Swiss Agricultural Policy: A Public Good Approach in a CGE Framework

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Abstract

This paper is a first attempt to modelling multi-functionality of the farm sector through a public good produced jointly with other agricultural goods. Agricultural policy is thus not intended to support farmer income but to redistribute them this implicit revenue. A wide range of instruments are available to the government so the question is to know how the consumer welfare is affected by marginal changes in the Swiss agricultural policy. This analysis is conducted in a basic 18-sector computable general equilibrium model with explicit modelling of agricultural policies. Results show that lump-sum transfers are not necessarily Pareto superior compared to other *à priori* distorting policies.

JEL classification: D58; F13; H23; Q18

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1 Introduction

It is well known that most agricultural sectors around the world are subject to economic policies interfering strongly with the free functioning of the markets. They are of two kinds. On the one hand we have support measures that attempt to raise agricultural incomes by improving the profitability of farming and on the other hand, those that do not. Switzerland makes no exception. However, the current reform of agriculture is intended to concentrate on an income support that does not attempt to operate via income from farming but that directly raises agricultural incomes through lump-sum transfers, hereafter also direct payments.

Lipsey and Lancaster (1956) show that the introduction of a constraint into a general equilibrium system which prevents the attainment of one of the Paretian conditions makes the other Paretian conditions, in general, no longer desirable. Put it differently, a situation with n distortions is not necessarily, or is not even likely to be, superior to a situation with $n + 1$ distortions.

Chambers (1995) applies this idea to agriculture. In a general equilibrium model with distortionary income taxation, he 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. Therefore a direct income support is not necessarily Pareto superior compared to other *à priori* distorting policies.

According to the Swiss Constitution the four new objectives for agriculture are to ensure food supply, to make a contribution to economic, social and cultural life in rural areas, to protect natural resources and to maintain the landscape. Only one is thus related to food production while the remaining three are concerned with environmental issues. Introducing this feature as a pure public good into a computational general equilibrium model with explicit modelling of policies, we try to analyse the welfare effects of marginal changes in the Swiss agricultural policy. The purpose of this paper is thus to analyse, in a second-best economy, the way of redistributing to farmers the implicit revenue they should get from the production of the public good.

The motivations of this study are twofold. First it is intended to be calibrated to Switzerland in order to be able to gain some insights in the conduct of the agricultural policy. Second we would like to explore some new issues since literature is quite absent on that subject while there has been a proliferation of CGE models applied to tax and tariff reforms (see Gunning and Keyzer (1995) for a survey).

The outline of the paper is as follows. The model is described in the next section. Then, section 3 discusses the explicit modelling of agricultural policies and presents the reform experiments. An brief overview of the data is given in section 4. Our results and concluding remarks follow in section 5 and 6 respectively.

2 The model

Our analysis of the redistribution of the implicit income to farmers is based on a static, single-country, 18-sector computable general equilibrium model[1]. Due to the importance of international trade in Switzerland, the model includes also a foreign sector but under the small country assumption. A public sector and a capital account are also part of the model.

Figure 1 illustrates graphically physical flows in this economy. For clarity, agricultural sectors are aggregated in an agricultural sector (AGRI) and food, industrial as well as service sectors in an industrial sector (INDU). Intermediate demand is ignored and government interventions are represented by dash lines. Moreover each equation has its complementarity variable written in parenthesis and equations referred to in the paper are in italic in the text.

