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Estimating Agricultural Supply Response with the dynamic sector model SILAS-dyn

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Abstract

The rapid ascent of commodity prices between late 2005 and 2008 led to renewed debate about what drives the demand and supply for basic food commodities. This paper examines the supply response to the output prices shocks for 22 commodity products in 3 regions of Switzerland by using a dynamic model system of Swiss agriculture (SILAS-dyn). The results suggest that almost all of the estimated own-price supply elasticities are inelastic (lower than one). Milk production appears to have one of the lowest elasticities, the short term supply response only reaches a value of 0.3. Fix input factors and non-economic reasons reduce the economic incentives of changes in milk price. For most of the activities, the response values over a longer time period lie between 0.5 and 1.0. In the case of crop activities, the differences between short and long term values are lower than in animal production. Almost all cross-price supply elasticities are negative (as expected) and near zero. They only play a role in the case of price changes of the main products.

Keywords: *Supply elasticity, short term, long term, dynamic recursive, Switzerland*

JEL classification: *C61, Q11, Q18*

1. Introduction

The high food prices experienced over recent years have led to the widespread view that food price volatility has increased. The rapid ascent of commodity prices led to renewed debate about what drives the supply and demand for basic food commodities. In Switzerland, the role played by the state in relation to the market has changed dramatically over the past few years. On the internal market, prices and quantities produced are largely determined by supply and demand. Overall, subsidies were strongly reduced between 1999 and 2011. On the other hand, agrarian reforms reinforced tools which are less interventionist vis-à-vis the market. That means the supply response has become a more important and crucial research issue associated with agricultural growth in Switzerland since the introduction of a series of policy reforms in the agricultural sector. Questions have been raised, however, about how responsive Swiss agricultural commodities are to price, and whether there would in fact be a positive supply response to higher prices. The estimation of supply functions of agricultural products is of great interest both practically and theoretically. Reliable estimates of the responsiveness of the supply of and demand for agricultural products to prices and other factors are fundamental to accurate economic forecasting, valid analyses of the impacts of new production technologies or promotion campaigns, and effective policy decision making. This requirement holds true whether the estimates are used by academics, government departments, research institutions or producer organizations such as the Swiss Farmers' Union.

A research project on supply response analysis of the Switzerland agricultural commodities supply response will add value to the literature due to the fact that in Switzerland there is no research on this specific topic. Thus, the estimates of the elasticity of supply relative to its own price is a fundamental prerequisite for estimating the effects of future policy reform AP2017 on Swiss producers. It can be concluded that in a small country such as Switzerland, research on the field of supply response on a specific food commodity is relevant to a secure sustainable future of food security.

The paper seeks to estimate agricultural commodity supply response in Switzerland through estimation of supplies responses to changes in producer's price. The remainder of this paper is organized as follows. In section 2, the choice of

methodological considerations underlying this study are presented. Section 3 and 4 describe the dynamic sector model SILAS-dyn method and theoretical framework used to calculate the supply elasticities. Estimated parameters, elasticities and tests carried out are presented in section 5. The final section 6 summarizes conclusions and makes recommendations for policy and future research.

2. The preferred modelling approach

In literature, there are two broad approaches used to estimate agricultural supply response – the programming approach and the econometric approach. However, neither of the two approaches can estimate all of the elasticities accurately. They both have strengths and weaknesses that must be taken into account when applying these estimates. The programming approach tends to give higher estimates (Griffith et al. 2001) and to be better for long term estimation, while the econometric approach is better for the estimation of cross-price elasticities of supply. Hall, Fraser and Purtill (1988) give several reasons why such a difference can be expected. Programming models permit a higher level of disaggregation, which has served to illustrate variations in supply response by region that would be hidden by an aggregate model. Linear programming techniques are particularly suitable for analysis of new situations involving for example, longer-term shifts in the supply curve, development of new products or markets, and institutional changes such as the application of quotas or subsidies. The factors influencing dynamic supply response have been the subject of considerable research (Askari and Cummings 1976). Supply dynamics have been associated with the dynamic nature of the production process. In the case of production from biological populations, biological time lags typically influence the nature of population dynamics, which in turn affects the dynamics of supply response (Marsh 1983; Whipple and Menkhaus 1989). However, there are only a few studies of supply response concerning agricultural production using the well-known dynamic modelling agricultural supply.

