

Europe 1992 and Beyond: Towards a Quantitative General Equilibrium Assessment for Switzerland

By Gabrielle Antille and Fabrizio Carlevaro, University of Geneva,
and by Nicolas Schmitt, Simon Fraser University, Burnaby

I. Introduction

The realization of a single market in 1992 within the European Community (EC) should induce important economic adjustments for each member, as well as for non-members who are economically integrated with the Community.

Economic theory teaches us that two major effects arise as a consequence of the elimination of economic borders within the EC: an increase of production efficiency due to a better exploitation of economies of scale and a broadening of product diversity for final consumption. According to recent studies¹ a welfare gain should result from the 1992 measures through these two effects. It is evaluated between 4 and 7 % of today's GNP of the EC. The economic impact on non-members depends on their reaction to the new environment. If they preserve the status quo without liberalizing their economy or their trade, they are likely to suffer a welfare loss.

To our knowledge, no measure of the welfare changes has been carried out for Switzerland whatever option it may choose with respect to the Unique Market. In particular, no general equilibrium model has been developed for this purpose. The aim of this paper is to propose such a methodology of applied quantitative analysis which relies on the micro behaviour of agents and markets and which enables to assess the impact of policy measures on the domestic economic activity and on the domestic welfare. Only an "applied or computable general equilibrium model" (AGE model) can account for the complexity of the mechanisms through which the policy measures operate. It also allows to simulate a spectrum of scenarios ranging from the status quo to the full integration of Switzerland to the EC. The policy measures² attached to each situation can be evaluated individually or jointly. Hence, such a methodology helps to clarify possible consequences for the Swiss economy in the new European economic environment.

Our methodology relies on an AGE model developed to analyse energy policy issues in Switzerland³. It is also inspired from AGE models of international trade⁴, especially those of *Harris/Cox* (1984) and *Wigle* (1988), introducing imperfect competition, as well as the models of *Goulder/Eichengreen* (1989) and *Gray/Parks/Ziller* (1988), integrating financial flows.

¹ For a survey, see *Cecchini* (1988).

² Such measures include, for instance, the suppression of tariffs, the introduction of the free movement of labour and capital.

³ See *Carlevaro/Müller/Antille* (1988, 1990).

⁴ See *Shoven/Whalley* (1984) and *Whalley* (1989) for a survey of this literature.

The plan of this paper is the following: Section 2 is devoted to the presentation of the AGE modeling strategy we propose. In Section 3, we sketch the mechanisms underlying the real activity of the Swiss economy. This basic logic is extended to the financial activities in Section 4, and to the case of imperfect competition in Section 5. In Section 6, the relevant concepts for measuring the changes in domestic welfare are discussed, while Section 7 draws up a non-exhaustive list of integration policies whose impact could be assessed using this methodology. Some concluding remarks are given in Section 8.

2. Modeling Strategy

Implementing an AGE model is not an easy task. The scope and the nature of the work to be undertaken is illustrated in Figure 1, and four main tasks must be distinguished:

- (i) the analytical specification of the model;
- (ii) the numerical evaluation of the parameters of the model;
- (iii) the computation of the solution of the model representing an equilibrium;
- (iv) the economic interpretation of the results.

In this Section, we examine the problems arising from step (i) with reference to an AGE model building strategy implemented at the World Bank by *Drud/Grais/Pyatt* (1986). Their methodology is called the SAM approach since it uses a Social Accounting Matrix framework, both as a tool to specify a consistent system of structural equations and as a data base to calibrate and solve the model.

An AGE model is an interdependent system of simultaneous non-linear equations whose solution represents an economic equilibrium for a given time period (a year, in general). Depending on the economic problem, it reflects either a *long-run equilibrium* expressing the conditions of a steady state, or a *temporary equilibrium* specifying the link of a development path for the economy. In the former case, the model is *static* while, in the latter, a *dynamic* model or, at least, a coherent time path for all the moving parameters determining the sequence of temporary equilibria (*pseudo-dynamic model*) has to be considered.

In both cases, the technical problems are essentially the same and can be solved within the SAM approach using a four step strategy.

- One starts by setting out a system of N accounts, each registering the money transactions made by a representative economic agent. The number and the kind of accounts to be adopted depend on the economic problem to be solved, as well as on the availability of statistical information. Such an account system is organised in a SAM framework. It is a double-entry table where an account is represented by a row, with entries to be read as receipts from column accounts, and by the corresponding column containing payments to row accounts. A SAM is thus a single-entry book keeping, an item in row i and column j being an

