Module-9

Assessing the Implications from Trade Liberalisation: Use of Different Methods and their Limitations

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Acronyms

ADF	Augmented Dicky-Fulter
CRDW	Co-integrating Regression Durbin-Watson
CES	Constant Elasticity of Substitution
CET	Constant Elasticity Transformation
CGE	Computable General Equilibrium
CRS	Corporate Social Responsibility
DF	Dicky-Fulter
GDP	Gross Domestic Product
ECM	Error Correction Mechanism
FDI	Foreign Direct Investment
GTAP	Global Trade Analysis Project
LDCs	Least Developed Countries
MFA	Multi-Fibre Arrangement
NAMA	Non-Agricultural Market Access
NTBs	Non-Tariff Barriers
OLS	Ordinary Least Square
SAM	Social Accounting Matrix
ToT	Terms of Trade
WTO	World Trade Organisation
WWW	World Wide Web

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1. Why do We Need Models?

We need models for the following reasons:

A. There exist complex interactions among economic agents.

B. Because of Policy Matters since:
- Policies have economy-wide effects;
- Policies change behaviour;
- Policies may have international effects;
- Monitoring and analysing policies; and
- Forecasting their impacts.

C. Modeling helps us to understand complex issues and to take better decisions.

2. Ex-ante and Ex-post Assessments

2.1 Ex-ante/Ex-post Analysis

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There are at least two ways to analyse the effect of a trade policy.

The first is an *ex-ante* simulation of a change in trade policy, which involves projecting the future effects on a set of economic variables of interest. *Ex-ante* analysis simulates the (future) impact of alternative trade policies (simulations using PE/GE model). The *ex-ante* analysis approach answers "what if" type of questions. *Ex-ante* analysis means what would be the future impact of a simulated policy change or a shock. In principle, *Ex-ante* analysis generally uses a model with a base period.

2.1.1 Examples of Ex Ante Analysis

There is a long tradition in the use of Social Accounting Matrices (SAMs) and Computable General Equilibrium (CGE) models for analysing the impact of policies, especially of trade liberalisation, on income distribution and poverty. Some recent literatures on this area are presented in Box 1.

Box 1: Example of Ex-Ante Analysis (Agriculture)
Global Agricultural Trade Liberalisation: **Implications for the Bangladesh Economy** *Selim Raihan and Mohammad A. Razzaque* In full liberalisation of all agricultural goods (AGRLIB1), only Bangladesh encounters a high welfare loss. All other least developed countries (LDCs) together register a positive welfare gain. However, it is likely that there are significant differences among the LDCs, as some of them are net exporters of agricultural commodities and the rest are the net importers. The welfare impact of AGRLIB1 is more likely to be negative for the net importing countries, as is evident from the case of Bangladesh. However, it appears that the gains of the net exporting LDCs are large enough to offset the losses of the net importing LDCs, thus generating a net welfare gain for all LDCs. The partial liberalisation of all agricultural goods (AGRLIB2) and the Hong Kong scenario (AGRLIB3) generate relatively less welfare loss for Bangladesh. Among the other South Asian countries India has the highest welfare gain under all scenarios.

Table 1: Welfare Effects on Selected Countries (in US$ million)			
Country	**AGRLIB1**	**AGRLIB2**	**AGRLIB3**
Bangladesh	-56.5	-11.0	-12.1
India	1125.6	827.9	6.4
Sri Lanka	118.1	40.4	-2.2
Rest of South Asia	62.4	55.6	-10.6
EU	3083.4	2948.6	2826.1
US	6974.8	2865.2	-152.1
Japan	16426.2	4601.4	-489.1
China	3229.1	2083.5	-98.9
Source: GTAP Simulation Results.			

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The simulation in the Bangladesh dynamic model is performed by introducing these changes in the model together with domestic policy reform as consistent with the simulation scenarios.

GDP and welfare decline both in the short and long run, though the long run effects are more intense. The effect on aggregate welfare is negative in this scenario. Also, there are strong negative impacts on the head-count poverty both in the short and long run. Both imports and exports register positive growth in the short run, and growth effects are stronger in the long run. Consumer prices for both rural and urban households fall because of the fall in domestic import prices of most of the commodities. Both skilled and unskilled wage rates fall, but unskilled wage rate falls more than the skilled wage rate. However, wage rates decline at smaller magnitudes in the long run when capital is re-allocated toward the expanding sectors. Also, both the agricultural and non-agricultural capital rental rates decline, though the decline is more prominent in the agricultural sectors.

As a result of full global agricultural trade liberalisation, in the short run, a number of 340 thousand new rural households and 34 thousand new urban households will fall into poverty. In the long run, however, the numbers of new households falling into poverty increase dramatically, for example, 547 thousand in the rural area and 52 thousand in the urban area.

Source: Raihan and Razzaque (2007).

