10. GENERAL EQUILIBRIUM DYNAMIC MODELS AND THE DOHA ROUND IMPACT ON UNDERDEVELOPED ECONOMIES

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Abstract

The authors have focused on the provision of a general outlook on global multiregional models that enable the study of the effects of commercial policies, and have particularly analysed the models that can be applied to underdeveloped economies. Starting from a simple model, the hypotheses introduced into general equilibrium models are analysed, focusing on the study of commercial policies. Following a synthetic description of the main Walrasian global multiregional models, selected according to the possibility of applying these instruments to the analysis of commercial policies in underdeveloped countries, attention is particularly given to the main limitations entailed by these models, thus emphasizing their disagreement with the characteristics of the underdeveloped economies. Moreover, the study underlines the hypotheses according to which these models would not be suitable for the economies of those states. The authors also insist on the impact of the possible scenarios derived from the Doha Round, which have caused significant assessment differences.

Keywords: general equilibrium models, trade policies, trade predictions, Doha Round scenario
JEL Classification: F12

Introduction

The use of instruments for the quantitative analysis of economic policies has been quite significant in the past few years. Simulation models have been constantly improved, as far as calculus techniques were concerned, thus triggering changes in the general theory, in order to provide a more accurate picture of the real dynamics.

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The Walrasian theory of general economic equilibrium does not undergo profound changes for a period of 20 years, between the time the first theoretical contribution of Walras was published (1874) and the moment his fourth edition of *Eléments d'économie politique pure* (1900) came out, the event that also ended the long and creative period of this economist. This paper does not attempt to recreate the evolution of Walras's scientific work, but focuses on the existing links between balance, imbalance and time in the numerous models that Walras developed and continued to elaborate on during those years.

This paper aims at providing a general outlook on global multiregional models that focus on the study of the effects of commercial policies, particularly on models that can be applied to underdeveloped economies. The first part of the paper will emphasize the main differences between general equilibrium models and partial equilibrium models, with particular focus on their common, Walrasian nature. The second part of the paper will introduce certain studies on the impact of the possible scenarios derived from the Doha Round, in order to assess better whether the use of various models or the use of different versions of the same model can lead to different forecasts. Where possible, we will also try to identify the causes.

1. The evolution of the Walrasian theory of general equilibrium from 1847 to 1900

Walras's main work, which presents the most articulate and complete description of his theory of general economic equilibrium, is, without a doubt, *Eléments d'économie politique pure*. Four parts of this work have been published during his lifetime: the first edition, divided into two volumes, was published in 1874 and 1889; the three successive editions, all as single volumes, were published in 1889 (2nd edition), in1896 (3rd edition) and in 1900 (the 4th edition, while Walras was still alive). These four volumes are closely connected to the first edition of *Eléments*; the first two, "memoires", mostly cover the arguments debated in the 1st edition of *Eléments*; of these, only the first study (*Principe d'une theorie mathematique de l'échange*, January 1874) was published before the 1st volume of the first edition of *Eléments* – July 1874; the second (*Equations de l'échange*) was finally published in October 1876. The other two "memoires" – *Equations de la production* and *Equations de la capitalisation*, which mostly cover the arguments discussed in the 2nd volume of the first edition of *Eléments*, were published in October 1876 and March 1877. The four "memoires" were incorporated by Walras in 1877 in a "brochure", called *Théorie mathématique de la richesse sociale*, subsequently republished in 1883, with the same title but in a revised and unabridged edition that included the four original "memoires" and three more that were written afterwards.

We must underline the fact that the two subsequent papers, written separately, were published in 1891 and 1892, respectively, in an attempt to reconstruct Walras's theory of balance and imbalance; these two papers were later reviewed by Walras and merged into one single document that was published as Annex I in the 3rd edition (1896) and the 4th edition (1900) of *Eléments*, under the title of *Théorie geométrique de la détermination des prix*.

In the texts quoted above, and especially in *Eléments*, Walras developed his own theoretical system for successive periods, aiming at a certain constructive and layout method that has partly survived till this day, under the name of "the theory of general economic balance".