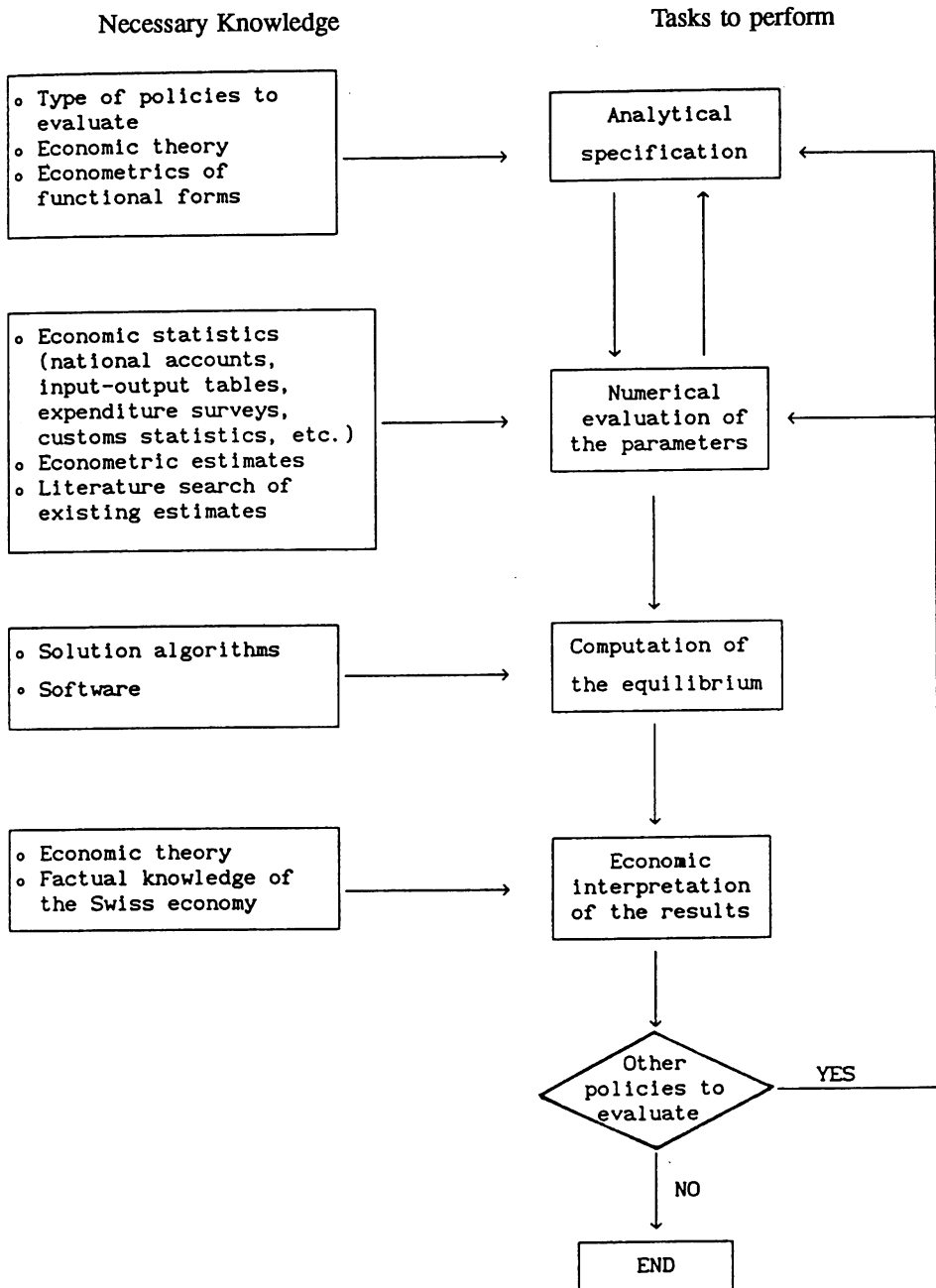


Figure 1: Implementation of an AGE model

outlay by account j and a receipt by account i . The system is made consistent by enforcing the totals for all corresponding row and column pairs to be equal. From a macroeconomic point of view, this equality expresses the condition of an ex-post equilibrium between available resources and their uses.

- The second step consists in introducing variables, which are of three types:
 - (I) values (aggregates at current prices), denoted by y ;
 - (II) quantities (aggregates at constant prices), denoted by q ;
 - (III) prices (implicit price indices), denoted by p .

A value y_{ij} is associated to each non-zero transaction in the SAM and a value y_i to every account, to express both total receipts and total payments:

$$y_i = \sum_j y_{ij} = \sum_k y_{ki}. \quad (1)$$

When an account i refers to an activity of supply of commodities or factor services⁵, total receipts y_i may be paired with a supplied quantity q_i to a price p_i , with $p_i q_i = y_i$. In that case, payment y_{ij} may also be paired with a purchased quantity q_{ij} , with $p_i q_{ij} = y_{ij}$. By convention, we impose the one price rule on any supply activity which supports an account. This simply means that if the same good or service is sold at different prices in different markets, we should provide separate accounts for each of these markets.

- The structural behaviour equations are specified in the third modeling step. Such equations express any value y_{ij} and y_i or price p_i as a function of the price vector $p = [p_i]$, of the total receipts-expenditures vector $y = [y_i]$, and of a vector Θ , of any relevant economic, social, technical or behavioural parameters. In short:

$$y_{ij} = f_{ij}(p, y, \Theta), \quad y_i = f_i(p, y, \Theta), \quad p_i = g_i(p, y, \Theta). \quad (2)$$

This way of specifying structural equations is called modeling in TV (Transaction-Value) form. Quantities are simply implied by values and prices through the identities:

$$q_i = \frac{y_i}{p_i}, \quad q_{ij} = \frac{y_{ij}}{p_i}. \quad (3)$$

- The fourth and last step of the modeling strategy consists in matching the independent structural equations with the variables in order to determine them. This step may require an additional set of restrictions called closure rules which determine, in particular, the sharing of variables y_{ij} , y_i and p_i between endogenous

⁵ It is useful to provide a price and a quantity also to the accounts of final consumption, capital accumulation and transactions abroad. The price of the former accounts measures the general price level of total consumption or investment whereas for the latter it is an index of exchange rates (the domestic price of a unit of foreign currency).

and exogenous variables. Formally, it can be seen as an addition of equations of the type (2) to the model, where the exogenous variables become parameters Θ . One of these closure rules is the choice of the *numéraire*⁶.

3. Accounting Framework and Modeling the Real Activity of the Economy

Our AGE model for Switzerland relies on the one implemented by *Carlevarol Müller/Antille* (1988, 1990). In this section, we present the modeling issues regarding the specification of the mechanisms of the real activity of the Swiss economy. Table 1 displays, in the SAM format, a system of accounts which recognizes six main economic activities, covering the full range of macroeconomic transactions in a real economy:

- (1) domestic production of commodities;
- (2) trade of domestic and imported commodities;
- (3) distribution of factor income;
- (4) income transfers between institutions (household, government, social security, firms), final consumption and saving;
- (5) gross capital formation (gross investment in fixed-capital and changes in inventories);
- (6) transactions with the rest of the world on factors, commodities and income transfers.

