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The Agricultural Policy Reform in Switzerland: An Assessment of the Agriculture Multi-functionality

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Abstract

The main feature of the Swiss reform is to tie environmentally friendly farming to a reduction in price supports. Subsidies are given for environmental farming and not as a function of the quantity produced. We study the impact of these measures within the framework of a single-country, 22-sector computable general equilibrium model, where farm policy instruments are explicitly represented and environmental farming modelled as a public good. For the parameters of our model, the reform increases the consumer welfare because of substantial gains from agricultural trade liberalization. The increase in payments for environmental farming rises the share of the country's agricultural land farmed in an ecological way.

JEL classification: D58; F13; H41; Q18

Keywords: Agricultural policy; Computable general equilibrium; Multi-functionality; Public good

1 Introduction

Before the 1992 Swiss agricultural reform, agriculture policy has been marked by the principle of ensuring self-sufficiency and characterized by price and market guarantees. This has led to an over-production and high production costs within the agricultural sector during the 1970s and the 1980s. The aim of the reform is then to make the farm sector move away from an exclusive food producing role and become more clearly multi-functional. Public services are remunerated through direct payments. These are not tied to agricultural production, but linked to the degree of ecological farming. The central element in the reform package is the gradual shift from price supports to a system of direct payments conditional on an environmentally friendly farming. The purpose of the paper is to analyze how consumer welfare is affected by this new orientation of the agricultural policy. One intuitively expects he should be better off[1].

This question is investigated within the framework of a single-country, 22-sector computable general equilibrium model, where farm policy instruments are explicitly represented and environmental farming modelled as a public good. Some existing CGE models of Europe have addressed EU agricultural protection and policy reform (Harrison, Rutherford, and Wooton, 1989; Burniaux et al., 1990; Folmer et al., 1995). Other CGE models have examined the economic implications of the Uruguay Round Agreement (Francois, McDonald, and Nordström, 1995; Goldin and van der Mensbrugghe, 1995; Harrison, Rutherford, and Tarr, 1995; Hertel et al., 1995). However all these models either approximate policies as exogenous price wedges or does not provide a detailed coverage of agricultural sectors. Work on explicitly modelling the Common Agricultural Policy in CGE models is scarce (Harrison, Rutherford, and Wooton, 1995; Weyerbrock, 1998) and relies on work by Kilkenny and Robinson (1988) and Kilkenny (1991) on modelling US agricultural policies.

In Switzerland however there is no research on this specific topic. Nevertheless, some existing CGE models have examined the issue of a EU membership (Grether and Mueller, 1999a; van Nieuwkoop and Mueller, 1999) or the impact of the Common Agricultural Policy for the Swiss economy (Grether and Mueller, 1999b). Our contribution is therefore twofold. First the Swiss agricultural policy reform have not been quantified yet. Second the model formulation integrates the explicit modelling of agricultural policies and the multi-functionality of agriculture.

The outline of the paper is as follows. A brief description of the Swiss agricultural reform is given in the next section. The model is described in section 3. Section 4 discusses the explicit modelling of agricultural policies. An overview of the data is given in section 5

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[1]The theory of second best tells us it is not always the case. Using a GE model with distortionary income taxation, Chambers (1995) analyses the incidence of different agricultural policies and found that, at the margin, supply control through input retirement may dominate lump-sum transfers if the tax system is highly inefficient and subsidies are very high.

and section 6 presents the different scenarios of the agricultural reform. Our results and concluding remarks follow in sections 7 and 8 respectively.

2 The Reform of the Swiss Agricultural Policy

Since the Second World War farm policy objectives are exclusively oriented towards economic ends through the maintenance of farm incomes, the assurance of reasonable prices to consumers and the need for food security. Market-managed price supports provide the principal thrust of policy mechanisms and are completed by structural policy measures to take into account the modernization of the farming industry. This leads to an increase in food production towards a greater degree of self-sufficiency and high production costs within the agricultural sector during the 1970s and 1980s. Consequences are significant shifts in the objectives of agricultural policy by the end of the 1980s. Whilst farm income maintenance and consumer protection remain, food security goals are displaced by specific objectives for the environment, ecology and the welfare of the rural community.