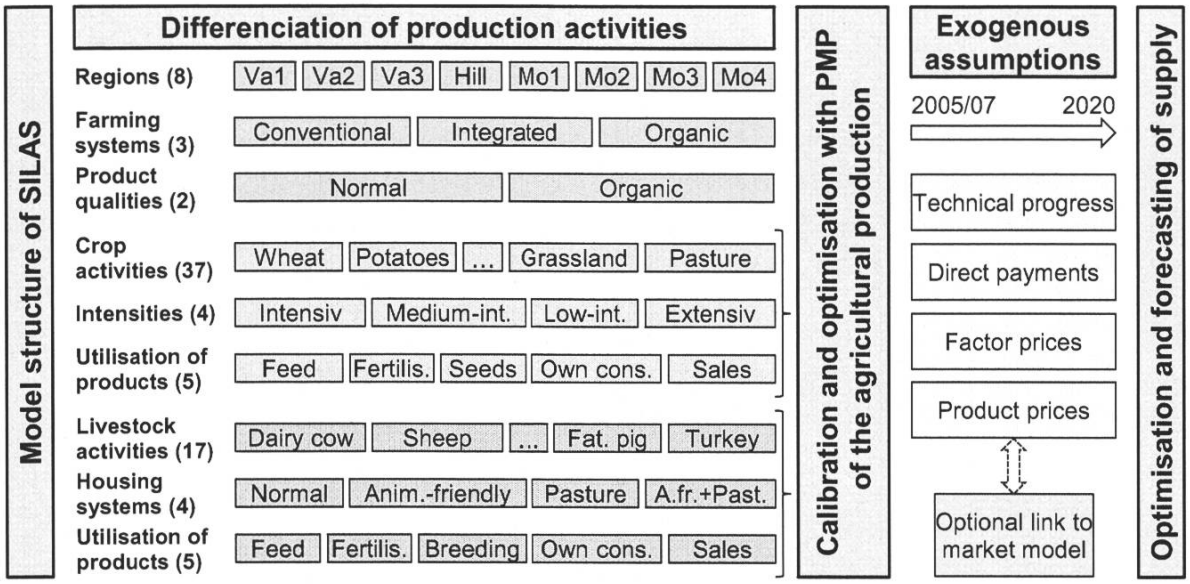
As already summarized in literature, the econometric modelling approach has a number of advantages and should not be ruled out a priori. The disadvantages, however, outweigh the advantages in this particular case. There are several reasons why the econometric approach is discarded. First, these elasticities are derived from structural modelling work that already has been completed, thereby saving time and expense. Second, a programming approach has the advantage of not needing estimates or assumptions of behavioural function forms while allowing for very detailed modelling of production technology. Finally, the number of dimensions of the sector model to be constructed is very large since there are many products, inputs and regions with corresponding product balance and other constraints. The estimation of parameters of large systems of simultaneous equations, particularly if embedded with dynamic lags, is very difficult. Thus the econometric models are discarded and the remaining methodological choice is a dynamic model based on optimization.

3. The model SILAS-dyn

The dynamic sectoral information and forecasting system of Swiss agriculture (SILAS-dyn) is used as a decision support system in connection with budget fund planning for Switzerland's agricultural sector (Mack and Flury 2006). The system provides information on the effects of different agricultural policies on production volumes and agricultural income in different regions in Switzerland in order to help agricultural economists in their research and policy makers in estimating the effects of different policy decisions. The complex multi-relationships involve recognition of all the effects on supply due to change in product prices, input prices as well as the incorporation of technological and physical restrictions. The model is expected to forecast production and income ratios as realistically as possible over a short to medium-term period of five to fifteen years.