To build an AGE model, a further breakdown of this system of accounts is necessary, in particular:

- a disaggregation of domestic production activity by sectors;
- a disaggregation of trade activity by commodities and markets;
- a disaggregation of factor income accounts by type of factor services (labour and capital) and by degree of mobility;
- a disaggregation of current accounts of institutions capturing income transfers and allocations;
- a disaggregation of the foreign current account by regions, in order to isolate transactions between Switzerland and the EC with respect to those between Switzerland and the rest of the world.

This accounting scheme describes the well-known “production-income-demand” macroeconomic circuit open to the rest of the world. The AGE model for Switzerland should express the logic of an open and semi-small real economy, in the sense that prices of imports are international prices, but that prices of exports may be determined domestically. In this scheme, a supply of goods and services, fed by

⁶ Choice of a numéraire is enforced by the fact that the $2N$ accounting identities (1) is a system of only $2N - 1$ independent equations (Walras law).

Table 1: Simplified Accounting Framework for the Real Activity of the Swiss Economy

Outlays	Domestic Production	Trade	Factor income	Current account of institutions				Accumulation	Rest of the world ¹	Totals
				Households	Consumption needs	Government and Social Security	Firms			
Receipts										
Domestic Production		Gross production at factor costs								Gross production at factor costs
Trade	Expenses for intermediate consumption				Private consumption expenditure	Government consumption expenditure		Gross capital formation	Income of exported commodities	Total receipts of sold commodities
Factor income	Value added at factor costs								Factor income received from abroad	Total factor income
Current Account of Institutions	Households		Wages and income of self-employed			Current transfers and Social Security benefits	Households' property income		Current transfers from abroad	Gross income of households
	Consumption needs			Private consumption of residents					Private consumption expenditure of non-residents	Receipts from private consumption
	Government and Social Security	Indirect taxes net of subsidies and import duties		Personal income taxes, social security contributions and current transfers			Business income taxes		Current transfers from abroad	Current income of Government and Social Security
	Firms		Gross profits of firms			Interests on public debt				Gross income of firms
Accumulation				Private saving		Public and Social Security saving	Business saving		Net borrowing from abroad	Total saving
Rest of the world		Expenses for import of commodities	Factor income paid abroad	Private consumption abroad and current transfers		Current transfers abroad				Current payments abroad
Totals	Total cost of gross production	Total cost of commodities	Income of primary factors	Total expenditure of households	Private consumption expenditure	Current expenditure of Government and Social Security	Total expenditure of firms	Fixed-capital and inventory changes expenditure	Total receipts from abroad	

¹ To conform to the usual national account terminology, outlays of the Rest of the World are written from the point of view of the country and not from that of the economic agents living abroad as it should be in a SAM framework.

domestic production and imports, is created to meet domestic and foreign demand. As a counterpart, the production and trade activities generate income which, in turn, creates domestic demand. An overall economic equilibrium is reached when distributed income generates a level of effective demand matching that of supply. For each commodity, this equilibrium is met by valuing supplied quantities with a proper system of relative prices to which effective demand reacts.

We now examine the relevant assumptions to set up in order to simulate behaviours and mechanisms in the six main activity sectors of the accounting framework.

Domestic production. Domestic production of commodities is performed using factor services (labour and capital) and intermediate commodities, which determine a structure of inter-industry flows. The technology used by each sector is specified as a production function allowing both perfect or imperfect substitutability between inputs, as well as complementarity. Input demand is derived from this technology specification by assuming a cost minimization behaviour by producers. In AGE models, the supply of commodities is commonly set out as perfectly elastic, assuming that each sector produces an homogeneous output with constant returns to scale technology and zero-profit. In our model, this assumption is only a special case of a more general supply behaviour which should account for multi-products firms, increasing returns to scale, product differentiation and cartels. The relevant assumptions allowing us to introduce these features of imperfect competition are presented in Section 5.

Trade. The purpose of this economic activity is to satisfy the demand on the various markets (intermediate, final and exported products) by including transport and distribution margins, import duties and indirect taxes into commodity prices.

For tradables (imported commodities) domestic demand is met using two sources of supply: domestic production and imports. Homogeneity of the commodity supplied on the domestic market is enforced by combining quantities of both foreign and domestic origin to form a composite bundle. We adopt, the usual *Armington* (1969) assumption which allows an imported commodity to be only an imperfect substitute of its domestic counterpart. This aggregation is performed using, for each commodity, an aggregator formally specified as a one-output and two-inputs production function allowing inputs to be perfect or imperfect substitutes as well as complements. Minimizing the cost of this aggregate for a given quantity of composite leads to derived demands for domestic and imported commodities and to a price of the composite equal to the unit cost of the aggregate.

Distribution of factor income. This activity supplies labour and capital services to the production sectors and allocates factor rentals to the institutions owning factor stocks.

Homogeneity of factors can vary leading to different degrees of mobility between production sectors. Formally, this can be accounted for by considering many "qualities" of a given factor and assuming that demand from a production sector can be met using a composite of these qualities, in an analogous manner to the *Armington*

hypothesis for commodities. Using this method, it is also possible to simulate various degrees of labour mobility between Switzerland and the EC. For capital, the modeling of the same mobility conditions with the EC will be dealt with in Section 4.

In modeling the allocation of factor income to the institutions, reference has to be made to the distribution of factor ownership among institutions since it determines the allocation shares of factor rentals.

Current transactions of domestic institutions. The accounting framework adopted allows to model current transactions of domestic institutions according to four distinct representative agents: households, government, social security and firms. However, operations on capital (tangible assets) are consolidated and have to be explained through the behaviour of a single representative investor.

Households' behaviour with respect to consumption and saving is modelled according to the microeconomic theory of consumers. Using a separable utility function, it is possible to explain the stepwise allocation of households' income between saving, consumption of needs and of commodities.

It is useful to adopt the same assumption to model current transactions of the government. Indeed, as we point out in Section 6, the assumption of a government utility function enables to solve the problem of measuring changes in domestic welfare.