Walras's method consists in the development of a succession of standard models, arranged in an ascending extension order; the models are called *standard* because the applicative area described by each model is much wider than the one described by the previous model (provided that there is a previous model). Each model includes the previous model and is subsequently included in the following one (provided that the previous and/or the following model exist).

Throughout the editions of *Eléments*, the four "memoires" and the other works quoted above, three models were developed: the effective change model – which deals with the exchange of commodities (consumer goods), one for the other, i.e. the comprehensive exchange, made up of an arbitrary finite number of goods (consumer goods); a model of exchange and output, which, apart from the fact that it includes the previous model (from a certain viewpoint, this model is partly analytical) is dealing with the conversion of productive services into consumer goods; and, finally, a model of capital formation, which, apart from the fact that it includes the previous model, also analyses the problem of converting the production services into capital assets for the new output. The structure of these three models, characterized by mutual relations, stays unaltered in all the editions of *Elements* (as emphasized by Walras himself in the preface to the 4th edition – 1898, p. 5). Walras explicitly develops a fourth model in his 4th edition, a model that, apart from dealing with the issues raised in the third model, also tackles the issues of circulating capital and currency. Currency-related issues were already discussed in the preceding editions, but it was only in the 4th edition, as Walras himself stated in the preface (Walras, 1988, pp. 8-9), that monetary issues were integrated into the real formal apparatus of the theory.

It is also very important to mention that after the first edition of his work, Walras developed the general analytical architecture of his own theory by saving a special chapter for issues related to circulating capital and currency (Walras, 1988, pp. 276-277); this chapter stayed unwritten for a quarter of a century and was formally completed only after 1900.

2. Theoretical and empirical solutions in Walras's equilibrium models

According to Walras, after a specific problem is formalized through a mathematical model, things must be completed, but only if preceded by explanations of how the model can be "solved" and followed by the identification of the appropriate "solutions". When talking about formal models, on which the general equilibrium theory is also based, Walras argues that, in order to "solve" a certain model, one would need a special two-level solving procedure, each level being associated with a specific notion, classically entitled "solution".

Walras also states that in order to solve a system, a theory should meet at least two distinct requirements, each involving the completion of several steps.

For instance, for any given economic issue, identified through a set of data or well-defined conditions, the theoretician should develop a formal model of the problem and specify an "equation system" that would appropriately incorporate the data and the conditions (parameters, functions, relations) of that specific issue; for Walras, the number of equations must "necessarily be equal to the number of unknown variables". According to his own approach to each of the four equilibrium models, Walras anticipated a system of equations and ensured that in each case the number of known variables coincided with the number of independent equations. Walras suggested in his numerous theories (for each model) that the equality of the number of unknown variables and the independent equations should be a sufficient condition to guarantee the solving of the system of equations and the assessment of the equilibrium associated with a certain model.

The successful completion of the ordinary algebraic equations that describe the economic problem were called by Walras "the theoretical and monetary solution" or "the scientific solution" to the problem or, as some might say more precisely nowadays, the solution of the model that represents it (Walras, 1988, pp. 93, 307, 375; 1988, p. 189, 2nd and 4th editions).

It is not very clear whether Walras believed that the "theoretical and mathematical" solution of a certain system of equations could be calculated by the theoretician who formulated these equations; in this respect, Walras assumed for a few months two seemingly contrasting positions: actually, in "memoire", published in January 1874, he simply referred to the exchange of two goods, one for the other (see Walras, 1874, p. 37, and Walras, 1988, p. 93).

The apparent contrast between these two statements assumed by Walras on applying either theoretical solutions or computability of equilibrium in the actual exchange model will come second. More specifically, it is a situation when, in both steps mentioned, Walras insists on the fact that the definite assessment of the solutions or the actual attaining of equilibrium in the actual exchange model is the moment of "empirical output" or of the practical mechanism of competition on the market, manifested through the "rising or lowering of the prices". In other words, even if the theoretical solution is either coherent or not from the viewpoint of the calculus principle, it comes second when it is universally known that in any given situation the market is the one that "solves" the problems, either empirically or practically.