Box 2: Example of Ex-Ante Analysis (NAMA)

WTO Negotiations on the Non-agricultural Market Access (NAMA): Implications for the Bangladesh Economy

Selim Raihan, Mohammad A. Razzaque and Rabeya Khatoon

A full implementation of the NAMA negotiations (NAMA1 scenario) will lead to a net welfare gain for Bangladesh and other LDCs. It also appears that Bangladesh and other LDCs also gain from the NAMA2 scenarios. The developing countries have significant welfare gains from the NAMA scenarios. However, the welfare gains vary depending on the values of the coefficients in the Swiss Formula. It appears that the higher the value of the coefficient the greater is the gain for the developing countries. Among the developed countries, US and Canada suffer from welfare loss, mainly driven by the negative terms of trade shock. However, EU and all other developed countries register welfare gains under all NAMA scenarios.

Table 2: Welfare Effects of NAMA Scenarios on Selected Countries and Regions

(In US$ million)

	NAMA1	NAMA2	NAMA3
Bangladesh	108.9	89.5	63.2
India	706.3	582.4	760.7
Sri Lanka	210.5	179.7	130.0
Rest of South Asia	9.7	106.6	130.6
Other LDCs	27.3	13.8	10.1
Other Developing Countries	2043.6	1563.6	1637.8
USA	-5465.6	-4651.3	-2869.5
EU	2588.2	2668.1	2080.5
World	22941.1	18858.9	16700.4
Source: GTAP simulation results.			

Source: Raihan et al (2007).

Box 3: Example of Ex-Ante Analysis (Macro-model)

Macroeconomic Effects of Fiscal Policies: Empirical Evidence from Bangladesh, China, Indonesia and Philippines

Ducanes G., Cagas M. A., Qin D., Quising P., Razzaque M.A.

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The paper studies macroeconomic effects of fiscal policies in four Asian countries, viz. Bangladesh, China, Indonesia, and the Philippines by means of structural macro-econometric model simulations. It is found that short-term fiscal multipliers from an untargeted increase in government expenditure are positive but much less than those from an increased expenditure targeted to capital spending. The multiplier effects from fiscal expansion via a tax rate reduction are found to be typically much less than through higher spending. The effectiveness of automatic stabilisers in general and more specifically whether expenditure or tax-side stabiliser is more effective, differs across countries.

Table 3: Effectiveness of Automatic Stabilisers: Expenditure Adjustment

Shock To	Bangladesh	China	Indonesia	Philippines
Consumption	0.01 -0.01	0.07 -0.06	-0.05 0.24	0.04 0.09
Investment	-0.04 -0.02	0.08 -0.06	-0.12 0.25	0.05 0.05
Exports	-0.04 -0.02	0.08 -0.06	-0.05 0.23	-0.03 0.03

The second is *ex-post* approach that uses historical data to conduct an analysis of the effects of a past trade policy. Most econometric models of trade are of this form. These include gravity models, which quantify the effects of past trade policies (all econometric analysis). The challenge for any econometric study is to attribute a cause to a certain effect, that is, for example, to show that trade costs affect trade flows. Econometric analysis, in general, and gravity models, in particular, can only guide policy by explaining its effect where it has already been implemented. But the *ex-post* analysis can often be used to answer "what if"

questions if after estimation, the model is used for simulations, relying on the assumption that the past impact of a policy may give guidance about what can be expected from a change in future policy.

Ex-post assessment means what has been the impact of a certain reform implemented in the past. Although an *ex-post* study can also provide information about the likely future impact of a policy change, the two approaches serve different purposes. *Ex-post* studies are based on a rigorous analysis of the actual past data.

2.1.2 An Example of Ex Post Analysis

Box 4: Example of Ex-post Analysis

Bangladesh's Trade Liberalisation in a Global Perspective: A Comparative Analysis

Selim Raihan

Here the following multivariate model of cross-country trade Liberalisation is tested:

$$TRLIB = \beta_0 + \beta_1 PCY + \beta_2 POP + \beta_3 PD + \beta_4 FDIY + \beta_5 LIT + \beta_6 WD + \varepsilon$$

Where, *TRLIB* is the dependent variable (five indicators of trade liberalisation), PCY stands for per capita GDP expressed in 1995 US$ in hundreds; POP is the population in the thousands; PD is the population density expressed as the population per square kilometer; $FDIY$ is the ratio of foreign direct investment (FDI) to GDP (in percent); LIT is the literacy rate (in percent); WD is the weighted distance measured in 100 kilometers; and ε is the classical error term.

The study finds that:
1. Cross-country variation in the level of per capita income does have a positive and statistically significant impact on the cross-country variation in the export-orientation.
2. The bigger the size of population the lesser is the trade-orientation.
3. A higher population density is associated with higher export-orientation.
4. Higher the FDI-orientation the higher is the export-orientation in a cross-country context.
5. A positive impact of literacy rate may observe on export-orientation.
6. The higher the 'weighted distance' the lower is the export orientation.

Source: Raihan (2007).