The 1992 reform embraced a full reappraisal of the functions and role of the farm sector, in particular the desire to conform to the Uruguay Round agreements and to satisfy the new objectives. The farm sector has to move away from an exclusive food producing role to become more clearly multi-functional. The first phase of this new orientation focuses on splitting up price and income policy. Public services such as maintaining the landscape, biodiversity and wildlife habitats are remunerated through direct payments, which are not in function of the agricultural quantity produced. Moreover compensatory payments induce farmers to a more ecological farming or even organic farming. The second phase consists mainly of abolishing all price and market guarantees. At the same time, the more ecological farming regime becomes compulsory for all direct payments. In 1996 the Swiss nation approves this reform by accepting the new article in the federal constitution assigning to agriculture the role

- to ensure food supply;
- to protect natural resources;
- to maintain the landscape;
- to make a contribution to economic, social and cultural life in rural areas.

In the pursuit of these new objectives, Swiss agricultural policy may be at present characterized by three elements. The central element is the gradual shift from price supports to direct payments decoupled from production[2]. These are given only to farmers satisfying the environmentally friendly farming on the whole of their agricultural land and not just targeted areas. The second one is related to the consequences of the Uruguay Round agreements, in particular the scaling down of domestic support prices by 20% and the conversion of all non-tariff border mea-

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[2]These transfers are computed on an hectarage or headage base.

3

sures into tariff equivalents. Finally, social and structural policies provide the third element of policy, to ease the operation of the industry and to allow its adjustment towards the fulfilment of the new policy objectives.

According to the new objectives for agriculture only one of the four is related to food production whereas the three others are a matter of public services. This multi-functionality of agriculture is represented in this study by the joint production of a agricultural private good and a public good. The production is joint because the farmers have the choice between the ecological farming implying a decrease in agricultural production and a standard farming with a smaller public good output[3]. The modelling of these public services as an externality is not adequate because it does not permit to take into account the allocation of primary factors into the production process. It was true before the reform since it was more the resulting of a traditional farming than the application of given ecological standards whereas now farmers have to engage primary factors to satisfy the necessary conditions linked to direct payments.

3 The CGE Model

The analysis of the Swiss agricultural policy reform is based on a static, single-country, 22-sector computable general equilibrium model.

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[3]The reason is for example that in the latter case, a higher agricultural production is achieved only with a high contribution of natural resources which decreases the public good output.

Because of the importance of international trade in Switzerland, the model includes a foreign sector but under the weaker form of the small-country assumption. The institutions are represented by a representative household and the government. Capital expenditure for both institutions are included in a capital account.

Producer behavior The sub-model of producer behaviour encompasses ten agricultural sectors, four food sectors, four industrial sectors and four service sectors. All need two primary factors, labour and capital. In addition, agricultural sectors employ land and produce, through a constant elasticity of transformation (CET) function, a sector specific output together with part of the public good. Then, each sector produces a composite commodity that can be transformed into domestic supply and exports according to a CET function. Producers are assumed to maximize profits subject to their production technology represented by a two-stage production function. The upper level is a Leontief combination of value-added and intermediate inputs. On the lower level, all primary factors are combined using a constant elasticity of substitution (CES) function and, following Armington (1969), intermediate demand is represented as a composite of imported and domestic goods.

Consumer behavior In this economy the representative consumer maximizes a utility function subject to a budget constraint that equals the revenue of primary factors net of

taxes, rents from production and tariff rate quotas as well as capital account net outflow. This income is allocated to private expenditure, savings (domestic and foreign investment demand), transfers to government and the balancing of the net trade surplus. The consumer's welfare is achieved through a three-stage procedure using at each nest a CES function. At the highest decision level, the household chooses between public and private consumption. At the second and third levels of the optimization process, the agent determines the optimal quantity for each private good which is, as intermediate inputs, imperfect substitute for domestic and imported commodities.

Using the dual approach allows us to get rid of the constant returns to scale problem on the production side and, on the consumption side, gives us immediately a Hicksian money metric welfare index and a true cost-of-living index. Moreover, in order to take the consumer utility for the public good into account, this one has to be part of its expenditures. Following Rutherford (1998), the trick is to endow the consumer with his own demand of the public good leaving thus the budget constraint unaffected. A quantity constraint assures that he does not consume more than the available production.

Public sector The role of the government in this economy is twofold. The first is to regulate the public good market whereas the second is to ensure public sector output. This one is exogenous and is produced from the intermediate demand of public administration and social security. Real government expenditure are supposed to be fixed.