2.1 Producer behaviour

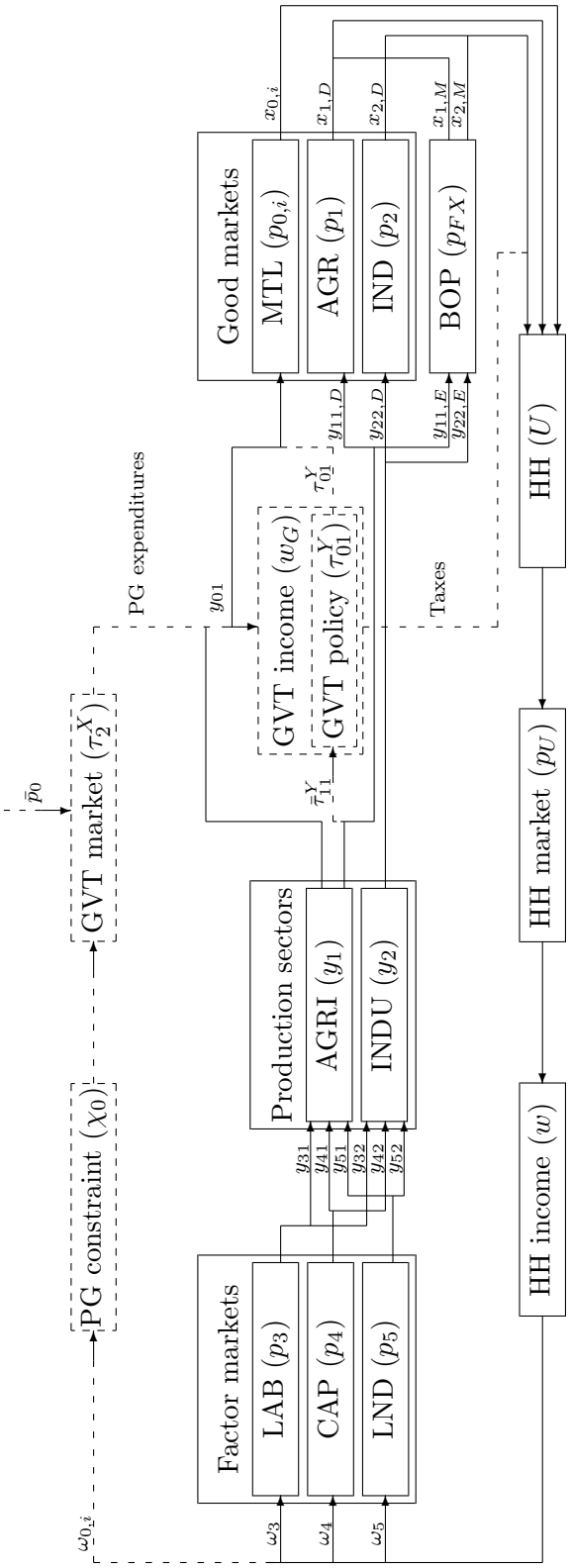
The sub-model of producer behaviour encompasses eight agricultural sectors, four food sectors, four industrial sectors and two service sectors. All need two primary factors, labour and capital. In addition, agricultural sectors employ land and produce, through a constant elasticity of transformation (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.

2.2 Household behaviour

In this economy the representative consumer maximizes a utility function subject to a budget constraint that equals the revenue of primary factors less income taxes on labour. This income is allocated to investment, private demand and a net transfer abroad. Utility maximization is achieved through a three-stage procedure using at each nest a CES function. At the highest decision level, the household chooses between private consumption and the public good. At the second and third levels of the optimization process, the household determines the optimal quantities of the composite private goods which are, as intermediate inputs, imperfect substitutes for domestic and imported commodities.

[1]This basic model incorporates simple producer and consumer behaviours through standard functional forms but nevertheless encompasses all the hypothesis needed for the analysis.

Figure 1: Flow chart



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 into account the consumer utility for the public good, this one has to be part of its expenditures. Following Rutherford (1998), the trick is to endow the consumer with her own demand of that good leaving thus the budget constraint unaffected. A *PG constraint* assures that he does not spend more than available production.

2.3 Government

Public sector is the most complex component of the model. Its main objective is to regulate the public good market. The consumers have indeed no incentives to reveal their preferences for the public good which implies a zero market price and makes the government intervention necessary[2]. We assume the government takes charge of the whole public good production - the *GVT market* - by fixing the production price $\bar{p}_0$ it gives to farmers. This can be viewed as the direct payments and the price as an incentive to produce the public good. This incentive represents in fact the degree of ecological farming set exogenously and thus a more environmentally friendly farming regime is achieved through an increase in the price of the public good.

However, taking into account that a difference between the value of the public good production and the lump-sum transfer may occur, an endogenous ad valorem tax τ_{01}^{Y} is levied on the public good and redistributed through other agricultural policies representing by $\bar{\tau}_{11}^{Y}$. The *GVT policy* includes thus a wide range of distorting agricultural supports. For now, it is composed of output and input subsidies as internal market support measures and of tariff quotas and variable import levies as trade policies. An important assumption here worthwhile to be emphasized. The government sets exogenously the value of the public good to the net expenditures of support measures to farmers. Moreover it is also assumed that it does not support the agricultural sector but gives it the revenue it should get from the public good production.