Social security and firms carry out only income-transfers and saving. It is natural to model social security behaviour with reference to the institutional rules prevalent in Switzerland for collecting contributions and paying pensions. However, explaining firm's current transactions calls for a broadening of the model to financial activities.

Finally, we must point out that modeling investment demand in a static model is a very difficult task and, therefore, investment is exogenously given. Alternatively, in a dynamic model it becomes possible to explicitly link capital used in production sectors to the demand for tangible assets through producers' behaviour (see next Section).

Current operations with the rest of the world. The behavioural assumptions underlying the structural equations on the receipts-side of this account⁷, have already been presented: namely, the domestic demand for imports, that for factor abroad and the expenditure abroad of residents.

By symmetry, we can infer the outlays of this account assigning to the economic agents living abroad the same kind of behaviour as in the account receipts. Thus, similarly to the demand for imports, the demand for exports is modelled, using the Armington assumption. Then, foreign demand for an exported commodity is a function of a "price-competitiveness" defined as the ratio of two prices: the price in Swiss francs of a competing commodity on the export markets and the export price of the domestic commodity. This foreign demand model is also a function of income of the importing countries. The same principle may be applied to model the

⁷ Recall that transaction values with the rest of the world are booked in the SAM from the point of view of the economic agents living abroad.

other outlays, in particular those arising from the consumption of non-residents in Switzerland.

4. Accounting Framework and Modeling the Financial Activities of the Economy

Given the non-negligible weight in the Swiss economy of the international flows of financial assets, it is very important to integrate them in the model. Not only do these flows take place directly or indirectly in the adjustment processes, but the economic theory has shown that, when capital is internationally mobile, a reduction of tariff rates creates capital movements that can compensate the benefits of trade liberalization⁸. The importance of such flows depends on the elasticity of substitution between domestic and foreign financial assets.⁹

Taking into account the financial activities in an AGE model requires a broadening of the accounting framework. This extension¹⁰ is shown in Table 2 in the SAM format. It consists in disaggregating the accumulation account into a real account containing the gross capital formation and into many financial accounts describing how capital formation is financed. For each institution, these accounts register the changes in their assets and liabilities. They also register savings as a receipt, and gross investments and changes in inventories as outlays. Accounts, similar in their intent to the accounts describing the trade of commodities, are developed for financial assets. They book as receipts, changes in assets and, as expenses, the issue of new liabilities. These assets may be distributed according to various degrees of liquidity as, for instance, notes and coins, bank deposits, shares and other financial assets. The current account of the rest of the world must also be enlarged by adding an account related to capital transactions with changes in liabilities of the rest of the world with respect to the country, as receipts, and changes in domestic assets taken up by the rest of the world, as outlays. The difference between new assets and new liabilities expresses a borrowing from abroad, if it is positive, and a loan to the rest of the world, if it is negative. This difference also sets up the link with the real side of the economy since it is identical to the balance of the current transactions with the rest of the world.

Accounts of financial assets are flow accounts which have to be complemented with opening and closing stocks. For stocks, the link with the real side of the economy requires the introduction of tangible assets (fixed-capital goods, stocks of non durables, land). Thus, for each institution we have the following equality, both at opening and at closing:

$$\text{financial assets} + \text{tangible assets} = \text{liabilities} + \text{net worth}.$$

⁸ See *Brecher/Diaz-Alejandro* (1977).

⁹ See *Smith* (1988).

¹⁰ See *United Nations* (1968).

Table 2: Accounting Framework of Financial Activities

		OPENING LIABILITIES	CURRENT ACCOUNT OF INSTITUTIONS	ACCUMULATION			REST OF THE WORLD	CLOSING LIABILITIES
				Gross capital formation	Financial assets	Capital account of institutions	Current account Capital account	
OPENING ASSETS					Financial assets		Financial assets	
					Tangible assets			
TRADE				Gross capital formation				
ACCUMULATION	Gross capital formation				Gross capital formation			
	Financial assets				Net acquisitions of financial assets		Net acquisitions of financial assets	
	Capital account of institutions	Financial liabilities Net worth	Saving		Net issues of financial liabilities			Financial liabilities Net worth
REST OF THE WORLD	Current account							
	Capital account	Financial liabilities Net worth			Net issues of financial liabilities		Net borrowing from abroad	Financial liabilities Net worth
CLOSING ASSETS					Financial assets		Financial assets	
					Tangible assets			

Of course, the difference between the net worth at the beginning and at the end of the year is equal to saving.

The introduction of financial assets requires a respecification of the agents' behaviour, particularly for households who buy financial assets and for non-financial firms who sell them. The specification we suggest assumes that households own only financial assets and disregard real assets, while industrial and commercial firms own the latter but disregard the former.

Households are faced with the problem of allocating their disposable income between consumption and saving and, in turn, of allocating saving among financial assets differentiated according to domestic or foreign origin. The modeling of these behaviours may be performed in two steps or simultaneously. In the first alternative, we consider the consumption decisions as described in Section 3, which determine the amount of saving. This amount sets up the value of households' wealth at the end of the year. The second step is devoted to the allocation of this wealth among various assets: money, bank deposits, shares and bonds, etc. It is a function of the rate of return on assets treated as imperfect substitutes. Accordingly, households' preferences with respect to different financial assets, particularly domestic assets versus foreign assets, are specified using a utility function to be maximized under a wealth constraint¹¹.

It is also possible to model the households' behaviour following *Goulder/Eichengreen* (1989). It allows to determine simultaneously households' consumption and portfolio choices for a given year t , by maximizing an intertemporal utility function:

$$u_t = \sum_{\tau=t}^{\infty} (1 + \delta)^{-(\tau-t)} u(C_{\tau}, A_{\tau}) \quad (4)$$

where δ is the rate of time preference, C_{τ} an index of overall consumption and A_{τ} an aggregate of the households' asset holdings. This aggregate enables to account for the preferences of households for domestic financial assets.