3. Econometric vs Computable General Equilibrium Models

Table 4: Econometric vs CGE

Econometric Analysis (Partial eq.)	CGE Models
I. These models are mostly *ex post* in nature. II. Econometric Analysis or a partial equilibrium analysis typically focuses only on a specific market or product and ignores interactions with other markets. All other factors that can affect this market are assumed constant. This appears in a number of ways. It is usually assumed that a policy change in a certain market only affects the price of that good, but that this does not lead to a spillover of the income effect on other markets (that is, the fact that a lower price for a certain good increases the income available for purchasing other goods, thus	I. These models are *ex ante* in nature. II. A CGE model consists of a set of simultaneous equations that describe the functioning of an economy. These equations specify how all the payments (economic flows) that are recorded in a SAM change as a consequence of a change in an exogenous variable or parameter. As a consequence, the model follows the SAM disaggregation of factors, activities, commodities, and institutions. III. It is written as a set of simultaneous equations, many of which are non-linear.

ceteris paribus increasing demand for them is neglected). Thus prices in other markets remain constant. III. A partial equilibrium model also does not take into account the resource constraints of the economy, that to increase production in one sector resources need to be pulled away from other sectors. IV. A partial equilibrium model is most suited for policy analysis of an intervention when the effects of that intervention on rest of the economy are small.	IV. The equations define the behaviour of the different actors. In part, this behaviour follows simple rules captured by fixed coefficients (for example, *ad valorem* tax rates). For production and consumption decisions, behaviour is captured by non-linear, first-order optimality conditions. V. The equations also include a set of constraints that have to be satisfied by the system as a whole but which are not necessarily considered by any individual actor. These constraints cover markets (for factors and commodities) and macroeconomic aggregates (balances for savings-investment, the government, and the current-account of the rest of the world).

4. Basic Features of Econometric Models

Literally interpreted, *econometrics* means "economic measurement". Although measurement is an important part of econometrics, the scope of econometrics is much broader. There exist eight stage processes in building econometric models:

(1) Statement of theory/hypothesis

(2) Specification of mathematical model

(3) Specification of the econometric model

(4) Obtaining the data / conduct preliminary data analysis

(5) Estimation of the econometric model and interpretation of regression results

(6) Diagnostic Analysis

(7) Hypothesis testing

(8) Prediction/forecasting

The two main purposes of econometric models are to give empirical content to economic theory and to subject economic theory to potentially falsifying tests. For example, consider one of the fundamental relationships in economics, the relationship between the price of a commodity and the quantity of that commodity that people wish to purchase (the demand relationship). According to economic theory, an increase in the price should lead to a decrease in the quantity demanded. Using econometric tools, a researcher would write a mathematical equation that described the relationship between price and quantity (which may include other variables like income):

$$Q = \beta_0 + \beta_1 Price + \beta_2 Income + \varepsilon$$

Econometric methods would be used to estimate the unknown parameteres in the relationship, β_0 and β_1, using price and quantity of demand data. The research would then statistically test the hypothesis that an increase in price leads to a decrease in the quantity demanded by testing the hypothesis that $\beta_1 < 0$.

There are different types of econometric models.

4.1 Cross-Section Model

- Cross-section model uses cross-section data.
- Cross-sectional data are data on one or more variables collected at the same point of time.
- That is, each observation is an individual, firm etc., with information at a point in time. In Cross-Section Model, a multiple regression equation takes the following form:

$$Y_i = \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + U_i$$

Where, i = Cross-sectional unit.

- Cross-sectional data are widely used in economics and other social sciences.
- In economics, the analysis of cross-sectional data is closely aligned with the applied microeconomics fields, such as labour economics, state and local public finance, industrial organisation, urban economics, demography, and health economics.
- Data on individuals, households, firms and cities at a given point in time are important for testing microeconomic hypotheses and evaluating economic policies. As a result this branch of econometrics is sometimes referred to as microeconometrics.

Apart from the traditional multiple regression equation, two special types of models, namely *Logit and Probit* are calculated, using cross-section data, when dependent variable is dichotomous in nature, taking 1 or 0 value. Suppose, we want to study the labour-force participation of adult males as a function of the unemployment rate, average wage rate, family income, education, etc. A person either is in the labour force or not. Hence, the dependent variable can take only two values: 1 if the person is in the labour force and 0 if he/she is not.

4.1.1 Logit Model

A logit model is a univariate binary model. That is, for dependent variable y_i that can be only 1 or 0, and a continuous independent variable x_i, that:

$$\Pr(y_i = 1) = F(X_i'b)$$

Here b is a parameter to be estimated, and F is the logistic cdf.

4.1.2 Probit Model

A probit model is a popular specification of a generalised linear model, using the probit link function. Probit models were introduced by Chester Ittner Bliss in 1935. Because the response is a series of binomial results, the likelihood is often assumed to follow the binomial

distribution. Let Y be a binary outcome variable, and let X be a vector of regressors. The probit model assumes that

$$\Pr(Y = 1|X = x) = \Phi(x'\beta),$$

Where, Φ is the cumulative distribution function of the standard normal distribution. The parameters β are typically estimated by maximum likelihood.