Regarding the government income - *GVT income*, it is obtained from collecting a consumer flat ad valorem tax τ_2^X on the industrial good. In the disaggregated model, this is composed of an income tax on labour and indirect taxes on consumption, non agricultural tariffs and net production taxes. Note that all agricultural policies in *GVT policy* may be left out since it is just a matter of redistribution. Real government expenditures are fixed and balanced budget is achieved through the endogenous ad valorem tax τ_2^X on the industrial good. Again the net government income represents then the value of the public good.

[2]The second-best provision of the public good leads in general to an undersupply compared to the Pareto optimal level, except when allowing for differentiated households, Wilson (1991), which is not the case here.

2.4 Investment

The second closure rule is the balance between aggregate investment and savings. In this simple static model, we assume that each element of the investment demand is a fixed quantity so that aggregate savings is determined residually. This is modelled as a negative endowment for the representative consumer. Moreover, investment includes inventories so that net negative investment corresponds to inventory reductions fixed exogenously at the base year.

2.5 Foreign sector

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. In order to close the model, we impose trade balance with respect to the rest of the world accounting for an exogenously specified net trade surplus.

3 Swiss agricultural policy

Before the 1992 Swiss agricultural reform, farm policy objectives are exclusively oriented towards economic ends. Market-managed price supports provide the principal thrust of policy mechanisms and are completed by structural policies 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 during the 1970s and 1980s, which fulfills the agricultural policy objectives at that time. However, in the 1990s, these reveal to be out of date, in particular due to the Uruguay Round agreements, and thus leads to the 1992 reform. The farm sector indeed has to move away from an exclusive food producing role to become more clearly multi-functional as it is now specified in the Swiss Constitution.

In the pursuit of these new objectives, Swiss agricultural policy may be at present characterized by three elements. The central element in the reform package is the gradual shift from price supports to direct payments decoupled from production. These include general direct payments conditional on an environmentally friendly farming and compensatory payments for an even more ecological farming or organic farming. These three transfers are computed on an hectarage or headage base. The second one is related to the World Trade Organization, whose Switzerland belongs to since 1995. All non-tariff import barriers thus have to be converted into tariff equivalents. Moreover, these resulting tariffs as well as other tariff on agricultural products are to be reduced by an average of 36 per cent over the 1995-2000 implementation period. Finally, structural policy

measures provide the third element and include research as well as subsidies and loans to help farmers to improve the land and modernize their farms.

3.1 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. However, due to time constraint, only trivial policies are implemented for the moment. Nevertheless we discuss them in turn in this subsection.

The most important policy are the decoupled from production direct payments. As mentioned in section 2, this is not intended to support agricultural income but to remunerate farmers for their public good production. Thus the government sets exogenously the degree of ecological farming through the price of the public good, which gives incentives to farmers to produce it. Direct payments are then represented by the net of tax purchase of the whole production y_{01},

$$DP = \bar{p}_0(1 - \tau_{01}^Y)y_{01} \tag{1}$$

where a positive {negative} tax implies a lump-sum transfer smaller {greater} than the value of the public good. Again this rate of public good payment is determined endogenously in the *GVT policy*

$$\tau_{01}^Y p_0 y_{01} = -\bar{\tau}_{11}^Y p_1 y_{11} - \bar{\tau}_{51}^Z p_5 y_{51} + \tau_{11}^M \bar{p}_{1,W} p_{FX} m_1 \tag{2}$$

so as to keep the total value of the support measures equals to the value of the public good for the government.

Output price and structural policies are implemented in a simpler manner. Both are represented by an exogenous ad valorem subsidy on output $\bar{\tau}_{11}^Y$ for the former and on capital $\bar{\tau}_{51}^Z$ for the latter. The user price is then

$$p_1^Y = p_1(1 - \bar{\tau}_{11}^Y) \tag{3}$$

for the output of the agricultural sector and

$$p_5^Z = p_5(1 + \bar{\tau}_{51}^Z) \tag{4}$$

for the capital of the agricultural sector.