The behaviour of producers as mentioned in Section 3 relates only to decisions with regard to production activity and takes investments as exogenous. Since investments must now be determined endogenously, they can be modelled either separately from production decisions or together with them. The first alternative, suggested by *Gray/Parks/Ziller* (1988), consists in explaining investments starting from a stock of "desired" capital derived from the maximization of anticipated profits. The joint determination of production and investments implicitly assumes that these two decisions are taken by the same agents. This simultaneous choice proposed by *Goulder/Eichengreen* (1989), is based on the maximization of the present value of the firm.

¹¹ See *Gray/Parks/Ziller* (1988).

5. Modeling Imperfect Competition in the Swiss Economy

Imperfect competition has been shown to have significant consequences on the outcome of policy experiments simulated with AGE models¹². The degree of competition plays an important role because it affects the exploitation of the comparative advantage, the factor prices, and thus the allocation of resources. Among the numerous ways of introducing imperfect competition into an AGE model, three characteristics leading to imperfect markets seem particularly relevant for the Swiss economy: economies of scale and of scope, product differentiation and cartels.

(I) Economies of Scale and of Scope

The presence of economies of scale at the firm level leads to imperfect competition since the average cost decreases with production, favouring larger firms over smaller ones. Economies of scope help multi-product firms since they are present when cost-saving externalities within a firm's product line reduce the average cost of any good belonging to this product line.

Scale and scope economies are mainly present in manufacturing, but also in the service sectors (bank, insurance). In general, Swiss firms prefer exploiting economies of scope rather than economies of scale because of the small size of the domestic market as compared to that of their main rivals. Even if access to foreign markets is relatively easy, firms know that trying to exploit economies of scale, that rivals with large internal markets benefit from, could have catastrophic results in case of fluctuations in export demands and might even favour the introduction of protectionist measures in foreign markets. Therefore, diversification of risk leads Swiss firms to adopt a kind of "puppy dog" strategy¹³ which naturally makes them exploit complementarities between products rather than specialize through mass production. Such a strategy could be hardly successful without product differentiation.

(II) Product Differentiation

Product differentiation arises from buyer's tastes for diversity. Competition is imperfect since products are imperfect substitutes, giving some scope to the firms to influence the price of their product(s). Product differentiation is a crucial environment for multi-product firms, since it allows them to choose product characteristics for which the consumer's willingness to pay is high and for which the elasticity of substitution is low. Such an environment is even more important if one believes that the average cost cannot decrease as much by exploiting economies of scope than through mass production. In this case, niches must be chosen carefully because it is

¹² See Brown/Stern (1988), Harris/Cox (1984) and Wigle (1988), among others.

¹³ See Fudenberg/Tirole (1984).

the only way domestic firms with high unit cost can compete effectively with foreign firms producing at low unit cost.

Economies of scope and product differentiation should thus be seen as complement features which describe well the environment in which Swiss sectors like manufacturing or services operate. This environment leads to very different outcomes than constant returns to scale and homogeneous products. The introduction of these features into an AGE model is well documented (see note 2) and does not pose any particular problem other than data availability.

(III) Cartels

The influence of cartels is a well-known characteristic of the Swiss economy. It is particularly interesting to capture their behaviour in a simple fashion in order to take into account the necessary adjustment that they will have to go through in a more competitive environment. To our knowledge, this has not yet been satisfactorily introduced in any AGE model¹⁴. There are several possible alternatives; we choose to summarize only one based on the theory of tacit collusion¹⁵.

In this theory, cartels are viewed as surviving only in so far as they are sustainable or self-enforcing through their members' free will. Cartels must therefore satisfy a criteria of individual rationality. The effect on individual firms and cartel's behaviour of any structural change can then be easily investigated since it becomes sufficient to analyse whether the individual's incentives to cheat and deviate from the cartel rule are enhanced or not.

This can be done with the following simple model. Assume that, whether they belong to a cartel or not, all firms maximize profit either by determining prices or quantities¹⁶. Assume also that at any point in time, a firm has always the choice to deviate from the cartel's rule and, if it does, the cartel breaks down once the other members have identified the cheater's behaviour. A cartel is sustainable only if, for any of its members, the net gain of deviating from the cartel rule is smaller than the gain of remaining in the cartel.

Let x be the decision variable of the firms. So, x represents either the output per firm agreed on by the cartel members, or the joint-profit maximizing price at which products should be sold. Denote by $\pi_C(x)$ the firm's profit in the cartel and by $\pi_D(x)$, its profit if it deviates from the cartel while the other firms continue to obey the cartel rule. Finally, π_N represents the firm's profit when all firms act non-cooperatively.

If one member cheats, all the other members of the cartel stick to the cooperative solution for one period, and then act non-cooperatively ever after. Since the present value of the profit stream in a market arrangement which lasts forever is $\frac{\pi_i}{\rho}$ ($i = C, N$),

¹⁴ Harris/Cox (1984) for instance model cooperative behaviour based on the so-called Eastman and Stykolt hypothesis.

¹⁵ See d'Aspremont et al. (1983) for an alternative theory based on price leadership.

¹⁶ In models of product differentiation, firms usually select prices.

where ϱ is the discount rate, a firm cheats only if

$$\pi_D(x) + \frac{\pi_N}{(1 + \varrho)\varrho} > \frac{\pi_C(x)}{\varrho}$$

A cartel is thus sustainable and it maximizes its member's profit for all solutions satisfying

$$\text{Max}_x \pi_C(x) \quad \text{such that} \quad \frac{\pi_C(x)}{\varrho} \geq \pi_D(x) + \frac{\pi_N}{(1 + \varrho)\varrho}. \quad (5)$$

This maximization problem provides two crucial informations. Firstly, the firm's strategy depends on all the factors underlying the firm's profit function. In particular, it depends on the demand elasticity (higher demand elasticity makes the cartel less stable), the variable cost curve (rising marginal cost helps the cartel) and fixed costs (a higher proportion of fixed with respect to total costs increases the temptation to raise production, and thus to cheat). *Davidson* (1984) shows that the firm's choice also depends on barriers to trade. He demonstrates in particular that trade liberalization leads to an equilibrium which is less conducive to collusive behaviour¹⁷.