Since there is no market for the public good, the intervention of the government is necessary. The whole public good production is thus purchased by the government at the producer cost. This transfer represents the direct payments. The market value of the public good is defined as the net social cost of the agricultural policy given the fact that agricultural policy represents the mean to attain the objectives stated in the Constitution. Net cost means that customs duty on agricultural and food products decrease total cost. Moreover social cost implies that rents attributed to consumers are also taken into account since they represent a potential benefit if they were to be auctioned. All this implies that the market value of the public good may differ from the production value. To bridge this gap, an endogenous ad valorem tax on the public good is introduced. It gives the rate public good is financed through other policy measures than direct payments.

Regarding the government income, it is obtained from collecting value-added taxes represented by a flat ad valorem tax on consumption goods, income taxes on labour and capital, tariffs and net production taxes. Balanced budget is achieved through the endogenous VAT rate on industrial goods.

Investment Investment output is assumed to represent a Leontief aggregation of market commodities. Each of these investment sector demand is defined by an Armington (1969) aggregation of domestic and imported

inputs. The composition of investment sector inputs responds to relative prices. This defines a price index for investment composed by prices of the invested goods.

The second closure rule is the balance between aggregate investment and savings. In this simple static model, private and government savings are assumed to be fixed so that real aggregate investment is exogenous as well. Saving is modelled as a negative endowment for the representative household. In addition, as investment includes inventories, net negative investment corresponds to inventory reductions fixed exogenously at the base year.

Foreign trade Given the fact that Switzerland is a relatively small and open economy, world prices are treated as exogenous variables. Again we follow the Armington (1969) approach by assuming that imports are imperfect substitutes for similar domestic commodities. Exports and supply for the domestic market of a commodity are a joint product of domestic production. Transfers from and to the rest of the world are mainly composed of factor revenue and are fixed. The last closure rule of the model is to impose trade balance with respect to the rest of the world accounting for those transfers and an exogenously specified net capital outflow. This is modelled as a negative endowment of the foreign exchange commodity for the representative consumer. The balance-of-payments equilibrium is then achieved by purchasing this asset. As the balance of transfers and the balance on capital account are set exoge-

nously, the balance-of-payments equilibrium in the simulations is obtained by permitting the real exchange rate to float.

4   Modelling Policies

Our approach to policy modelling is based on Weyerbrock (1998) and Kilkenny (1991) since it allows a differentiation between exogenous and endogenous or coupled and decoupled policies. Explicit modelling of policies means that they are represented as closely as possible how they really work. The main instrument of the Swiss agricultural policy are direct payments not tied to agricultural production. Other internal market support measures are input subsidies on labour and capital, output subsidies and quotas on production. Trade policies include tariffs and tariff rate quotas as well as export subsidies.

Domestic policies As said earlier, the reform of the agricultural policy is intended to remunerate the public good production through direct payments not tied to agricultural production. These are modelled as the net of tax purchase by the government of the whole output,

$$\bar{DP} = p_{pgd}(1 - \tau^Y_{pgd})y_{pgd} \qquad (1)$$

where a positive {negative} tax rate τ^Y_{pgd} implies a transfer from the government smaller {greater} than the market value of the public good. The direct payments are set exogenously by the government. The producer value $p^Y_{pgd} = p_{pgd}(1 - \tau^Y_{pgd})$ is the direct payment rate necessary to obtain the given direct

payments and the resulting quantity y_{pgd} is the degree of ecological farming. The former represents the incentive degree to produce the public good and the latter the share of the country's agricultural land farmed in an ecological way.

Social and structural policies are represented by an ad valorem input subsidy rate on labour, $-\tau_{lab}^Z$, and capital, $-\tau_{cap}^Z$, respectively. The user cost is then

$$p_{lab}^Z = p_{lab}(1 + \tau_{lab}^Z) \qquad (2)$$

for labour and

$$p_{cap}^Z = p_{cap}(1 + \tau_{cap}^Z) \qquad (3)$$

for capital. Consequently, the subsidy decreases the producer cost of inputs. In both cases, the subsidy rate is endogenous to meet the target expenditure of the social and structural policies.

Subsidies on production are modelled as an ad valorem subsidy on output g, $-\bar{\tau}_g^Y$. The user cost is in this case

$$p_g^Y = p_g(1 - \tau_g^Y) \qquad (4)$$

so the subsidy increases the producer value of output. The subsidy rate is endogenous as well in order to satisfy the total expenditure relative to market support.

The model includes also a quota on raw milk production. Defining $\bar{y}$ as the output quota level and y as the unrestricted quantity of supplied production, the explicit modelling of this device takes the form of a quantity constraint

$$y_{rmk} \leq \bar{y}_{rmk} \qquad (\rho_{rmk}^Y) \qquad (5)$$

whose Lagrange multiplier ρ_{rmk}^Y is the shadow price representing the quota rent or rights to produce.