This information will lead us to the second requirement, which, according to Walras, must be met before a model can be considered "solved". In his opinion, attention is given to the fact that "the very array of reality phenomena is the empirical solution of the system of equations" the examined model is translated by. This necessity affects the entire Walrasian theoretical framework, even if Walras never succeeded in rationalising and expressing in an acceptable manner the theoretical implications of his approach.

In fact, in order to meet the second requirement asserted by Walras, theoreticians should proceed in the following manner: first, the system of ordinary algebraic equations that describe the equilibrium model under examination should be accompanied by a system of functional equations used to describe the "array of reality phenomena". In other words, the system of functional equations associated to each

equilibrium model should be an imitation of the dynamic process, based on the raising or lowering of the prices (in the case of exchanges) through which the "market competition mechanism" achieves the original "empirical solving of the ordinary system of equations".

This objective normally requires that the dynamic process described by the system of functional equations must be compatible with a stationary solution that would then be described as an "empirical or practical solution" reached by the market. Secondly, this stationary solution must coincide with the "mathematical or theoretical solution" of the system of ordinary equations described in the model. Walras does not avoid the tasks set out in his methodological statements; actually, for each of the four equilibrium models, the theoretician is trying to create a specific system of functional equations that interprets as an idealised representation of the competitive corrective mechanism for attempts and errors, i.e. "par tâtonnement" (Walras, 1988, p.189, 2nd and 4th editions). This is the origin of the word "tâtonnement", used in the Walrasian adjustment process. Walras is trying to demonstrate that the dynamic process encounters a stationary solution every day, interpreted as an "empirical or practical solution" provided by the market mechanism and invariably coinciding with the "mathematical or theoretical solution" of the system of ordinary equations that describe a model of relevant equilibrium (Walras, 1988, p. 461, 4th edition). As for the dynamic aspect of the theory, Walras' mathematical abilities can be qualified as modest, when contrasted with the brilliance he proved in creating the equilibrium models and in solving the associated systems of ordinary equations. Actually, Walras could not formalise the process of dynamic adjustment through a system of differential equations. Practically, he could not prove that the dynamic process agreed with a stationary solution. Based on heuristic attempts, Walras argued in the first edition of *Eléments* that, in each case, the dynamic adjustment process encountered a stationary solution that coincided with the "theoretical or mathematical" solution of that particular equilibrium model.

Wicksteed warned him after 1884, through a counter-example, that the assumed "demonstration" of the convergence of the dynamic adjustment equilibrium process was false. But Walras continued to stand by his own theories by replacing the word "convergence" with a less compromising phrase – "probable convergence", in all the subsequent editions of his work, *Eléments* (Walras, 1988, pp. 195, 326, 328, 2nd and 4th editions, and p. 698, 3rd and 4th editions). The truth value of the argument Walras had retracted is still uncertain as it entails that "the empirical or practical solution" coincides with the "theoretical or mathematical solution". Walras was fully aware of the relevance of these arguments; that is why the practical relevance and the empirical contents of the theory of general equilibrium may be compromised if the competitive market mechanism would not automatically drive the economy. It is obvious that, for Walras, the coincidence of the two solutions was a prerequisite of the theory, as it encompassed precisely the limitations necessity imposes on admissible adjustment processes.

3. The origin and principles underlying the equilibrium models

The general equilibrium model is usually of a Walrasian and non-linear origin, even if it encompasses various aspects. Schubert identifies different approaches in 1993; most of them belong to Johonsen (1960), who develops a first empirical model of linear general equilibrium by using logarithms. In this context, the deterministic model becomes the pioneer of the calibration method, being used to this day in acquiring the value of certain parameters.

Based on Scorf's algorithm (1967), the numerical calculus of Walrasian equilibrium can also be found in the demonstration of Shoven and Wholley (1973) or in the HSSW method (Harberger – Scorf – Wholley), used for solving public finance cases. The contributions of Adelmon and Robinson (1978) generate the first structured CGE model, used especially for solving income distribution problems. There is a noticeable drift from the typical Walrasian rigidity, as the influence and rigidity of the markets are also incorporated. These types of models, created at the World Bank, have been specially designed for underdeveloped countries and this is the very reason why many authors of these models insert rigidity and distortions in the Walrasian model; in many cases, the changes applied affect the macroeconomic structure of the models.