Secondly, depending on the values of the parameters, three solutions to the maximization problem are possible. The cartel could be immune to cheating. In that case, the monopoly outcome can always be enforced. At the other extreme, cheating is always prevalent so that the cartel cannot be sustainable. The intermediate case is one in which the cartel can survive provided it adopts a quantity (or a price) which is more competitive than the monopoly outcome.

Imperfect competition is introduced into the AGE model through the firm's optimization problem (5). For a given number of firms, it defines an equality between the firm's marginal revenue and marginal cost determining the firm's optimal price or quantity. Of course, in a general equilibrium model, marginal cost depends on factor prices, factor utilization, scale of production and the extent of the product line, while marginal revenue depends on quantities (or prices) of substitute products, consumer's income and elasticity of substitution between products. Any solution consistent with cartel behaviour must therefore also be consistent with the equilibrium in the rest of the economy.

If it is possible to analyse a cartel's behaviour for a given number of firms, the model should also be tractable to find the long-run equilibrium number of firms. A zero-profit equilibrium is not very useful since it would eliminate all justification for the cartel's existence. An asymmetry between incumbent and potential firms must therefore be introduced to justify the presence of pure profits in equilibrium. The simplest way is to assume that barriers to entry exist and that incumbent firms behave according to the limit quantity (or limit pricing) theory. In this case, potential firms decide whether to enter or not by calculating their profit taking as given the quantity

¹⁷ *Davidson's* result is based on a game in quantity in which both foreign and domestic firms belong to the cartel. Alternative assumptions might change these results.

(or the price) of the cartel. If their expected profit is negative, they do not enter, and if it is positive, they enter and join the cartel provided that by doing so they earn more than by remaining independent. If they earn less by joining the cartel, the cartel cannot be sustainable because, once inside it, new and old firms cannot be distinguished. With this procedure, not only pure profit can exist in equilibrium, but the number of firms is also endogenous¹⁸.

The determination of the number of firms (n) introduces an additional constraint so that the firm's optimization problem is now

$$\text{Max}_{x,n} \pi_C(x, n)$$

such that

$$\begin{aligned} \text{(i)} \quad & \frac{\pi_C(x, n)}{\varrho} \geq \pi_D(x, n) + \frac{\pi_N(n)}{(1 + \varrho)\varrho} \\ \text{(ii)} \quad & \pi_\epsilon(n + 1 \mid x, n) < 0, \end{aligned} \tag{6}$$

where $\pi_\epsilon(\cdot)$ represents the entrant's expected profit in a market with n established firms.

It is apparent that the determination of the equilibrium is different in imperfect competition than in perfect competition (with constant returns to scale), and so are the transmission mechanisms. Since none of these simple aspects of imperfect competition create obvious difficulties to be introduced into an AGE model, and since they reflect realistic features of the Swiss economy, they should be part of a model describing the mechanisms of the domestic economy.

6. Measuring Changes in Domestic Welfare

An AGE model is intended for comparing pairs of long term equilibria or, more realistically, pairs of sequences of temporary equilibria (development paths of the economy). These pairs of equilibria are:

- a *benchmark* equilibrium, reflecting a lack of structural change of the economy, i.e. a state of “status quo”;
- a *counterfactual* equilibrium, simulating a new state of the economy generated by a new policy regime or any other structural change. It is a thought experiment reflecting what would happen to the economy if, contrary to the reality, some conditions of the environment leading to the “status quo” equilibrium were changed.

¹⁸ A more sophisticated approach is to assume that potential firms are able to anticipate the effect of their entry on the market equilibrium.

Appraisal of gains or losses for the economy due to the shift from the benchmark to the counterfactual equilibrium may proceed directly from the model's endogenous variables, especially production, employment, wages, profits, etc. Nevertheless, multiplicity of these variables makes difficult an overall assessment of the results. To do so, one needs a summary measure allowing us to judge whether the counterfactual equilibrium is "better" or "worse" than that of the benchmark.

If we consider the satisfaction of individual needs as the main purpose of the economic activity, it seems natural to base such a summary measure on changes in households' consumption. Following the neoclassical theory, we describe households' consumption as the outcome of the rational behaviour of a representative consumer through the maximization of a utility function $u(q)$, where q is a vector of consumption needs. The summary measure of welfare change for the representative consumer is then given by the difference

$$\Delta u = u(q^1) - u(q^0), \quad (7)$$

where superscripts 0 and 1 represent consumption levels in the benchmark and the counterfactual equilibrium respectively.

Still, the scope of such a measure is limited since u is an ordinal variable. As a consequence, aggregation of utility changes of different representative consumers modelled in the same AGE model is not allowed.

To overcome this drawback, it is common, since Hicks (1956), to use a money equivalent of Δu which has all the advantages of a value. This money equivalent is based on the notion of *indirect utility*. Let $u = v(y, p)$ be this function, where y is the consumption budget or total expenditure, and p the price vector of consumption needs q . It measures the maximum utility the representative consumer can achieve by spending a budget y to "buy" needs at prices p .

Two money equivalents of Δu can be considered, each one being positive, nil or negative, depending on whether Δu is positive, nil or negative respectively.

- The first one, $\Delta_E y$, is implicitly defined by the following equation:

$$v(y^0 + \Delta_E y, p^0) = u(q^1) = v(y^1, p^1). \quad (8)$$

It expresses the minimum money net compensation to be paid to the representative consumer at the benchmark equilibrium to let him reach the utility level achieved at the counterfactual equilibrium. This money compensation $\Delta_E y$ is called *equivalent variation*.