While easily motivated without it, the probit model can be generated by a simple latent variable model. Suppose that,

$$Y^* = x'\beta + \varepsilon,$$

Where, $\varepsilon|x \sim \mathcal{N}(0,1)$, and suppose that Y is an indicator for whether the latent variable Y^* is positive:

$$Y \overset{\text{def}}{=} 1_{(Y^*>0)} = \begin{cases} 1 & \text{if } Y^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

Then it is easy to show that

$$\Pr(Y = 1|X = x) = \Phi(x'\beta).$$

4.2 Time-Series Model

- Time series regression, generally, looks like as follows:

  $Y_t = \beta_1 X_t + \beta_2 X_t + \beta_3 X_t + U_t$

- Time series data assumes that the underlying time series is stationary.

- In regressing a time series variable on another time series variable, one often obtains a very high R^2 although there is no meaningful relationship between the two. The situation exemplifies the problem of spurious regression.

- Regression models involving time series data are often used for forecasting.

- In time series econometrics, a time series that has a unit root is known as a random walk.

- At the formal level, stationarity can be checked by finding out if the time series contains a unit root. The Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests can be used for this purpose.

- A stationary time series can be modelled as a TS process, whereas a non-stationary time series represents a DS process.

- Co-integration means that despite being individually non-stationary, a linear combination of two or more time series can be stationary. The EG, AEG, and Co-integrating Regression Durbin-Watson (CRDW) test can be used to find out if two or more time series are co-integrated.

- Co-integration of two (or more) time series suggests that there is a long-run relationship between them.

- The Error Correction Mechanism (ECM) is a means of reconciling the short-run behaviour of an economic variable with its long-run behaviour

4.3 Panel Data Models

- Pools time series information across cross-sectional units.

- Pooling over individuals, firms, countries, or regions over a specific time period.

- The general structure of such a model:

Equation: $y_{it} = \alpha + \beta x_{it} + u_{it}$

where, $u_{it} \sim IID(0, \sigma^2)$ and

i = 1, 2,....., N individual-level observations,

and t = 1,2,.....,T time series observations.

4.3.1 Advantages of Panel Data

(1) Panel data increases the number of data points.

(2) Reduces collinearity among the explanatory variables thus improving the efficiency of the econometric estimates.

(3) The use of longitudinal data allows analysing a number of important economic questions not readily answerable by either a cross-section or a time-series data alone.

(a) *Example 1:* In a cross-section of married women 50 percent are found to work. What can be the interpretation? (1) Each woman has a 50 percent chance of working; or (2) 50 percent of women always work and 50 percent never.

(b) *Example 2:* In a cross-section of male workers the unionised workers are seen to earn higher wages. Again two possible explanations: (1) either unions raise wages; or (2) unionised firms in response to higher unionised wages select higher quality workers.

(4) Dynamic effects cannot be estimated using cross-sectional data. Even time series data are imprecise:

Example: $y_t = \sum_{\tau=0}^{h} \beta_\tau x_{t-\tau} + u_t$

The model posits a dynamic relationship between *y* and *h-1* lags of *x*. In estimating this, using only time series data, multi-collinearity lowers the precision of the estimates. Panel data models can provide greater variation in the *x* variable for a given year thus reducing the degree of multi-collinearity and improving the precision of the estimates.

(5) Panel data models can take into account a greater degree of the heterogeneity that characterises individuals, states, firms etc. over time.

(6) Panel data models can often control for omitted or unobserved variables.

4.4 Limitations of Econometric Models

- There is a heavy resource requirement when dealing with econometric models. Good quality data sets are required to ensure sensible coefficient values, a factor that often limits the scope of such models.
- Gravity models explain and measure the effect on trade flaws of a policy that has already been implemented. Unlike CGE models, they are not used to predict the impact of introducing a new policy. They can be used as a policy guide only to the extent that past policy impact may serve to understand the implications of a change in future policy.
- The results of econometric models depend on the appropriate '*proxies*' and '*instruments.*' Biased estimates as a result of wrong '*proxies*' and incorrect '*instruments.*' For example, Rodrik and Rodriguez (2001) observe that Dollar's 1992 two indices of outward orientation are inappropriate and misleading, hence produces biased results.
- Typically, technology is assumed to be exogenous, although much of the more recent analysis of convergence and the 'new growth' literature emphasises the important role of endogenous effects linked to human capital growth. Because potential output can never be observed there is more debate over how it should be measured, leading to different structures, different model properties, and ultimately different evaluation results.
- A common criticism of macroeconomic models where aggregate production functions are used is that they are not consistent with microeconomic theoretical foundations of profit maximisation and/or cost minimisation by producers. The aggregate relationships are not built up from consistent demand and cost functions which retain the properties that are desirable in economic theory.
- A sequence or a vector of random variables is heteroscedastic if the random variables have different variances. The complementary concept is called homoscedasticity. The term scedastic is Greek for 'variance', which, when combined with hetero, meaning 'different', gives us heteroscedastic, or different variance. For example, the error term could vary or increase with each observation, something that is often the case with cross sectional measurements. Heteroscedasticity is often studied as part of econometrics, which frequently deals with data exhibiting it. The model using ordinary least square (OLS) will produce unbiased but inefficient estimates, if the problem is not addresses properly.
- Autocorrelation occurs when assumption IV of the classical LRM breaks down, meaning that the error term observations in a regression are correlated. This