The supply side of the model is highly detailed (Figure 1). The SILAS-dyn model bases the regional farms on eight agricultural areas defined by increasingly difficult production and living conditions. These areas form the basis for a number of agricultural policy measures. This enables very accurate modelling of the Swiss direct payments system, which is characterized by regionally graduated direct payment approaches and contribution restrictions. Furthermore, the relatively homogeneous production potential of individual areas can be very realistically represented in the model, as most of the statistical data is available at this regional level. SILAS-dyn comprises all the principal types of crop and livestock activities in Swiss agriculture, divided into different levels of intensity. These activities are in competition for scant resources such as land, labour or stable places. Several restrictions have to be fulfilled and have an impact on supply response: Regional nutrient balances determine lower and upper limits of fertilizer consumption. Crop rotation rules prevent strong expansions of single crops. Feeding requirements and accounting equations ensure adequate feed rations and utilization of the produced roughage. Investments are modelled by means of a recursive dynamic approach. The machinery and building stock – reduced by the part that has reached its useful lifetime – is transferred to the next model year. In order to maintain or increase livestock, investments are needed, corresponding to the current technology standard. All these restrictions affect supply response. Furthermore, changing parameters relating to the development of technical progress may modify relative productivity of the activities.

Figure 1. The Swiss agricultural model SILAS-dyn as a recursive dynamic supply model



Nevertheless, developments in reality usually differ from model results mainly because of additional incentives not formulated in the model. Therefore, the optimization is carried out according to the Positive Mathematical Programming (PMP) method (Howitt 1995). The objective function which maximizes sectoral income is extended by activity specific PMP terms. The mathematical model is:

$$Max\ Z_t = \sum_{iz} p_{izt}Y_{izt} + \sum_{hz} d_{hzt}L_{hzt} + \sum_{gz} d_{gzt}C_{gzt}$$

$$-\sum_{jz} q_{jzt}F_{jzt} - \sum_{kz} v_{kzt}U_{kzt} - \sum_{kz} v_{kzt-1}U_{kzt-1} - \sum_{rz} \alpha_{rz}X_{rzt} - \sum_{rz} 0.5\beta_{rz}X_{rzt}^2$$

Subject to

$$\sum_{h} e_{hkzt}L_{hzt} \leq U_{kzt} + (1-n)U_{kzt-1}$$

$$Y_{izt}, L_{hzt}, C_{gzt}, F_{jzt}, U_{kzt}, X_{rz} \geq [0]$$

With

Z_t: Objective function (sectoral income) in year t (2005/07–2020)

p_{izt}: Producer price for product i, in zone z (Swiss production regions 1–8) and year t

Y_{izt}: Sales of product i, in zone z and year t

d_{hzt}: Direct payment for livestock activity h, in zone z and year t

L_{hzt}: Livestock activity h, in zone z and year t

C_{gzt}: Crop activity g, in zone z and year t

q_{jzt}: Price of production factor j, in zone z and year t

F_{jzt}: Purchases of production factor j, in zone z and year t

v_{kzt}: Investment costs for building or machinery k, in zone z and year t

U_{kzt}: New investments in building or machinery k, in zone z and year t

v_{kzt-1}: Fixed costs for existing building or machinery k, in zone z and year t-1

U_{kzt-1}: Existing investments in building or machinery k, in zone z and year t-1

α_{rz}: Linear PMP term for production activity r in zone z

β_{rz}: Quadratic PMP term for production activity r in zone z

X_{rz}: Production activity r, in zone z and year t

e_{hkzt}: Demand of livestock activity h for building or machinery k, in zone z and year t

n: Amortization period for building and machinery (inverse of duration)

Since agriculture is characterized by the long duration of investments, the economic adjustment to policy or price changes is likely to take a long time. The investment constraints play a key role in the annual supply response. In respect to resource endowment changes we can identify two situations:

- In the short term, producers are able to change the quantities of some but not all the resources (machinery, building) they employ. This time period is too short to change plant capacity but long enough to use fixed plant more or less intensively.
- In the long term, producers are able to change most of the resources they employ. This time period is long enough for firms to adjust their plant sizes and for new firms to enter (or existing firms to exit) the sector.

The short term elasticities are derived from the SILAS model solution for one of the first forecast years (2009), in which almost all resource endowments of the previous year remain in the model data as fix factors. For the long term elasticities, the model is run over a period of 12 years; most of the machinery and a part of the buildings would have to be replaced in order to maintain production capacity. Theoretically, the supply of a product is more price elastic in the long term than in the short term.