Trade policies encompass tariff quotas and variable import levies. The former are modelled through a two-part monotone increasing tariff,

$$\bar{\tau}_{11}^M = \begin{cases} \underline{\tau}_{11}^M & \text{for} \quad m_1 \leq \bar{m}_1 \\ \overline{\tau}_{11}^M & \text{for} \quad m_1 > \bar{m}_1 \end{cases} \tag{5}$$

where $\bar{\tau}_{11}^M$ is the specific tariff rate for a specified threshold level $\bar{m}_1$. The latter are determined endogenously in order to bridge the gap between the threshold

price $\bar{p}_{1,M}$ set exogenously by the government and the world market price for imports $\bar{p}_{1,W}$,

$$\bar{p}_{1,M} = \bar{p}_{1,W}(1 + \tau_{11}^{M})p_{FX} \tag{6}$$

where p_{FX} defines the exchange rate.

3.2 Experiment design

All our experiments study the impact of the agricultural reform on the consumer welfare, especially the shift from coupled output payments to decoupled from production payments. The reform includes also the conversion of all non-tariff import barriers into tariff equivalents, which is taken into account in two different ways. The first assumes tariff quotas and the second variable import levies. Quota levels are set to the benchmark quantities at a tariff rate 25% less than the benchmark tariff rate. For imports greater than the threshold level, the tariff rate is identical to the tariff in the base year. Variable import levies are equal to the domestic price of imports in the benchmark year. We do not simulate the 36% tariff reduction required by the WTO in order not to take into account the gains from trade liberalization into the consumer welfare variation.

The objective of the government is to reduce its intervention on the agricultural markets and to increase direct payments. However, these lump-sum transfers are given only to farmers satisfying the more environmentally friendly farming, that is contributing to the production of the public good. This degree of ecological farming is set exogenously by the government and is our first policy parameter. The government intervention on agricultural markets is represented by the output price subsidy which gives us our second policy parameter. For each of them, we define three variation levels: zero, low and high. The zero level assumes no variation at all for the public good price and the output subsidy. The low level stands for a 5% increase in the price of the public good and a 20% reduction of the subsidy level. Finally, an increase in the public good price of 10% and a decrease in the output subsidy of 40% represent the high variation level[3]. Together with the two trade scenarios, tariff quotas or tariffs only, we thus have 18 experiments, whose results are commented in section 5.

Regarding structural policies, we assume that the government increases the capital subsidy by 20% in all scenarios. Finally, other taxes or subsidies on food, industrial and service goods are assumed to remain unaltered.

4 The data

The 1995 social accounting matrix used to calibrate and initialize the model is based on Grether and Mueller (1999) and follows the Global Trade Analysis

[3]The decrease in output subsidy is indeed the double for the grain and raw milk goods resulting from a far to high producer price on these markets.

Table 1: Sectoral disaggregation

	GTAP composition	Description
Agricultural sectors		
GRN	pdr, wht, gro, osd	Grains
V_F	v_f	Vegetables, fruit, nuts
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	wol, for	Other agricultural products
Food sectors		
CMT	cmt	Bovine cattle, sheep, goat, horses meat
OMT	omt	Meat products nec
MIL	mil	Dairy products
OFD	fsh, vol, pcr, sgr, ofd	Other food products
Industrial sectors		
NRG	gas, ely, gdt, wtr	Energy
MNF	b_t, tex, pfb, wap, lum	
	ppp, lea, crp, oil, p_c, col	Manufactured products
	omn, nmn, i_s, nfm, fmp	
EQP	mvh, otn, ele	
	ome, omf, cns	Equipment
T_T	t_t	Trade, transport
Service sectors		
SRV	osp, dwe,	Private services
OSG	osg	Public services

Project (GTAP) classification. Table 1 shows how sectors are disaggregated and an overview of the Swiss economy for the 1995 base year is given in the appendix. It is important to emphasize that this SAM is here to give a first appreciation of policy implications but not to get accurate results. Some data misses for the moment, as for example, export subsidies which are included in the tariffs. A more detailed SAM has thus to be built in the future in order to take into account more precisely all the data related to agricultural sectors.

Regarding the benchmark value of the public good, we assume that the consumer willingness to pay is identical to the value for the government. However, this is true only for the benchmark year since then the price of the public good for consumer may be different from the one set by the government in the experiments. As mentioned in section 2, the value of the public good production is assumed to be the net total cost of the farmer sector. This includes indeed some receipts at the frontier which are then used to finance domestic production.