A non-calibrated econometric estimate of CGE models was developed by Jorgenson; this highly complex methodology requires a sophisticated calculus system and a high number of estimation parameters. Ginsburgh, Walbroeck and Manne are looking for a model derived from planned models of linear programming type from the 60's and the 70's. This model uses a format different from the one usually employed, less successful than HSSW, and introduces the hypothesis of a more advanced dynamics. This attempt occurred because the model in question is based on a theoretical framework – as the economy is in a "first best" situation and thus prevents the insertion of distortions into the model and narrows down the applicability area.

4. General equilibrium models for the analysis of the effects of commercial policies in underdeveloped countries

This part of the paper will focus on the features of several CGE models, especially of those multiregional global models of Walrasian origin designed for the study of commercial policies. The models have been selected on the basis of the possibility of being assessed for PVS analysis, which depends, firstly, on the data base they refer to and, secondly, on the correspondence between the theoretical approaches the model is based on and the economic realities of those countries. The basic theoretical structure of these models is constantly evolving, and certain essential hypotheses that are specific to neoclassical theories – already distanced from the realities of underdeveloped countries – can be considered completely inadequate for the analysis of underdeveloped countries.

In 2004, Stiglitz and Charlton underlined the low relevance of those approaches that defined standard analyses of CGE models for calculating the benefits derived from a

commercial liberalization of the economic reality of PVS. We are specifically referring to hypotheses of output factors involvement, perfect competition and completion of financial markets.

GTAP and LINKAGE

Created in early 90's by T.W. Hertlel, through the "Global Trade Analysis Project" initiative, the project was considered by various nations and organisations, among which the World Bank, the WTO, the European Commission, and the OECD.

Commercial and agricultural policies are the particular focus, even if numerous applications are being developed beyond these specific fields. European interest has been particularly directed towards analysing the impact on Europe and the compatibility of the community agricultural policy under the Uruguay Round.

GTAP divides economic activities into 57 sectors and 87 countries or regions, of which 70 are individual countries and five are considered as holding basic factors (the land, skilled and unskilled labour, capital and natural resources). The PVS's are quite representative, even if certain African countries have been aggregated as a consequence of the lack of input and output. The agricultural field is represented by 12 primary sectors, of which eight are foodstuff sectors; there are also significant divisions of the industrial sector, services and fossil fuel extraction. The data concerning commercial protection are provided by Centre d'Etudes Prospective et d'Informations Internationales (CEPII, Paris) and by the International Trade Centre of Geneva (ITC). The information and the data CEPII/MacMap (see Bonet, Decreux, Fontogne, Jean and La Borde, 2005) also concern preferential mutual and unshared agreements. This also entails the need to calculate the equivalent value of certain prices/tariffs and estimate the equivalent TRQ (the tariff reduced quota that consists of a double tariff level aimed at restricting the import of sensitive goods in a certain country, especially for agri-food products) in a particular country. TRQs also affect the effective tariff quota and the most favoured nation tariffs.

Thus, one can measure the importance of preferential access and the difference between consolidated tariffs (or bound tariffs, representing the maximum level that each member state can apply to imported products) and applied tariffs.

The Standard GTAP model is a compared static model; certain studies, such as the one conducted by Boch in 1998, uses the forecasts of the annual output growth rate, of GDP and other variables in order to design the data base in time. The Standard GDP model can be described as a "first generation" model", but it can also adjust to the operating conditions of the second or third generation. The deviation from perfect competition has been analysed by Hertel in 1997 and François in 1998, as the dynamics analysis was conducted by McDougall in 1998; aspects related to the dissemination of international technologies can be found in Van Tongeren and Van Mijil H., in 1999.

A model that had been developed by the same standards as GTAP, but with a supplementary recursive dynamic structure, is the LINKAGE model, developed by Kym Anderson at the World Bank in 2005. The dynamics is concerned with demographics and the rising exogenous job opportunities, while economies are analysed in close connection with the accumulation of capital.