Trade policies Switzerland uses export subsidies to dispose its exports of agricultural or food commodity g on world markets. The export refund rate, $-\bar{\tau}_g^E$, is exogenous

$$p_g^E = \bar{p}_g^{W,E}(1 - \bar{\tau}_g^E - \gamma_g^E)p_{FX} \qquad (6)$$

where p_{FX} is the real exchange rate. Adding an inequality constraint defining a ceiling $\bar{c}_g^E$ on export subsidy expenditure

$$\tau_g^E \bar{p}_g^{W,E} p_{FX} e_g \leq \bar{c}_g^E \qquad (\gamma_g^E) \qquad (7)$$

ensures that export subsidies are not greater than the specified level but may be smaller.

All customs duty are considered as ad valorem tariffs and are represented by an exogenous price wedge between the world market price, $\bar{p}_g^{W,M}$, and the domestic price of imports, p_g^M,

$$p_g^M = \bar{p}_g^{W,M}(1 - \bar{\tau}_g^M)p_{FX} \qquad (8)$$

where $\bar{\tau}_g^M$ is the tariff rate for a given commodity g.

Owing to the Uruguay Round agreements all non-tariff barriers on product g are converted in Switzerland into a two-part tariff rate quota. This is explicitly modelled, which means that a lower rate τ_g^M applies until a specified threshold level $\bar{m}_g$ is attained and a higher tariff rate $\bar{\tau}_g^M$ is used beyond this level. This two-part tariff rate schedule is thus monotone increasing,

$$\bar{\tau}_g^M = \begin{cases} \tau_g^M & \text{for} \quad m_g \leq \bar{m}_g \qquad (\rho_g^M) \\ \bar{\tau}_g^M & \text{for} \quad m_g > \bar{m}_g \end{cases} \qquad (9)$$

Table 1: Domestic and trade policies in the base year (in mio. CHF)

Instruments	Agriculture	Food	Industry	Services	Totals
Direct taxes					50'228
Value-added taxes	229	421	6'666	5'112	12'428
Direct payments	1'512				1'512
Social measures	88				88
Structural measures	338				338
Net output subsidies	1'248	167	-2'794	1'660	281
Production quota rent	608				608
Export subsidies	33	480	249		762
Tariffs	184	462	4'646		5'292
Tariff rate quota rents	548	1'591			2'139

where ρ_g^M is the rent associated with a binding quota.

Policy allocation As explained in section 3 the tax rate on public good τ_{pgd}^Y is endogenous. It is determined in

$$\tau_{pgd}^Y p_{pgd} y_{pgd} = - \tau_{lab}^Z p_{lab} z_{lab} - \tau_{cap}^Z p_{cap} z_{cap}$$
$$- \sum_{g \neq pgd} (\tau_g^Y + \rho_g^Y) p_g y_g$$
$$- \sum_g (\bar{\tau}_g^E + \gamma_g^E) \bar{p}_g^{W,E} p_{FX} e_g$$
$$- \sum_g (\tau_g^M + \rho_g^M) \bar{p}_g^{W,M} p_{FX} m_g$$

(10)

such that the net social cost of the agricultural policy is kept equal to the market value of the public good. In other words, when substituting this equation into the direct payment equation shows how the market value

of the public good is computed

$$p_{pgd} y_{pgd} = \bar{D}P - \tau_{lab}^Z p_{lab} z_{lab} - \tau_{cap}^Z p_{cap} z_{cap}$$
$$- \sum_{g \neq pgd} (\tau_g^Y + \rho_g^Y) p_g y_g$$
$$- \sum_g (\bar{\tau}_g^E + \gamma_g^E) \bar{p}_g^{W,E} p_{FX} e_g$$
$$- \sum_g (\tau_g^M + \rho_g^M) \bar{p}_g^{W,M} p_{FX} m_g$$

(11)

where τ_{pgd}^Y is the rate of financing public good by other policy measures than direct payments.