Elasticity estimates are drawn from the literature. On the production side, the CES function for the primary inputs is assigned an elasticity of 0.25 for the agricultural sectors, 0.4 for the food sectors and 0.5 for the industrial and

Table 2: Tax rate on the industrial goods (in percent change)

Trade regime	Level of PG price increase	Subsidy decrease level Zero	Low	High
Tariff quota	Zero	-0.06	0.77	1.45
	Low	2.46	3.31	4.01
	High	5.06	5.93	6.65
Tariff	Zero	-0.19	1.53	2.82
	Low	2.70	4.37	5.63
	High	5.65	7.27	8.50

service sectors. The elasticity of transformation between the public good and agricultural goods is set to 0.1 reflecting the high complementarity between these two goods. On the consumption side, the elasticity of substitution between the public good and the composite private good is equal to 0.3 while the one between private consumption goods equals 1.5. On the foreign sector, the imperfect degree of substitution for imports and similar domestic commodities is measured by a elasticity of 2.5 for the agricultural and food sectors while this one is 3.0 for the industrial and service sectors. Finally, the joint production function for exports and domestic supply is assigned an elasticity of transformation equals to 2.0.

5 The results

Agricultural policy reform leads to expected as well as unexpected results. First of all, regarding the anticipated results, the distinction between the two trade regimes is superfluous since both of them reproduce more and less the trade situation at the benchmark equilibrium. However, two remarks are worth to note. The first concerns the welfare analysis and is discussed at the end of this section. The second is the higher tax rate on industrial sectors[4] in case of tariffs only, as shown in table 2, compared to tariff quotas. The reason is that part of the tax revenue from domestic consumption is taken away when imports are allowed to enter freely. We should therefore also constraint the industrial imports in order not not penalize the domestic consumption.

Then, concerning the level of the public good production, table 3 shows that it is increasing in output subsidy reduction on the one hand and in its price on the other hand. This result is not surprising at all since it comes from the

[4]Remember that this endogenous tax is determined on the *GVT market*. Moreover, the percentage variation has to be the same for all domestic industrial goods.

Table 3: Production of public good (in percent change)

Trade regime	Level of PG price increase	Subsidy decrease level Zero	Low	High
Tariff quota	Zero	-0.35	2.20	4.45
	Low	1.14	3.57	5.76
	High	2.60	4.93	7.05
Tariff	Zero	-0.35	2.27	4.41
	Low	1.15	3.64	5.71
	High	2.62	4.99	7.00

Table 4: Rate of direct payments (in percent)

Trade regime	Level of PG price increase	Subsidy decrease level Zero	Low	High
Tariff quota	Zero	66.83	84.15	101.12
	Low	68.54	84.81	100.86
	High	70.07	85.47	100.65
Tariff	Zero	66.84	84.42	101.11
	Low	68.46	85.00	100.74
	High	69.93	85.53	100.41

profit-maximizing behaviour of the producer.

Finally, it is important to remember that the increase in the exogenous public good price is not related to the lump-sum transfers but represents the degree of ecological farming. This can be seen indeed in table 4 for any reduction level of subsidy output[5]. In the case of an unaltered subsidy level, the small increase in the rate is due to the increase of the value of the public good production. Holding now its level price constant shows that the rate of direct payments varies positively with a reduction of output subsidy. This results from the reallocation policy of the government, which has to balance the difference between the public good value and the lump-sum transfers.

Welfare analysis gives however unexpected and unclear results. The only clear result is the decrease in welfare due to an increase in price of the public good,

[5]The benchmark rate of direct payments is equal to 69.74%. Moreover, rate greater than 100 percent means that the government subsidized the production of the public good.

Table 5: Welfare analysis (in percent change)

Trade regime	Level of PG price increase	Subsidy decrease level Zero	Low	High
Tariff quota	Zero	-0.00279	0.00538	0.00560
	Low	-0.03666	-0.03165	-0.03405
	High	-0.07352	-0.07143	-0.07615
Tariff	Zero	-0.00196	-0.00038	-0.00401
	Low	-0.04066	-0.04174	-0.04727
	High	-0.08216	-0.08556	-0.09281

and this for any level of output subsidy. However, holding the public good price constant leads to different conclusions. Among both trade regimes, only the case of unchanged public good price in a tariff quota regime shows an increase in welfare. This corresponds indeed to a situation where ecological farming remains at the benchmark degree but where the public good production is financed with increasing direct payments. In other words, the consumer via the government does not want more environmentally friendly farming but wants a reduction of its intervention on the agricultural markets. However, this is true only for a conservative trade policy, while this is what might be expected in general when implementing such a reform.