MEGABARE and **GTEM**

The MEGABARRE model and its recent GTEM version are recursive dynamic models of the world economy, developed by the Australian Bureau of Agricultural and Resources Economics (ABARE) under the supervision of Kevin Hanslow. The data base this model was developed on was the GTAP, while the data concerning output, export and prices of energy were provided by the United Nations Industrial Statistics Yearbook. The main objective is to create a dynamic general equilibrium model that would be appropriate when analysing the effects of the environment, rather than international commercial policies and, especially, for agricultural commercial reforms.

These are recursive dynamic models because they encompass a partial adjustment of stock capital, of population growth and of labour force. The investments in physical capital follow a partial adjustment procedure, influenced by the increasing deposits made by the population ranging between different age groups and different regions, as well as by the international capital flows. An added structure consists in a dynamic model that simulates demographic growth, by taking into account both the local and the migrating population, and the increasing labour force, by looking at the entries and exits in each time period.

MICHIGAN

The MICHIGAN model can be described as a static model compared with the second generation models with monopolistic competition in the manufacturing sector. This model was created in the second half of the 70's, under the supervision of Brown, Deardoff and Stern - the BDS model. The main objective was to analyse the effects of commercial liberalization policies, especially the effects on multiregional agreements. The data base includes 34 countries (including EU-12) and 29 sectors. It is not a model designed for analysing the agricultural sector, as this sector is considered as a single aggregate. The model only refers to the industrial and the services sector.

A restrictive Cobb-Douglas functional form is used in the case of demand. The model differs from the standard one since it introduces monopolistic competition and the Armington hypothesis for the supply as well. The model demonstrates the scale and variety effects, but the manufacturing sector is the only one that is modelled under imperfect competition.

As far as the supply is concerned, the model cannot represent the quantitative demand of production, considering the aggregated basis of products of the agricultural sector. The commercial balance is fixed, so that investment will not be modelled to use a "long-term" conventional closure.

The model incorporates nominal tariffs, apart from the import rates and other non-tariff barriers, such as endogenous equivalent tariffs. The present tariffs combine nominal tariffs and those equivalents of the non-tariff barrier. As for technical barriers, the model introduces different hypotheses about the intensity of the liberalization of certain sectors. Exports are not modelled, given the very low level of dispersal of the agricultural sector.

MIRAGE

The MIRAGE model (Modelling International Relationship in Applied General Equilibrium) was created by Centre d'Etudes Prospectives et d'Informationales of

Paris. The model is primarily concerned with the factors influencing commercial flows and the way in which these flows can have an impact on the economy.

The production level of each sector is calculated by a function created by Scontieff for value added and intermediary inputs. The intermediary input is given by a CES function aggregated for all goods; the added value is a CES function of natural resources, land, unskilled workforce and an aggregated CES of skilled labour and capital. The form of the CES function has several levels, requiring a less substitutable capital and skilled labour between these two factors and others.

The only factor for which the supply is constant in time is the human resource factor; the capital supply changes every year as a result of investment depreciation. The land provided is endogenous and its supply depends on the real remuneration rate.

In certain countries, the land is a reduced factor (the EU, Japan, etc.), and the elasticity of supply is very low; in others (Australia, Canada, Brazil, Argentina), there is plenty of land, and elasticity is very high. The capital is assigned the pretty-day nature within each sector, a necessary approach in order to consider the adjustment costs associated to commercial liberalization. Investments play a crucial role, since they are the only factor that allows the stock management of the sectoral capital. The same technique is used for external investments, based on the return on capital manifested in the receiving sector. Skilled labour is the only completely mobile factor, as land is not perfectly mobile in the agricultural sector. The allocated capital and the natural resources are specific to the sector they belong to and unskilled labour is not perfectly mobile between the agricultural and non-agricultural sectors, according to a CET function.

The model incorporates a Cournot-type imperfect competition, with variable profit margins. The "zero profit" requirement is valid in the basic year and for long term, but not throughout the successive adjustment periods of a stock. The adjustment speed of the number of enterprises varies between sectors, depending on their market structures (fragmented, segmented, etc.). A new calibration procedure is used to identify the coherent and exhaustive use of the information available on the concentration level of enterprises, the degree of product differentiation and profit rates.