5 The Data

The core of the 1995 social accounting matrix used to calibrate and initialize the model is based on Grether and Mueller (1999) and follows the GTAP classification. It is an update of the 1990 SAM taking into account two points. First as Switzerland introduced the VAT in 1995, the 1996 VAT data are used

Table 2: Elasticity values used in the model

Description	Value
Elasticity of transformation between public good and agricultural goods	0.1
Elasticity of substitution between value-added and intermediate inputs	0
Elasticity of substitution between labour, capital and land	
- Agricultural sectors	0.25
- Food sector	0.4
- Industrial and service sectors	0.5
Elasticity of substitution between public good and private consumption	0.3
Elasticity of substitution between private consumption goods	1.5
Elasticity of transformation between domestic goods and exports	2
Elasticity of substitution between domestic goods and imports	
- Agricultural and food sectors	2.5
- Industrial and service sectors	0.5

instead. Second, tariff data are provided by the customs authorities and refer to 1996 as well. The reason is that the first measures resulting from the Uruguay Round agreements were implemented only in July 1995, date of Switzerland WTO membership.

Additional data are provided by the Federal Office of Statistic. Expenditures regarding the agricultural policy are from the Federal Office of Agriculture. The value of the rent from the raw milk production quota is based on Lehmann et al. (2000). The total rents generated by tariff rate quotas are the difference between the tariff equivalents from the OECD (1998) including non-tariff barriers and the effective customs duty. In the benchmark year, imports are assumed to be at quota and at the higher tariff rate level. Finally since the government does not sell any production or import licences, the premia accrue to the representative household.

Regarding the benchmark value of the public good, we assume that the consumer will-ingness to pay is identical to the value government gives to the public good, that is the market value. However, this is true only in the base year since in the experiments the consumer preferences determine his own valuation of the public good on the personalized market. The production value of the public good is assumed to be equal to the direct payments. The market value is supposed to be the net social cost of agricultural policy. Table 1 shows all the policies implemented in the model. Adding and subtracting the relevant agricultural and food policy costs and benefits gives a market value of 474 for the public good.

The whole SAM is then balanced using the cross entropy method and assuming select macroeconomic aggregates to be known together with specified row and column totals. The aggregation of sectors from the GTAP classification and the 1995 SAM for Switzerland are given in the appendix. Table 2 summarizes the elasticity values employed in the

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Table 3: Summary of the experiment design (in mio. CHF)

Instruments	AP 99	AP 02	DP	MS	DP&MS
Subsidies on labour	90	90	168	119	197
Subsidies on capital	321	471	875	619	1'024
Output subsidies	1'155	701	701	524	524
Direct payments	2'286	2'482	2'000	2'482	2'000
Export subsidy ceiling	440	440	440	440	440
Tariffs - TRQs	-15%	-15%	-15%	-15%	-15%

model.

6 Experiment Design

The major feature of the Swiss agricultural reform is the gradual shift from price supports to a system of direct payments conditional on an ecological farming. A good starting point is a sensitivity analysis to explore how this reduction in the government intervention on the agricultural markets linked to an increase in the remuneration of the public good affects the keys variables. This is done by reducing output subsidies of an amount equal to the increase in direct payments. The variation level goes from approximatively 250 mio. to 1'000 mio. in order to cover the actual range.

All other simulations study agricultural reform packages that require simultaneous changes in many policy instruments. They are 5 scenarios and 2 experiment types. The first scenario is an evaluation of the 1999 agricultural policy. The second scenario is the anticipated policy for the year 2002. The last three scenarios are reallocation policies

with regard to the 2002 agricultural policy[4]. This means that part of the government agricultural budget is allocated to another policy instrument. In scenario 3 direct payments are reduced by an amount of 482 mio. which are allocated to social and structural policies proportionally to their expenditure level. In the fourth scenario 25% of the production subsidies are converted in labour and capital subsidies. The final scenario is concerned with both diminutions of direct payments and output subsidies.

Each of the five scenarios is performed with and without the implications of the Uruguay Round. The former is labelled *With external reform* and the latter *Internal reform only*. Export competition target is the reduction of subsidy expenditure by 36% from 1986-90 levels for each product. Market access target is a minimum reduction of 15% per tariff line from 1986-88 base. This is true for both tariffs and new tariffs resulting from the conversion of non-tariff border measures into tariff rate quotas. Table 3 summarizes the data used for each of these 10 simulations.

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[4]This is the choice the government faces now. Either the status quo (scenario 2) or one of the reallocation policy scenario (scenario 3 to 5).