phenomenon is common in time series data and causes OLS estimates to lose some of their nice properties. The model using OLS will produce unbiased but inefficient estimates, if the problem is not addresses properly.

5. Basic Features of CGE Models

5.1 What is Meant by Computable General Economic (CGE) Model?

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Computable general equilibrium or CGE models are in essence numerical models based on general equilibrium theory, which are implemented in the form of a computer programme. These models have a number of features which make them powerful tools of analysis. Most importantly, they are multi-sectoral and in many cases multi-regional and the behaviour of economic agents (producers and consumers) are modelled explicitly through utility and profit maximising assumptions. In addition, they differ from other multi-sector tools of analysis in that economy-wide constraints are rigorously enforced, e.g. expansion in one sector can usually only occur at the expense of another, given limited resources.

Starting from some calibrated base, experiments are conducted by *shocking* the initial equilibrium, introducing distortions or removing existing ones, and observing the new equilibrium which results. Distortions in an economic system will generally have repercussions far beyond the sector in which those distortions occur, and where the distortions are wide-ranging, general equilibrium is perhaps the only method which is capable of capturing the relevant feedback and flow-through effects. **CGE provide a precise numerical answer to the question "what is the impact of .....(a numerically specified trade policy)?"**

CGE Generally introduces assumptions on:

- Market structure (imperfect competition).
- Production function.
- Representative household max behaviour.
- Government behaviour.
- Substitutability between domestic and foreign products (Armington assumption).
- Investment and dynamics.
- Model closure (unemployment?).
- Social Welfare = Welfare of the representative household.

5.2 What is Social Accounting Matrix (SAM)?

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CGE models are based on a SAM database. In principle, CGE calculates a subset of parameters that together with the SAM and imputed values for the elasticities can replicate the data of the reference year (baseline). The following are features of SAM:

- The main strengths of the SAM based approach are the comprehensiveness of the coverage of economic accounts, their inter-linkages and the consistency of the accounts (aggregate income must be equal to aggregate expenditure).

- A SAM is only a database, not a model. It can be as aggregated or disaggregated as desired, or as permitted by the data. It may focus on a particular sub-sector of the economy on the production side.
- An agricultural SAM may have 15-20 agricultural sub-sectors (e.g. major individual crops, food crops, export crops, processing, marketing etc) and a smaller number from rest of the economy, e.g. industry, services etc. It could include many household groups that receive incomes from the resources that they provide to these activities, and which consume the products of the activities. In other words, its design can be very flexible, depending on the focus of the study and availability of statistics.
- SAMs can be constructed at different levels. Besides the national SAMs, there are analyses based on regional SAMs and village SAMs.
- Even before a SAM is subjected to some form of behavioural modeling analysis, the statistics can be very revealing. For example, a SAM will show income levels generated by various economic activities, and their distribution to various household groups. Thus, it already illustrates a lot about how various economic sectors are contributing to household incomes and food security.
- The construction of a CGE requires much additional information, e.g. how various economic accounts would be linked, parameters describing how producers, consumers and other economic agents would react (supply-demand elasticities, substitution elasticities).

Table 5: Example of a Social Accounting Matrix for an Open Economy

	Expenditures								
	Activities	**Commo.**	**Factors**	**Ent.**	**HH**	**Govt.**	**Cap. Acc.**	**ROW**	**Total**
Activities		Gross output							Total sales
Commodities	Intermediate goods demand				HH Consum.	Govt. Consum.	Invest.	Exports	Agg. demand
Factors	Value added							Factor service exports	Factor income
Enterprises			Gross profits			Transfers			Enterprise income
Households			Wages	Dist. profits		Transfers		Foreign remitt.	HH income
Government	Indirect taxes	tariffs	Factor taxes	Ent. taxes	Direct taxes				Govt. revenues
Capital account				Ret. earnings	HH savings	Govt. savings		Capital transfers from abroad	Savings
Rest of the World		imports	Factor service imports		Transfers abroad	Transfers abroad	Capital transfers abroad		Foreign exchange payments
Total	Total Costs	agg. suply	Factor exp.	Ent. Exp.	HH exp.	Govt. exp.	Invest.	Foreign exchange receipts	

Source: Reinert, K. A. and Roland-Host, D.W. (1997), Adapted from Piermartini R. and Teh R. (2005).