4. Elasticity calculation measuring the price elasticity of supply

The price elasticity of supply is a measure of the responsiveness of the quantity of a crop supplied to the price of that product. There is consensus that when the price of a product rises, the response in supply takes two forms. The first is the expansion effect or the net increase in output of one or more products, and second is the transformation effect which reflects the change in the mix of products along the production frontier, resulting from the greater relative profitability of the product whose price has risen. Elasticities can be calculated in a variety of ways, and the choice of procedure should depend on the intended use of the estimates. For our simulations, the model is first calculated for the whole time period with the assumed development of the exogenous para-

meters such as technical progress or prices, in order to receive a reference solution. Then the price development of one product is increased by 10 percent, the model is solved again and the percentage changes in the endogenous variables of interest, in our case the production quantities, are recorded for the first year (short term) and the last forecast year (long term). This process is repeated for each other product in the model. A table is created of the percentage impact on the production of each of the activities from the shocks in prices.

Figure 2. Theoretical method for the estimation of supply elasticities

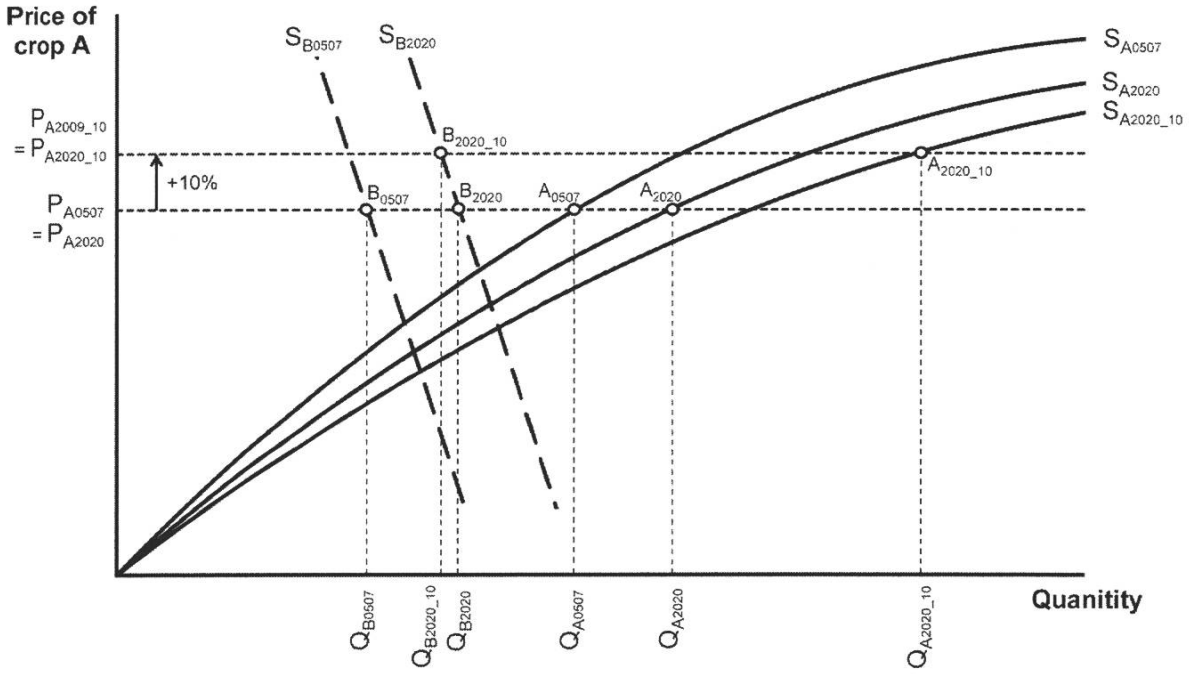


Figure 2 illustrates the procedure used to calculate the elasticities for the case of two substitutive crops A and B in SILAS. In this example the initial price development of crop A is assumed to be constant. The implicit supply curve in SILAS (which is nonlinear, as shown in figure 2) is represented by S_{A0507} supply curve for the base year 2005/07, and the curve S_{A2020} is the corresponding curve for 2020. The shift between the base year and 2020 is mainly caused by technical progress. In the reference solution, the production quantity of crop A reaches Q_{A0507} in the base year and Q_{A2020} in 2020. In a second model run, the price of crop A is increased by 10 % for the whole time period from 2009 on-