- The second money equivalent of Δu , denoted as $\Delta_C y$, is implicitly defined by the equation:

$$v(y^1 - \Delta_C y, p^1) = u(q^0) = v(y^0, p^0) \quad (9)$$

Thus, it expresses the minimum money net compensation to be collected from the representative consumer at the counterfactual equilibrium in order to let him reach

the utility level realized at the benchmark equilibrium. This money compensation $\Delta_C y$ is called *compensating variation*¹⁹.

The satisfaction of individual needs is carried out not only through “private consumption” but also through “public consumption”²⁰. Thus, the measure of domestic welfare change should also take into account the changes in public consumption. This can be done in two ways:

- (i) by entering public consumption into the utility function of the representative consumer;
- (ii) by modeling consumption behaviour of the government as for households, using an ordinal utility function to be maximized under a budget constraint, as in *Rossier* (1976) and in *Aprile* (1984). Based on this utility function a money equivalent of utility change for government can be computed and added to that of households.

7. Measures of Integration

The purpose of the AGE model for Switzerland is to evaluate the economic impact on the domestic economy of various measures of integration to the EC. These measures can be classified in four different scenarios we define below.

a) Status Quo

The status quo corresponds to the hypothesis that Switzerland does not adopt any additional measures that further integrate its economy to the EC. This “wait and see” attitude is not a realistic economic option, but it is a very useful hypothesis since it allows us to evaluate the economic impact in the domestic economy of the “1992” measures that the EC plans for its members.

In order to assess and to compare the impact of various options of integration faced by Switzerland, it is crucial to know what would be the economic consequences if no adjustment to the new environment took place. To do so, the main EC measures will be modelled either directly or indirectly. They include the elimination of economic borders within the EC, different measures aiming at increasing price competition, production efficiency and market penetration within the EC.

¹⁹ Equivalent variation is often preferred to compensating variation because it allows repeated pairwise comparisons when the benchmark equilibrium is unchanged. In *Antille/Carlevaro/Schmitt* (1990), it is shown how to adapt the compensating variation measure in order to allow such repeated comparisons.

²⁰ See *Solari/Du Pasquier* (1976).

b) Unilateral Adjustments

If all potential bilateral solutions between Switzerland (or EFTA) and EC fail, the only remaining option is to adopt unilateral measures of liberalization. Various possibilities exist; among them, Switzerland can adopt EC standards and regulations on products, replace the current manufacturing sales tax ("Icha") by a value-added tax, take a tougher stand on cartels, or suppress federal taxes on some financial services. The main purpose of unilateral measures is to free the domestic market of some of its rigidities in order to position it on the same "level playing field" as the EC.

c) European Economic Space (EES)

The content of the European Economic Space is still to be negotiated, but the main issues are reasonably clear. They include the suppression or relaxation of the rules of origin for the trade in products between EFTA members and EC, the opening of protected markets to international competition (public markets, construction, transport), freer movement for labour and capital, and more flexible rules for the establishment of firms in the different regions of the European Economic Space. The advantage of these measures is that they have a reciprocal character.

d) Adhesion to the EC

A Swiss membership to the EC requires additional arrangements with respect to the EES. They include the suppression of the economic borders, the adoption of common tariffs or quotas on extra-European imports, changes in agricultural policies, and the introduction of free movement of capital and labour. Membership has also important consequences on the government budget through transfers to and from the Federal Government. Last, but not the least, Switzerland must adopt the different measures forming the European Unique Market.

Table 3 summarizes the main measures that can be introduced into a Swiss AGE model for each of these four hypotheses. In order to assess the economic impact of anyone of these measures, it is imperative to understand as precisely as possible which variables are affected by each of them, and the exact channels through which the different sectors of the economy are influenced. To do so, it will be often necessary to disaggregate key sectors of the economy.

8. Conclusions

The prospect of the unique market among EC members is already bringing economic adjustments and is forcing EFTA members to make crucial choices. Today, none of the four hypotheses ranging from the status quo to the adhesion to the EC can be excluded. Economic aspects, although not the only one, will play an important role in future choices. The proposed methodology, because of its flexibility, constitutes a

Table 3: Main Measures of Economic Integration

	EC Measures		Swiss Measures	
	Status quo	Unilateral adjustments	EES	Adhesion to the EC ¹
1. Trade in products	- Elimination of economic border	- Standards, regulations	- Rules of origin	- Common external tariffs and quotas - Harmonization of non-tariff borders
2. Agriculture		- Lower protection		- EC common policy
3. Indirect taxation	- Common VAT rates	- Introduction of VAT		
4. Public markets	- Elimination of procurement policies		- Opening of protected markets	
5. Competition policy	- Stronger rules on mergers	- Stronger controls on cartels		
6. Services	- Deregulation of transport - Freedom of establishments	- Transport policy - Elimination of tax on financial services	- Reciprocal rules of establishment	
7. Factor markets	- Free mobility of labour and capital		- Freer mobility of labour and capital	
8. Government budget				- Budget net cost of adhesion

¹ The Swiss adhesion to the EC also requires that Switzerland adopts the measures listed under EES as well as those associated with the European Unique Market.

very useful tool to evaluate the economic impact of different scenarios of integration with the EC. Similar assessments have been performed in the past, whether it is to evaluate the economic impact of the UK adhesion to the EC²¹, or to understand the possible effects of the free-trade agreement between Canada and the United States²². Given the difficult choices faced by Switzerland, it is time that similar research be undertaken in this country.

²¹ Miller/Spencer (1977).

²² Harris/Cox (1984).