5.3 CGE Models: Advantages and Disadvantages

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Table 6: CGE Model: Advantages and Disadvantages

Advantages	Disadvantages
I. A general equilibrium setting is preferable when the policy experiment to be modelled affects simultaneously many countries and many sectors. II. The GEF allows considering consumption of all goods by the rest of the world thus allows to estimate income effect of non-reciprocal preferential treatment, which is not possible by partial equilibrium analysis. III. General equilibrium model can capture inter-sectoral linkage effects. IV. Partial equilibrium models neglect offsetting effects following liberalisation and working through inter-sectoral shifts, factor price adjustment and exchange rate changes. The GEF addresses these issues reasonably. V. Perhaps a neglected but very useful feature of CGE model is that they discipline thinking about how economies actually work, and that is a vital prerequisite for sound policy making. The "general equilibrium" character of CGEs reflects the interdependency of economic variables- the notion that every change affects a range of other elements in an economy. It would be poor policy making, for example, to assume that an export tax on a raw material is necessarily a good thing for the economy as a whole because it encourages industrialisation by lowering the domestic price of the raw material that is an input into manufacturing. A CGE simulation will also show that, among other things, the reduced domestic price will lower the incomes of producers of the raw material (perhaps a low-income segment of society) and probably reduce supply as well. These ripple effects of policy changes need to be taken into account when governments consider their options. VI. The utility of a CGE construct in understanding complex and sometimes unexpected interactions in an economy should	I. Results are sensitive to elasticities used, which are fixed for a particular situation. (Constant elasticity of substitution among exports of different origin), which have strong implication for the estimate of trade creation or trade diversion. II. The Armington assumption states that commodities imported and exported are imperfect substitutes of domestically produced and used commodities. This assumption is necessary to take into account two-way trade, while an unrealistically high degree of specialisation is avoided. The imported (exported) and domestically produced (demanded) commodities are aggregated into a new composite commodity using constant returns to scale like constant elasticity of substitution (CES) (Constant Elasticity of Transformation (CET) functions. This may lead to over-estimation of terms of trade effects. III. The model is based on assumption of perfect competition, absence of market failures and non-convexities in production. However, the perfect competition is not characteristic for majority of products traded in the world market. It is to be mentioned that this drawback is representative of all methodologies. IV. It is assumed that factors are immobile across the national boundaries. However, the mobility of capital is one of the fundamental factors accelerating globalisation. Thus, ignoring the movement of capital across the border (particularly when it happens in response to incremental market opportunities) is a major weakness of the method. V. The constant elasticity of substitution undermines efficiency gain and productivity factor in international competition.

not be underestimated.	

5.4 Types of CGE Model

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5.4.1 Static CGE (Single Country)

In a comparative static approach, one examines how a change in policy changes the endogenous variables. The concern is with discerning the difference between the initial and final equilibrium of the economy and not with the transition required to move from the initial equilibrium to final one. How much do prices, production, trade and welfare differ between the initial and final equilibrium of the economy? Most CGE models are comparative static in nature since they are theoretically simple and computationally easier to solve. Examples of studies which used static CGE model have been presented on the following Box:

Box 5: Examples of Studies Based on Static CGE (Single Country Model)	
Building Applied General Equilibrium Models With GAMS Examples and Additional Utilities *- Keyzer, M (1997)* This paper uses a CGE model to compare the 1993 system of agricultural supports to the less distorting 1996 system. In the absence of exogenous shocks, the newer system is better for the economy. All macroeconomic indicators increase, and even the agricultural sector experiences increases in output. When the economy is subjected to a negative external shock, the prognosis is not so clear. The exchange rate shock simulated in this study negates the inefficiencies of the 1993 system, by funneling resources from the protected crops toward the export crops.	**Welfare and Poverty Impacts of Policy Reforms in Bangladesh: A General Equilibrium Approach** *-Khondker B. H. and Raihan S. (2004)* Khondker and Raihan (2004) also examine the impact of different policy reforms in Bangladesh in a general equilibrium framework, and find that full trade liberalisation generates negative consequences for the macro-economy as well as for the welfare and poverty status of households. The paper also indicates negative implications for the macro-economy, welfare and poverty because of declining exports of garments as a result of the phasing-out of the Multi-fibre Arrangement in the international market.
Analysis of Tariff and Tax Policies in Bangladesh: A Computable General Equilibrium Approach *- Khondker, B. H. (1996)* Using the 1988-89 SAM for Bangladesh, Khondker (1996) develops competitive and non-competitive variants of static CGE models and examines the impact of tariff liberalisation under different policy scenarios. The study points out that trade liberalisation has differential impacts on different sectors in the economy and the outcomes of trade liberalisation also vary with the model structure: whether the model is competitive or non-competitive. The study finds	**A Computable General Equilibrium Analysis of Alternative Economic Policy Strategies for Agriculture in Bangladesh** *-Rahman, S. M. (2001)* Rahman (2001) develops a CGE model for the Bangladesh agriculture using a SAM for 1994-95 and simulates different policy options under trade and tax policy reforms. One of the conclusions of this study is that liberalisation of foreign trade should relate both to the structure of domestic industry and government finances. Without properly identifying the sectoral weaknesses, liberalisation might hamper the growth of output in the short run. It is also pointed out that trade