Finally, the inertia and the adjustment costs are different in terms of restrictions applied to the amassing of the factors and the adequacy of the number of enterprises per sector, assuming the sectoral immobility of the already allocated capital.

The dynamic adjustment is sequential in nature and may occur progressively, in certain stages, throughout the liberalization process. In order to serve commercial protection more accurately, the MacMap data system is used, a system we have referred to when presenting the GTAP model.

WTO Model

This model was designed in order to assess the effects of commercial liberalization in multilateral negotiations and to support the preparation of the negotiation rounds (Francois, McDonald and Nordstrim, 1995); this model may be considered a first generation model as it introduces several imperfect competition hypotheses.

The model covers 13 regions and another 19 production sectors; agriculture is represented by three primary sectors and a foodstuff sector. The basic elasticity values mirror the extrapolations of the GTAP data. The subsequent information for commercial protection of the countries enjoying the most favoured nation clause derive from the GATT Integrated Database, whereas the value of the equivalent tariff for non-tariff industrial values are only collaterally estimated.

This model exists in different versions, while the basic version – compared static, introduces the hypotheses of perfect competition, constant yields and the Armington approach for international trade; a correct version includes the hypothesis of domestic monopolistic and economic competition for each type of enterprise, in line with Dixit and Stiglitz model (1977).

5. The analysis of the studies concerning the Doha Round impact on the economies of underdeveloped countries

The analysis of the possible economic effects derived from the current commercial agreements of the Doha Round, by means of various CGE models, underlines significant differences, both between models and between the different versions of the same model.

The WTO and Doha Round have been monitoring the evolution of the international commercial regime and the negotiations at WTO for several years.

The main objective is to contribute to the development of strategies and to indicate an effective involvement of national/domestic systems at different levels of negotiations.

The complexity of the themes under examination derives from the multiple interests one must take into account, so that the commercial policy of the member states will mirror a local (domestic) demand that would match the one of the group.

If we consider the group of states that are members of the EU, we note numerous negotiations at the regional level; the analysis of the interests and of the strategies of different countries/players must be performed on several levels: national, European, regional and multilateral.

In the past few years, the system of international commercial relations has become highly complex and even more articulate, due to two phenomena:

- The transition from simple forms of commercial integration (shallow integration), limited only to the liberalization of tariff barriers to the exchange of goods, to more complex forms (deep integration). Actually, the current liberalization process is only concerned with tariff and non-tariff barriers, services, copyright, and there is word of new themes being inserted (investments, competition, environment, internal regulations, etc.); all these have radically altered the expenses and the tasks within the WTO member states.
- The strong and gradual involvement, in terms of obligations and responsibilities, of several underdeveloped countries, as well as the role of these average income countries in the WTO sphere.

After almost nine years of negotiations, the Doha Round, the great multilateral negotiation within the WTO launched in 2001, is still facing uncertainties and several scenarios are still open regarding its final result.

The largest part of underdeveloped countries imports goods with high domestic support from OECD producers who, as Charlton and Stiglitz (2004) argued, feel more acutely the impact of commercial liberalization on prices. These countries are just producers and exporters of commodities that do not have the support of the policies of the OECD countries; therefore, we are not surprised that certain studies argue that the greatest part of the OECD countries will face deterioration in terms of agricultural trade, as a result of this type of "global reform" (Anderson, 2005).

There are two reasons why the exporting countries may win: on the one hand, because of the earnings derived from major efficiency and, on the other hand, thanks to improved commercial conditions, if the price of their own exports increases as compared to the price of imports. On the contrary, importing countries will suffer commercial losses that can be compensated by earnings in terms of efficiency, even if these can be slowed down by a very low mobility of factors.

The study conducted by Ackerman in 2005 allows for the analysis of the advantages derived from the possible commercial agreements currently discussed at the Doha Round. The assessment of the benefits derived from commercial liberalization is limited not only in terms of aggregates, as Ackerman argued, but it is often distorted, to the loss of the underdeveloped economies. The expected contribution of commercial liberalization to economic development and alleviation of poverty is very limited; the calculated benefits resulted from commercial liberalization are still being speculated upon.

