare gain is still relatively small. Adding external economies to the model does not seem to bring the large welfare gains found in models that feature internal increasing returns.

Although welfare increases up to 20 percent more with the external economies model compared to the perfectly competitive model, the absolute size of the increases are still small. To find out how large the external economies would have had to be to generate sizable welfare gains, I experimented with larger externalities. I selected the citrus fruit, vegetable, and textile industries for the experiment since they appeared to be particularly important to the Moroccan economy and

affected comparatively strongly by the trade policies.

I generated additional gross welfare gains of 7 to 10 percent by adding externalities of 50 percent to the model, but slightly smaller externalities of 40 percent generated welfare gains of only 2 to 3 percent. These results indicate that realistically large (1 or 2 percent) externalities are unlikely to substantially increase the welfare benefits of free trade. It is the new price vector that is the major contributing factor to welfare gains and even the combined gains of the two forces is still small compared to many other policy instruments' effects.

B) Welfare Losses:

What about the potential negative effects? Is the existence of negative externalities a credible argument to forgo trade liberalization? Recall Graham's (1923) theory that external economies could cause a welfare loss to a trade-liberalizing country if the country's positive externality generating industries contract and its negative externality producing industries expand. To investigate this, I assigned positive externalities to all contracting industries and negative externalities to the expanding ones. I found that in order to generate a welfare decline under the full liberalization scenario the externalities had to have a uniform absolute magnitude of about 35 percent. This is an unrealistically large industry-wide externality. It is an order of magnitude larger than most of my estimates; suggesting that Graham's argument may not be a valid reason for a small country to forgo trade liberalization.

C) Sources of the Gains From Trade:

Now I turn my attention to how the presence of external economies affects the more traditional sources of welfare gains by comparing my results to those obtained by Rutherford *et al* (1993). Recall that ASSOC, ECLIB, and ACCESS highlight different components of the

Moroccan/EC trade agreement. Under ACCESS, welfare can increase from improved terms-of-trade or better resource allocation, or both. Under ECLIB by contrast, the terms of trade are not altered and welfare changes come from improved resource allocation alone.

The results in Table 2 (columns 2, 4, 10, and 12) show that relative to ECLIB, ACCESS yields larger welfare gains from smaller resource shifts. These differences indicate that the primary source of the welfare benefits in the ACCESS scenario is the improvement in Morocco's terms-of-trade. These results closely parallel those obtained by Rutherford *et al.* Next, consider the welfare changes obtained under the ASSOC scenario (column 1 of Table 2). Compare them to those obtained under ECLIB or ACCESS, and recall that ASSOC combines the policy changes from ECLIB and ACCESS. Table 2 shows that the welfare gains from ASSOC are roughly equal to the sum of the gains from the two component scenarios.

Finally, consider the effects of external economies on the results from LIBALL. This policy scheme eliminates all import barriers on goods regardless of their origin, EC or non-EC. The changes in welfare shown in Table 2 are typically an order of magnitude or more higher under LIBALL than under ECLIB. Resource reallocation is also higher, but much less so. Typically, only about 60 percent more labor and capital reallocates under LIBALL than in ECLIB. These additional welfare gains, obtained with less than proportional resource shifts, indicate that while lowering tariffs against the EC alone induces welfare-increasing resource reallocation (the ECLIB scenario), the new vector is still sub-optimal. If this is true, then there is trade diversion under the Morocco-EC Free Trade Agreement. Rutherford *et al* (1993) draw this conclusion from their analysis and the evidence presented here does not indicate that the presence of industry-wide external economies alters their finding.

VI. CONCLUSIONS:

Since the 1920's economists have wrestled with the effects of external economies on trade liberalization. In this paper I show that under extreme conditions, externalities can reverse the gains from trade found in perfectly competitive trade models. However, the externalities needed to generate this result, even under the worst possible conditions (all expanding industries are subject to negative externalities, all contracting industries have positive externalities) are orders of magnitude larger than those estimated in Krizan (1997). This suggests that the presence of external economies of scale does not provide a credible argument for protectionism. On the other hand, the CGE model showed that external effects can increase the welfare gains from trade liberalization, but the combined effect is still small compared to other policy options. This finding contrasts sharply with many models featuring internal returns to scale that are able to generate large welfare benefits from trade liberalization.

BIBLIOGRAPHY

Caballero, R., and R. Lyons (1990) "Internal Versus External Returns to Scale in European Industry," *European Economic Review*, pp. 805-830.

Ethier, W. (1979) "Internationally Decreasing Costs and World Trade," *Journal of International Economics* No. 9 pp. 1-24.

Graham, F.D. (1923) "Some Aspects of Protection Further Considered," *Quarterly Journal of Economics* Vol. 37, pp. 199-227.

Harris, R., and D. Cox, (1984) *Trade, Industrial Policy and Canadian Manufacturing*, Ontario Economic Council, Toronto.

Helpman, E. (1984) "Increasing Returns, Imperfect Markets and Trade Theory." in R. Jones, ed.,

The Handbook of International Economics North-Holland, New York, NY.

Helpman, E. and P. Krugman (1985) *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International Economy* MIT Press, Cambridge, MA.

Knight, F. (1924) "Some Fallacies in the Interpretation of Social Cost," *Quarterly Journal of Economics* No. 38, pp. 582-606.

Knight, F. (1925) "On Decreasing Cost and Comparative Cost. A Rejoinder." *Quarterly Journal of Economics* No. 39, pp. 331-333.

Krizan, C.J. (1997) "External Economies of Scale in Chile, Mexico, and Morocco; Evidence from Plant-level Data," Ph.D Dissertation, Georgetown University.

Krugman, P. (1991a) *Geography and Trade* MIT Press, Cambridge.

Krugman, P. (1991b) "History Versus Expectations," *Quarterly Journal of Economics* pp. 651-667.

Lopez-de-Sianes, Markusen, and Rutherford (1994).

Markusen, J.R. (1990) "Micro-foundations of External Economies", *Canadian Journal of Economics* Vol. 23, pp. 495-508.

Marshall, A. (1890) eighth edition, *Principles of Economics: An Introductory Volume*. MacMillan Company, New York.

Pigou, A. (1928) "An Analysis of Supply," *The Economic Journal* No. 150 pp. 238-257.

Porter, M. (1990) *The Competitive Advantage of Nations* The Free Press, N.Y.

Romer, P. (1986) "Increasing Returns and Long-Run Growth", *Journal of Political Economy* Vol 94, pp. 1002-1037.

Rotemberg, J., and G. Saloner, (1990) "Competition and Human Capital Accumulation: A Theory of Interregional Specialization and Trade," *NBER Working Paper No. 3228*.

Rutherford, T., Rustron, E., and D. Tarr (1993) "Morocco's Free Trade Agreement with the European Community; A Quantitative Assessment," *World Bank Working Paper No 1173*.

Tybout, J.R. (1993) "Internal Returns to Scale as a Source of Comparative Advantage: the Evidence," *The American Economic Review* Vol. 83, No. 2, pp. 440-444.

Venables, A. (1987) "Trade and Trade Policy with Differentiated Products: A Chamberlinian-Ricardian Model," *Economic Journal* No. 97, pp. 700-717.