Table 4: Volume in the agricultural sectors (in % change)

	AP 99	AP 02	DP	MS	DP&MS
Internal reform only					
Output	1.44	1.53	2.05	1.78	2.28
Export	0.90	1.00	2.45	1.27	2.71
Import	-0.10	-0.18	-0.42	-0.21	-0.42
With external reform					
Output	0.32	0.44	0.96	0.72	1.21
Export	-1.86	-1.67	-0.33	-1.36	-0.03
Import	7.15	6.81	6.42	6.65	6.29

Table 5: Welfare effects (EV in % change)

	AP 99	AP 02	DP	MS	DP&MS
Internal reform only	-0.17	-0.15	-0.16	-0.16	-0.16
With external reform	0.15	0.15	0.14	0.14	0.13

7   The Results

The consequences of the agricultural reform in Switzerland are analyzed under three different aspects. The first details the impact of the Uruguay Round (UR) targets. The second tries to assess the multi-functionality of agriculture and the last one reports some macroeconomic indicators.

UR impact analysis   In comparison to the experiment type *Internal reform only*, the decrease in both tariffs and export subsidies leads to a decline in agricultural prices which reduces agricultural domestic and exported output on the one hand and increases the volume of agricultural imports on the other hand.

This has also an impact on agricultural policies not controlled by the government.

Export subsidies, output and tariff rate quota rents decrease whereas revenues from tariffs increase resulting in a smaller public good market value. This implies a higher subsidy rate for the public good and, since direct payments are held constant, a decrease in the public good price and quantity. Farmers are not remunerated for public services through high import and export agricultural prices anymore. Consequently an increase in direct payments are necessary to held the production of public good constant.

Table 5 reports the equivalent variations in percentage change for each experiment. The major consequence of the reform is the welfare gain from partial agricultural trade liberalization. The results for the scenarios the government faces are in welfare terms not significantly different from each other. The sensitivity analysis shows that the consumer is

Table 6: Public good analysis (in % change)

	AP 99	AP 02	DP	MS	DP&MS
PG volume	5.12	6.34	4.98	6.77	5.36
PG price	86.54	97.75	105.69	106.43	114.57
PG market value	96.10	110.29	115.93	120.41	126.07
Subsidy rate on PG	-33.29	-31.87	-56.32	-37.09	-60.31
Ind. good tax rate	2.19	0.06	0.06	0.15	0.12
PG private price	-14.93	-18.11	-14.56	-19.24	-15.62
PG private value	-10.57	-12.92	-10.30	-13.78	-11.09

better off only when the reduction in output subsidies outweighs the increase in direct payments. The tax rate on industrial goods resulting from the balanced budget reduces in theses cases by a significant amount.

Agricultural policy analysis The major result is that the public good production is positively related to direct payments. The output of public good rises by 6.34% in the AP 02 scenario. A rough comparison can be made with the actual 90% share of agricultural useful area farmed in an ecological way. However, if direct payments decline compare to the 2002 level, farmers may find more profitable to increase their agricultural production to the detriment of the public good production.

The reallocation policy scenarios (scenario MS compared to scenario AP 02 and scenario DP&MS compared to scenario DP in table 6) show that for a given level of direct payments, the reallocation output subsidies to social and structural policies is more expensive for the government, since it increases the cost of the agricultural policy. However this has a positive effect on the public good pro-duction and increases the share of direct payments financing the production of the public good. Holding now the output subsidies constant, the reallocation policy scenarios (scenario DP compared to scenario AP 02 and scenario DP&MS compared to scenario MS) imply a decrease in the public good output. The reason is that social and structural policy measures are available to all farmers and not just to those satisfying the required ecological conditions.

The relation between the way the public good is financed and the welfare is clear only from the sensitive analysis. As the subsidy rate on public good decreases, the welfare declines as well. This would say that as the public good is financed with increasing direct payments relatively to other instruments, the consumer is not better off. One should have thought it goes the other way round.

Another interesting result is the private valuation of the public good by the representative agent. For each scenario, both the private price and value decline. One possible explanation is that the preferences of the consumer take into account only the economic externalities of the public good such as the

Table 7: Macroeconomic indicators (in % change)

	AP 99	AP 02	DP	MS	DP&MS
Real GDP	0.29	0.37	0.37	0.38	0.38
Agr. prod. volume	0.32	0.44	0.96	0.72	1.21
Agricultural exports	-3.82	-3.49	-2.19	-3.15	-1.87
Agricultural imports	3.72	3.46	3.06	3.31	2.93
Industrial exports	0.42	0.54	0.47	0.52	0.46
Industrial imports	0.08	0.23	0.22	0.23	0.22
Real exchange rate	0.14	0.14	0.14	0.14	0.14

preservation of natural resources, the maintenance of the landscape, rural sightseeing, and so on. On the other hand, the government considers also societal externalities as, for example, the food security or the balance between rural and urban zones.