Numerous empirical limitations of the CGE forecasts derive from the theoretical framework; general models are closed and commercial policies do not trigger changes in the total occupancy structure. Nevertheless, most recent models prove the existence of different results as compared to those obtained through previous models (see MIRAGE).

The forecasts derived from the hypothesis of full commercial liberalization, developed by means of the GTAP 6 and LINKAGE models, published in 2002 and 2005, respectively, can be analysed by means of the data presented in the following table.

Table 1

Benefits of full liberalization

Model	Year	Benefits (billion dollars):	
		Developing countries	World
GTAP	2005	22.00	84.00
GTAP	2002	108.00	254.00
LINKAGE	2005	90.00	587.00
LINKAGE	2003	539.00	837.00

Source: Ackerman (2005).

In both cases, there is a noticeable decrease in the global benefits, by almost one-third, and almost one-fifth in the underdeveloped countries. Both models now predict lower earnings derived from commercial liberalization than they forecasted a few

years ago. In the previous versions, these models used a GTAP 4 or 5 database to describe the situation during 1995-1997.

Even if these models tried to forecast future commercial agreements, they would not fully incorporate the reduction in tariff barriers, the fast growth of East Asian economies and the changes occurring in other economies that make up the model. A disagreement between these forecasts would be that the high figures some are still mentioning are outdated, and the path towards liberalization is overrated as contrasted with the current realities.

The analysis of the data provided by the GTAP model, supplied by Stiglitz and Carlton in 2004, allows us to observe the pattern of earning distribution for certain regions and for certain types of policies applied. What is relevant here is that these earnings are not distributed evenly.

Table 2

Benefits derived from a complete liberalization of the agricultural sector in high-income countries (GTAP) (million dollars)

	Beneficiary region			
Policy	**High-income**	**Transition**	**Developing**	**World**
Import market access	31,811.00	1,606.00	10,376.00	43,793.00
Export subsidies	2,554.00	-488.00	-1,023.00	1,043.00
Domestic support	2,450.00	76.00	284.00	2,810.00
Total	36,815.00	1,194.00	9,637.00	47,646.00

Source: Ackerman (2005).

We observe that over 90% of the effects of agricultural liberalization depend on the removal of import tariffs and quotas. Most of the benefits are for the high income countries, as consumers are favoured by lower prices, while the losses to producers are, on the contrary, artificially minimised by the model.

Table 3

Benefits deriving from a complete liberalization (GTAP)

Liberalizing sector	**Beneficiary region**			
	High-income	**Transition**	**Developing**	**World**
	Total = amounts, billions of dollars			
Agriculture	41.60	2.00	11,90	55.50
Textiles	1.30	-0.20	8,80	9.90
Other	16.60	1.00	1,40	19.00
Total	59.50	2.80	22,10	84.40
	Per capita, dollars per person			
Agriculture	$ 40.00	$ 5.37	$ 2.54	$ 9.09
Textiles	$ 1.25	- $ 0.49	$ 1.88	$ 1.60
Other	$ 15.96	$ 2.44	$ 0.30	$ 3.08
Total	$ 57.21	$ 7.32	$ 4.72	$ 13.77
	Percentage of GDP			
Agriculture	0.16 %	0.25 %	0.24 %	0.18 %
Textiles	0.01 %	-0.03 %	0.17 %	0.03 %
Other	0.06 %	0.10 %	0.03 %	0.06 %
Total	0.23 %	0.32 %	0.44 %	0.27 %

Source: Ackerman (2005).

In the same way, the removal of subsidies will create losses to underdeveloped economies, as the price paid by these countries for foodstuff imports will rise.

By means of the data provided in the above-mentioned table, we can identify the contribution made by the liberalization of various sectors to the total earnings; over 70% of the total benefits of liberalization, from all sectors, are directed towards high income countries; if we report the earnings in terms of percentage of GDP, they are normally higher for the underdeveloped countries – 44% than for the high income countries - 23%.