that in the competitive and constant returns to scale model variant, resources move from the heavily protected sectors to the less protected sectors as a result of tariff liberalisation. In contrast, the heavily protected manufacturing sectors turn out to be the main beneficiaries of liberalisation when imperfect competition is introduced. The expansion of manufacturing output appears to come from the pro-competitive effect of tariff liberalisation. Almost all the manufacturing sectors show much larger output growth with the incorporation of increasing returns to scale. The larger expansion of output of manufacturing sector is due to a reduction in unrealised scale economies.	liberalisation policies should be conceptually separated from fiscal policies as a source of government revenue. Because of the narrow internal revenue base of Bangladesh, tariff continues to play a major role as a potential source of government income. The revenue consequences of a tariff reduction ought, therefore, to be a matter of concern for the economy of Bangladesh.
Opportunities and challenges in agriculture and garments: A general equilibrium analysis of the Bangladesh economy *- Arndt, C., Dorosh, P., Fontana M., Zohir, S., El-Said, M. and Lungren, C. (2002)* Arndt *et al.* (2002) look at the opportunities and challenges in the agricultural and garments sectors in Bangladesh through a number of simulations relating to trade policy reforms. Overall, these simulations illustrate the importance of trade policy and the links between Bangladesh and the world economy as far as the impacts of the reforms in agricultural and garment sectors are concerned.	**Welfare and Poverty Impacts of Tariff Reforms in Bangladesh: A General Equilibrium Approach** *-Mujeri, M. and Khondker B.H. (2002)* The paper by Mujeri and Khondker (2002) examines different trade liberalisation scenarios for the Bangladesh economy, considering various way ways of compensating revenue losses resulting from the removal of tariffs. This paper comes to the conclusion that the short-run impacts of trade liberalisation of the real GDP growth and on the welfare of the households are negative. The paper also suggests that partial trade liberalisation is a better option than a wholesale liberalisation.

5.4.2 Dynamic CGE (Single Country)

It has often been argued that the impacts of trade Liberalisation are not static, rather dynamic in nature, and, thus the medium and long-run impacts are likely to be different from the short-run impacts. Therefore, a CGE model, taking into account the dynamic aspects of trade policy reforms in the context of Bangladesh economy, is much warranted. Box 6 presents one such example.

Box 6: Examples of Studies Based on Dynamic CGE (Single Country Model)

Implications of WTO Agreements and Domestic Trade Policy Reforms for Poverty in Bangladesh

Nabil Annabi, Bazlul H. Khondker, Selim Raihan, John Cockburn and Bernard Decaluwe

Working Paper MPIA 2005-02

The paper examines the impacts of WTO agreements and domestic trade policy reforms on production, welfare and Poverty in Bangladesh. A sequential dynamic computable general equilibrium (CGE) model is used allowing for long run analysis which takes into account accumulation effects. The study is based on 2000 SAM of Bangladesh including fifteen production sectors, four factors of production (skilled and unskilled labour, agricultural and non-agricultural

capital), nine household groups (five in rural areas and four in urban areas), based as per the year 2000 household survey. The representative household approach with actual intra-group income distribution is used to examine the link between the micro and macro effects in terms of poverty. The study presents five simulations for which the major findings are:

1. The Doha scenario has negative implications for the overall macro economy, household welfare and poverty in Bangladesh. Terms of trade (ToT) deteriorate and consumer prices, particularly food prices, increase more than nominal incomes, especially among poor households.

2. Free world trade has similar, however, larger impacts.

Figure 1: Aggregate welfare effects path)

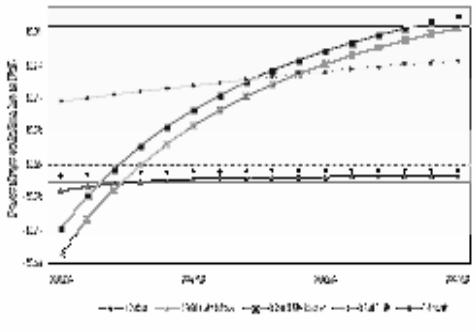

Table 7: Macro results (Percentage change from BaU

3. Domestic trade Liberalisation induces an expansion of agricultural and light manufacturing sectors, favourable changes in the domestic terms of trade. Although the short run welfare and poverty impacts are negative, these turn positive in the long run when capital has adjusted through new investments. Rising unskilled wage rates make the poorest household the biggest winners in terms of welfare and poverty reduction.