Macroeconomic analysis Agricultural policy reform has moderate to significant effects on macroeconomic indicators. Table 7 summarizes these results. All experiments lead to a small increase in real GDP. This increase amounts to approximatively 0.4% for all future policy scenarios. For these scenarios, the real exchange rate increases slightly of about 0.2% meaning a depreciation of the national currency. Because of the contraction of agricultural sectors, total agricultural exports decrease. This reduction is attenuated with diminishing direct payments and output subsidies. Agricultural imports, on the other hand, increase between 2.9% and 3.7%. Both exports and imports of industrial products increase but in a smaller proportion relative to agricultural goods.

8 Conclusion

The Swiss agricultural policy reform has for its main objective the reduction of the government intervention on the agricultural good markets in order to concentrate its support to farmers through direct payments not tied to agricultural production. This kind of transfers does not distort trade and thus is recommended by the World Trade Organization. However, the existence of other distortions in the economy may not lead to anticipated results.

The analysis is based on two fundamental components. The first is the modelling of the multi-functionality of agriculture as a public good produced by farmers jointly with an agricultural good. The second one is the explicit modelling of agricultural policies in order to take into account the incentive impact of government intervention. Among them, the most important are the direct payments to farmers represented as the purchase of the net value of the public good production by the government.

Simulations show that an increase in direct payments inciting farmers to a environ-

mentally friendly farming produces the anticipated effect, that is an increase in the proportion of the country's agricultural land farmed in an ecological way. The share of the direct payments in the remuneration of the public good production increases as well. Under reasonable assumptions, the welfare analysis shows that the consumer is better off. However this results from substantial gains from partial trade liberalization on agricultural markets. The shift from output subsidies to direct payments give negative welfare estimates. Regarding the choice of the future agricultural policy the government is faced with, neither the welfare analysis nor the macroeconomic indicators give, in this study, results significantly different from each other.

Appendix

Aggregated sectors used in the model

Model	GTAP 5 composition	Description
Agricultural sectors		
wht	wht	Wheat
gro	gro	Cereal grains nec
v_f	v_f	Vegetables, fruit, nuts
osd	osd	Oilseeds
c_b	c_b	Sugar cane, sugar beet
ocr	ocr	Crops nec
ctl	ctl	Bovine cattle, sheep, goats, horses
oap	oap	Animal products nec
rmk	rmk	Raw milk
oag	pdr, pfb, wol, for	Other agricultural products
Food sectors		
cmt	cmt	Bovine cattle, sheep, goat, horse meat
omt	omt	Meat products nec
mil	mil	Dairy products
ofd	fsh, vol, pcr, sgr, ofd	Other food products
Industrial sectors		
nrg	oil, gas, p_c, ely, gdt, wtr	Energy
mnf	col, b_t, tex, wap, lea, lum, ppp, crp, nmn, i_s, nfm, fmp	Manufactured products
eqp	omn, mvh, otn, ele, ome, omf	Equipment
cns	cns	Construction
Service sectors		
t_t	trd, otp, wtp, atp, cmn	Trade, transport
srv	ofi, isr, obs, ros	Private services
osg	osg	Public services
dwe	dwe	Dwellings

Aggregate SAM for the 1995 base year (in mio. CHF)

		SECTORS		COMMODITIES				FACTORS			INSTITUTIONS			TAXES & RENTS	ROW			TOTALS
		s_agr	s_ind	pgd	agr	ind	vpg	lab	cap	lnd	hh	inv	gov		exp	tax	rent	
SECTORS	s_agr			1'512	36'474													37'985
	s_ind					609'487												609'487
COMMODITIES	pgd												472					472
	agr	14'118	6'380								20'338	300			2'639	513		44'289
	ind	10'821	268'819								190'508	75'584	54'076		110'773	249		710'830
	vpg										472							472
FACTORS	lab	8'978	220'319															229'296
	cap	3'400	113'969															117'369
	lnd	1'095																1'095
INSTITUTIONS	hh						472	196'042	100'396	1'095				608	58'896		2'139	359'649
	inv										70'246		31'585					101'831
	gov										20'693			60'909		5'293		86'895
TAXES & RENTS	inc							33'254	16'974									50'228
	lab	-88																-88
	cap	-338																-338
	prod				608													608
	rent			-1'039	-1'415	1'134												-1'320
	agr										650							650
	ind										11'778							11'778
ROW	imp				5'836	95'562					44'963	25'948						172'309
	tax				646	4'646							762					6'054
	rent				2'139													2'139
TOTALS		37'985	609'487	472	44'289	710'830	472	229'296	117'369	1'095	359'649	101'831	86'895	61'517	172'309	6'054	2'139	

References

Armington, P. S. (1969). A theory of demand for products distinguished by place of production. *International Monetary Fund Staff Papers 16*(1), 159–78.