Regarding the other cases, a decrease in welfare appears for a low or high public good price in the tariff regime while for the remaining three, the pattern of the welfare variation is non-linear. It is decreasing for low output subsidy reduction and increasing then for higher reduction. An element of answer is maybe the price of the public good. Increasing ecological farming thus has a cost which has not to be neglected.

Consequently, at this stage of modelling, the 1992 agricultural policy reform does not lead to robust conclusions. It is therefore necessary to improve both the model and the data quality before making more precise judgements on the reform implications.

6 Conclusion

This paper presents the current state of the author Ph. D. dissertation. It is thus intended to be completed as you notice it through the lecture. A lot of questions are still open and are discussed below. Nonetheless, it tries to contribute to the current debate on the multi-functionality of agriculture.

The 1992 Swiss agricultural policy reform has for its main objective the re-

duction of the government intervention on the agricultural good markets in order to concentrate its support to farmers through direct payments not tied to production. This kind of transfers does not distort trade and thus is recommended by the World Trade Organization. However, in second-best economies, this may be not optimal for consumers maximizing welfare.

The analysis is based on two fundamental elements. The first is the modelling of the multi-functionality of agriculture as a public good produced by farmers jointly with other agricultural goods. 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 is the lump-sum transfers to farmers represented through the purchase of the net value of the public good production by the government.

Policy sensitivity experiments show that the reduction of government intervention on the markets increases the public good production. This is also the case when the government increases the incitation to a more environmentally friendly farming through the public good price. As a corollary of the former only, the share of the direct payments in the remuneration of the public good production increases as well. However, conclusions on welfare are not so clear. Results show that high lump-sum transfers may be dominated by a low (but non zero) output subsidy reduction. Therefore as long as economies are subject to institutional constraints, a situation with n distortions is not necessarily, or is not even likely to be, superior to a situation with $n + 1$ distortions.

Improvement of the analysis contains the following developments. The major one is the incorporation of additional agricultural policies. This includes on the internal market, price control with or without production quotas and diversion payments for voluntary land set-asides. Fixed or variable export subsidies are to be part of the trade policies as well. This implies a more complete SAM to be built with a larger disaggregation of the sectors, which allows then to better match the features of the Swiss agricultural policy.

Moreover, the choice of functional forms has to be more carefully modelled, especially on the consumption side where the specification of preferences for the public goods is involved. The last point should be the modelling of land as a fixed rather than variable factor, which implies decreasing returns to scale for the sector and thus a non zero profit due to the rent.

Table 6: Aggregate SAM for the 1995 base year (in mio. CHF)

		SECTORS		COMMODITIES				FACTORS			INSTITUTIONS			TAXES	ROW		TOTALS
		AGRI	INDU	MTL	AGR	IND	VML	LAB	CAP	LND	HH	GVT	INV		EXP	TAXES	
SECTORS	AGRI			1868	37793												39660
	INDU					608794											608794
COMMODITIES [a]	MTL											2678					2678
	AGR	14008	6291								19698		2495		2649		45141
	IND	10450	267895								191149	67145	62575		110763		709977
	VML										2678						2678
FACTORS	LAB	10175	220566														230741
	CAP	3439	114042														117480
	LND	1940															1940
INSTITUTIONS	HH						2678	180938	117480	1940							301206
	GVT [b]													62391		7432	69822
	INV [c]										65070						65070
TAXES	Income								49802								49802
	CAP	-351															-351
	Output			810	-1416	1118											512
	AGR										650						650
	IND										11778						11778
ROW	IMP [d]				5977	95421					12014						113412
	TAXES				2787	4644											7432
TOTALS		39660	608794	2678	45141	709977	2678	230741	117480	1940	301206	67992	65070	60560	113412	7432	

[a] $A + C + G + I + E = A + GDP + M$
[b] $T = G$
[c] $S = I + F$
[d] $M + F = E$

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