References

- Antille, G./Carlevaro, F./Schmitt, N.* (1990): Effets sur le bien-être national de la création d'un marché unique européen. Elaboration d'une méthodologie d'analyse quantitative, Cahier du Département d'économétrie 90.07, Genève.
- Aprile, G.* (1984): Les dépenses publiques en Suisse, Droz, Genève.
- Armington, P.* (1969): A Theory of Demand for Products Distinguished by Place of Production. International Monetary Fund Staff Papers, 16.
- d'Aspremont, C./Jacquemin, A./Gabszewicz, J.J./Weymark, J.A.* (1983): On the Stability of Collusive Price Leadership. Canadian Journal of Economics XVI, No. 1, 16–25.
- Brecher, R./Díaz-Alejandro, C.* (1977): Tariffs, Foreign Capital and Immiserizing Growth. Journal of International Economics 7, 317–332.
- Brown, D.K./Stern, R.M.* (1988): US-Canada Bilateral Tariff Elimination: The Role of Product Differentiation and Market Structure. WP 227, University of Michigan.
- Carlevaro, F./Müller, T./Antille, G.* (1988): Répercussions macroéconomiques d'une interruption du nucléaire en Suisse: analyse à l'aide d'un modèle d'équilibre général; Groupe d'experts scénarios énergétiques, Série de publications No. 27. Office central fédéral des imprimés et du matériel, Berne.
- Carlevaro, F./Müller, T./Antille, G.* (1990): Macroeconomic Impact of Nuclear Power Discontinuation Policies in Switzerland: A General Equilibrium Assessment, à paraître dans "Proceedings of IFAC/IFORS/IAEE, International Symposium on Energy System". Pergamon Press.
- Cecchini, P.* (1988): 1992 le défi. Flammarion, Paris.
- Davidson, C.* (1984): Cartel Stability and Tariff Policy. Journal of International Economics 17, 219–237.
- Drud, A./Grais, W./Pyatt, G.* (1986): Macroeconomic Modeling Based on Social-accounting Principles. Journal of Policy Modeling 8 (1), 111–145.
- Fudenberg, D./Tirole, J.* (1984): The Fat Cat Effect. The Puppy Dog Ploy and the Lean and Hungry Look. American Economic Review 74, 361–368.
- Goulder, L./Eichengreen, B.* (1989): Trade Liberalization in General Equilibrium: Intertemporal and Inter-Industry Effects. Working Paper 89–110, Department of Economics. University of California, Berkeley.
- Gray, C./Parks, J./Ziller, B.* (1988): A Macro Economic Framework for an Open Economy. Document interne, Banque Mondiale, Washington.
- Harris, R.G./Cox, D.* (1984): Trade, Industrial Policy and Canadian Manufacturing. Ontario Economic Council and University of Toronto Press, Toronto.
- Miller, M.H./Spencer, J.E.* (1977): The Static Economic Effects of the U.K. Joining the EEC: A General Equilibrium Approach. Review of Economic Studies 44 (1), 71–93, February.
- Rossier, E.* (1976): Sur le comportement de l'état dans le cadre de la théorie des choix. In: Private and Enlarged Consumption, ed. by Solari, L./Du Pasquier, J.N., North-Holland, Amsterdam.
- Shoven, J./Whalley, J.* (1984): Applied General Equilibrium Models of Taxation and International Trade: An Introduction and a Survey. Journal of Economic Literature XXII.
- Smith, C.E.* (1988): Output Effects of a Tariff under Flexible Exchange Rates. Journal of International Economics 24, 359–372.
- Solari, L./Du Pasquier, J.N.* (1976): Introduction in: Private and Enlarged Consumption, ed. by Solari, L./Du Pasquier, J.N., North-Holland, Amsterdam.
- Whalley, J.* (1989): General Equilibrium Trade Modeling over the Last Five Years. Mimeo, University of Western Ontario.
- Wigle, R.* (1988): General Equilibrium Evaluation of Canada-US Trade Liberalization in a Global Context. Canadian Journal of Economics XXI, No. 3, August.
- United Nations* (1968): A System of National Accounts. New York.

Summary

Europe 1992 and Beyond: Towards a Quantitative General Equilibrium Assessment for Switzerland

The aim of this paper is to propose a methodology of applied quantitative analysis to assess the welfare changes for Switzerland resulting from different scenarios of integration to the European Community. The methodology relies on an applied or computable general equilibrium model taking into account the main mechanisms through which the various integration measures operate. The paper discusses the important aspects related to the implementation of such a model as well as the relevant concepts for measuring the changes in domestic welfare. It also presents four possible scenarios for simulation.

Résumé

L'Europe de 1992 et après: Vers une évaluation quantitative en équilibre général pour la Suisse

L'objectif de cet article est de proposer une méthodologie d'analyse quantitative appliquée permettant d'évaluer les changements de bien-être pour la Suisse résultant de différents scénarios d'intégration à la Communauté Européenne. La méthodologie s'appuie sur un modèle d'équilibre général appliqué ou «calculable» pour la Suisse qui rend compte des principaux mécanismes par lesquels opèrent les différentes mesures d'intégration. L'article présente les aspects les plus importants liés à l'élaboration d'un tel modèle ainsi que les concepts pertinents pour la mesure des variations du bien-être national. On discute également quatre scénarios retenus pour la simulation.

Zusammenfassung

Europa 1992 und danach: Versuch einer quantitativen Schätzung für die Schweiz im Rahmen eines Allgemeingleichgewichtsmodells

Der Artikel hat zum Ziel, eine Methodologie der quantitativen angewandten Analyse vorzuschlagen, die die Wohlfahrtsveränderungen für die Schweiz in Folge der verschiedenen Integrationssszenarien in die Europäische Gemeinschaft zu schätzen ermöglicht. Die Methodologie stützt sich auf ein angewandtes oder «berechenbares» Modell des allgemeinen Gleichgewichts für die Schweiz, das die ausschlaggebenden Mechanismen, durch welche die verschiedenen Integrationsmassnahmen wirksam sind, berücksichtigt. Der Artikel erläutert die wichtigsten Aspekte im Zusammenhang mit dem Aufbau eines solchen Modells sowie die angebrachten Konzepte zur Messung der Wohlfahrtsveränderungen. Vier mögliche Szenarien für die Simulation werden ebenfalls vorgestellt.