Brooke, A. et al. (1998, October). *GAMS : A User's Guide.* Washington: GAMS Development Corporation.

Burniaux, J.-M. et al. (1990, August). Walras - a multi-sector, multi-country applied general equilibrium model for for quantifying the economy-wide effects of agricultural policies: A technical manual. Working Paper 84, OECD, Department of Economics and Statistics, Paris.

Chambers, R. G. (1995). The incidence of agricultural policies. *Journal of Public Economics 57*(2), 317–35.

Conseil fédéral suisse (1996, June). Message concernant la réforme de la politique agricole : Deuxième étape (politique agricole 2002). Technical report, Administration fédérale, Berne.

Folmer, C. et al. (1995). *The Common Agricultural Policy beyond the Mac-Sharry reform*, Volume 230 of *Contributions to Economic Analysis.* North-Holland: Elsevier Science.

Francois, J. F., B. McDonald, and H. Nordström (1995). Assessing the uruguay round. In W. Martin and L. A. Winters (Eds.), *The Uruguay Round and the Developing Economies*, 307. Washington, D.C.: The World Bank.

Goldin, I. and D. van der Mensbrugghe (1995). The uruguay round: An assessment of economywide and agricultural reforms. In W. Martin and L. A. Winters (Eds.), *The Uruguay Round and the Developing Economies*, 307. Washington, D.C.: The World Bank.

Grether, J.-M. and T. Mueller (1999a). Effets à long terme d'une intégration de la suisse à l'Europe. Technical report, Office fédéral du développement économique et de l'emploi, Berne.

Grether, J.-M. and T. Mueller (1999b). Long-run effects of the common agricultural policy for switzerland: A simulation analysis. Unpublished paper.

Harrison, G. W., T. F. Rutherford, and D. G. Tarr (1995). Quantifying the uruguay round. In W. Martin and L. A. Winters (Eds.), *The Uruguay Round and the Developing Economies*, 307. Washington, D.C.: The World Bank.

Harrison, G. W., T. F. Rutherford, and I. Wooton (1989, May). The economic impact of the european community. *American Economic Review 79*(2), 288–94.

Harrison, G. W., T. F. Rutherford, and I. Wooton (1995, June). Liberalizing agriculture in the european union. *Journal of Policy Modeling 17*(3), 223–55.

Hertel, T. et al. (1995). Liberalizing manufactures trade in a changing world econ-

omy. In W. Martin and L. A. Winters (Eds.), *The Uruguay Round and the Developing Economies*, 307. Washington, D.C.: The World Bank.

Kilkenny, M. (1991, June). Computable general equilibrium modeling of agricultural policies. documentation of the 30-sector FPGE GAMS model of the united states. Staff Report AGES 9125, US Department of Agriculture, Economic Research Service, Washington DC.

Kilkenny, M. and S. Robinson (1988). Modelling the removal of production incentive distortions in the US agricultural sector. In A. Maunder and A. Valdes (Eds.), *Agriculture and Governments in an Interdependent World*, Aldershot: England, pp. 553–66. International Association of Agricultural Economists: Dartmouth Publishing Co.

Lehmann, B. et al. (2000, August). Evaluation der milchkontingentierung. Working paper, ETH, Institut für Agrarwirtschaft, Zürich.

OECD (1998). Politiques agricoles des pays de l'OCDE : Mesure du soutien et informations de base. Paris.

Rutherford, T. F. (1998, October). *Economic Equilibrium Modeling with GAMS: An Introduction to GAMS/MCP and GAMS/MPSGE.* Washington: GAMS Development Corporation.

van Nieuwkoop, R. and A. Mueller (1999).

The economic effects of the bilateral sectoral agreements and the swiss EU membership. Unpublished paper.

Weyerbrock, S. (1998, February). Reform of the european union's common agricultural policy: How to reach gatt-compatibility. *European Economic Review 42*(2), 375–411.

18