4. Domestic Liberalisation effects far outweigh those of free world trade when these scenarios are combined.

5. Remittances constitute a powerful poverty-reducing tool given their greater importance in the income of the poor.

5.4.3 Differences between Static and Dynamic CGE

Table 8: Static vs Dynamic CGE Approach

Static Approach	Dynamic Approach
I. A standard static CGE model examines the one-period sectoral reallocation of resources. II. While the agents, in a static CGE setting, optimise their with-in period decisions, they are not allowed to optimise their between-period decisions, such as savings and investment. Therefore, the equilibrium prices obtained in a static CGE model are not in equilibrium over time. Thus, the policy conclusions derived from a static CGE model could be problematic.	I. A dynamic CGE model analyses the path of a transitional dynamic toward a new steady state after an initial shock. II. In contrast to a static CGE model, a dynamic counterpart is characterised by the inclusion of a driving force to move the economy from period to period. This driving force may relate to the growth in the underlying labour force or to a change in the level of technology in one or more sectors of the economy.

III. The consequences of most policy reforms are dynamic in nature. Therefore, the impact of a policy reform, for instance, trade liberalisation, is more likely to be captured by a dynamic CGE model rather than by a static one. IV. One limitation of this approach is that it may fail to capture some of the costs and benefits associated with the transition and so overstate or understate the benefits from the change in trade policy. For example, for the benefits of trade liberalisation to be realised, resources have to be moved from uncompetitive sectors to sectors where they can be more productively used. But this reallocation process may require workers to be retrained. Workers may also suffer temporary spells of unemployment during the transition. Capital that is specialised to the contracting sectors of the economy may not be transferable to the expanding sectors without expensive retooling. All the costs associated with this re-allocation of resources will not be included in a comparative static analysis.	III. In a dynamic CGE setting, similar to the static one, a process of calibration is required to replicate the actual output for each sector in a specific base year. Moreover, it is expected that the economy would grow according to a steady-state growth rate, and all sectors, quantities, and factors of production in the initial base-run are also required to grow at the same steady-state rate. IV. In a dynamic CGE setting, the welfare gains would be higher than in a static one, because trade liberalisation is thought to generate dynamic gains which are only realised over time. V. Dynamic analysis examines not only the nature of the final equilibrium but also the evolution of the economic system from the initial to the final state, Therefore, in theory, dynamic models will be able to capture some of the costs associated with adjustments to changes in trade policy. VI. Dynamic models allow other "dynamic" effects to be included in the analysis, which can dramatically change the estimates of the effect of a trade policy. Two important examples of these dynamic factors are capital accumulation and technological change. VII. With a dynamic equilibrium analysis, it is possible to examine whether changes in trade policy affect the rate of investment or accelerate the pace technological innovation. The process of capital accumulation and technological innovation are two of the most powerful sources of economic growth.

5.5 Multi-country Model- GTAP

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5.5.1 What is GTAP?

Global Trade Analysis Project (GTAP), established in 1992, is a global network of researchers and policy makers conducting quantitative analysis of international policy issues. GTAP's goal is to improve the quality of quantitative analysis of global economic issues within an economy-wide framework. The project consists of several components:

- A fully documented, publicly available, global database
- Software for manipulating the data and implementing the standard model.
- Bilateral trade flow data
- Bilateral duty collection data
- A standard modeling framework

- A global network of researchers, linked through internet, with a common interest in multi-region analysis of trade and resource issues
- A World Wide Website (www) for distributing software, data, and other project-related items of interest
- A consortium of national and international agencies providing leadership and a base level of support
- Perfect competition and CRS
- Goods are differentiated by country of origin
- Explicit treatment of international trade and transport margins
- No direct link between public expenditure and taxes
- Global Banking sector

Most of the GTAP models are static. However, recently some dynamic models are under construction.

5.5.2 Limitations of GTAP

- Some sectors in some countries could be characterised by imperfect competition and economies of scale.
- Armington assumption does not allow for the relocation of firms.
- Absence of the variety effect.
- The use of a global banking sector is due to the lack of bilateral investment and ownership data.
- No specific treatment of domestic vs foreign investment.
- Only a small proportion of domestic savings will return to a region as investment.
- Not appropriate to look at issues related to the composition of public expenditures.
- Labour market issues cannot be dealt with properly. However, some of the assumptions can be relaxed/modified (*Diversity of Approaches*).

5.6 Limitations of CGE Model

- One of the criticisms of such models is that they fail to disaggregate the impact over different groups of individuals (or, as in a number of the World Bank studies, even between different countries within regions).
- The conclusions of such exercises can be challenged on the basis of the assumptions used regarding, for example, the extent of price transmission and supply response. As indicated above, non-modeling approaches can be usefully combined with modeling approaches to improve the model equations.
- Data should be carefully taken.
- Results depend on econometric model.
- Most of the CGE models are static. That is, they consider the role that changes in relative prices have on the allocation of goods amongst consumers and resources amongst productive activities, and the consequences for economic efficiency. These models have no explicit time dimension. The results of static simulations are often interpreted as representing how the economic system in question would have looked, had the new policy been in place in the base year, after all relevant adjustments had taken place.

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