The advantages, even as absolute value, are higher in the textile sector of the underdeveloped countries than that of the high income countries; we emphasize the fact that these earnings are very low.

In the LINKAGE model, which differs from the GTAP model in its dynamic structure, there is an estimated annual increase from 2001 to 2015, including the effects derived from commercial negotiations. The estimated global benefits in 2015, for a complete liberalization, are three times higher than those forecasted by the GTAP model. The highest difference is a result of the fact that the world economy will be more developed in 2015 than in 2001.

The more realistic hypotheses on complete liberalization, observed by means of the Doha Round scenarios, include the long-term scenario analysed by Anderson in 2005; this scenario refers to an agricultural tariff reduction in developed countries of 45%, 70% and 75%, respectively, and of 35%, 40%, 50% and 60%, respectively, in underdeveloped countries, whereas for less developed countries there is no need for such a reduction. For non-agricultural products there may be a 50% tariff reduction in the developed countries, and 33% in the underdeveloped countries; in this case, there is no possible reduction in less developed countries.

The CGE models for the analysis of commercial policies are the only ones that do not make forecasts about income distribution or poverty alleviation; it takes additional hypotheses and specific analyses to assess the impact on poverty. Certain models study the impact of commercial losses on return on capital, on land and labour force, often making a distinction between skilled and unskilled workers. This income forecast is based on a hypothesis of perfectly functioning markets within countries, a viewpoint that is far from reality, especially in the case of the underdeveloped countries.

The precision of the forecasts for alleviation of poverty depends not only on the basic commercial model, but also on the assessment of the data needed to measure the changes in the distribution of the family income.

Based on Anderson's analysis through the LINKAGE model of changes in unskilled workers' real wage, one can calculate the reduction in the number of people living below the poverty threshold, according to the two different scenarios.

Table 4

Estimating poverty alleviation (million people) – Anderson

	South Africa	Sub-Saharan Africa	World
	$ 2 per day poverty line		
Reduction due to likely Doha scenario	2.30	6.50	6.20
Reduction due to full liberalization	9.60	20.40	65.60
Baseline: extent of poverty	912.20	612.20	1,946.30

	South Africa	Sub-Saharan Africa	World
	$ 1 per day poverty line		
Reduction due to likely Doha scenario	1.40	6.50	2.50
Reduction due to full liberalization	5.60	21.10	31.90
Baseline: extent of poverty	215.90	339.50	622.00

Source: Anderson and co-authors (2005).

By setting the poverty threshold at two dollars per day, the complete liberalization hypothesis would entail an estimation of 66 million people who would no longer be poor by the year 2010, of which 10 million in South Asia and 20 million in Saharan Africa; this means 3.4% poverty alleviation. According to the Doha Round scenario, the alleviation of poverty by the year 2015 would be of only 6 million people, i.e. 0.3% of global poverty. If we set the poverty threshold at one dollar per day, the alleviation of poverty would be 5.1%, while the Doha Round scenario would predict an alleviation by 0.4%.

Conclusions

The high interest in simulation models has risen exponentially over the past years, with special attention given to the introduction of certain changes in the original structure, closely tied to the neoclassical theory. As time passes, these models have become more adequate for mirroring reality, as there are several hypotheses that provide support for reflecting the underdeveloped economies described in this paper.

As we can notice in the first part of the paper, our focus was on the evolution and the theoretical specificities of Walras's general equilibrium model; subsequently, starting from a standard structure, the authors have tried to introduce the general characteristics of simulation models in order to analyse the effects derived from the adopted commercial policies.

The last part of the paper focused on the analysis of certain studies conducted on the expected impact of the so-called *Doha Round plausible scenario*. There is a noticeable disagreement among the estimated results, not only between models, but also between simulations of the same model, based on significant data from different years; all the assessments developed in this paper forecast benefits derived from commercial liberalization, with significantly higher values for the developed countries than for the less developed economies.

The use of Walrasian CGE simulation models in the analysis of the effects of commercial policies in underdeveloped countries is influenced by a series of approaches that encounter difficulties in adjusting to the economic realities of these countries and that also modify the results of the simulations.

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