wards. This leads to an additional shift of the supply curve due to investments in building and machinery which result from the price incentive and still exist in the following model years. The model solution reveals the quantity Q_{A2020_10} in the last year. The shift from point A_{2020} to A_{2020_10} determines the long term price elastitcity of crop A. The short term elasticity is calculated by using the model solutions for the year 2009. In contrast to crop A, the supply curve for crop B shows decreasing quantities as a function of the price of crop A. The position of the curve S_{B2020} is slightly influenced by the price increase of crop A, which is not shown in the figure. The (long term) cross-price elasticity of crop B against crop A derives from the shift from point B_{2020} to B_{2020_10}. The impacts of price increases are consecutively assessed for all products.

The general form of the long term own price elasticity of supply is given by the following:

$$\varepsilon_{A_{2020}} = \frac{(Q_{A_{2020\_10}} - Q_{A_{2020}})}{(P_{A_{2020\_10}} - P_{A_{2020}})} * \frac{P_{A_{2020}}}{Q_{A_{2020}}}$$

ε_{A2020} = own price elasticity of supply for some good A

Q_{A2020} = quantity of good A supplied in reference solution

Q_{A2020_10} = quantity of good A supplied with price increase by 10 %

P_{A2020} = farm gate price of good A in reference solution

P_{A2020_10} = farm gate price of good A with price increase by 10 %

Cross elasticity of supply is defined as the responsiveness of the supply of commodity B to a change in the price of commodity A. For example, the cross elasticity of supply of wheat against potatoes is how much supply of wheat will change if the price of potatoes changes.

$$\varepsilon_{BA_{2020}} = \frac{(Q_{B_{2020\_10}} - Q_{B_{2020}})}{(P_{A_{2020\_10}} - P_{A_{2020}})} * \frac{P_{A_{2020}}}{Q_{B_{2020}}}$$

ε_{BA2020} = (long term) cross price elasticity of supply for some product B against product A

Q_{B2020} = quantity of good B supplied in reference solution

Q_{B2020_10} = quantity of good B supplied with 10 % price increase of good A

5. Results

Table 1 contains the estimated supply response parameters for the most important activities in Switzerland. The results for all activities examined are presented in the appendix, separated according to short and long term values and to valley, hill and mountain region. The outcomes reveal, for example, that the impact of the milk price on the quantity of milk produced is rather inelastic: When the price of milk rises by 1 percent within a year, farmers choose to increase the production by 0.33 percent. If the time of the price change is extended to 12 years, the increase of production reaches 0.48 percent. The cross-price elasticities show that a rise in milk price does not only increase milk production, but also decreases the amount of other activities by up to 0.65 percent. The coefficients of these estimated parameters for supply response are consistent with standard production theory: a positive supply response to own-price and a negative response to competing prices.

Table 1. Supply response of the most important activities

Change: Price	Milk		Nat. beef meat		Beef meat		Sheep meat		Pork meat		Poultry meat		Wheat		Barley		Maize		Potatoes		Rape		Fresh vegetabl.	
Quantity	short	long	short	long	short	long	short	long	short	long	short	long	short	long	short	long	short	long	short	long	short	long	short	long
Milk	**0.33**	**0.48**	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0.00	-0.04	-0.03	-0.03	-0.02	-0.01	-0.01	0.00	-0.01	-0.01	-0.01	-0.01	0.00
Natura beef meat	-0.12	-0.27	**0.54**	**0.53**	-0.01	-0.01	0.00	-0.01	0.00	0.00	0.00	0.00	-0.07	-0.03	0.00	-0.02	0.00	-0.01	-0.01	-0.01	-0.02	-0.01	0.00	0.00
Beef meat	-0.07	-0.24	-0.02	-0.03	**0.73**	**0.81**	0.00	-0.01	0.00	0.00	0.00	0.00	-0.03	-0.04	0.00	-0.03	0.01	-0.03	-0.01	0.00	-0.01	-0.01	0.00	-0.01
Sheep meat	-0.73	-0.65	-0.03	-0.08	-0.01	-0.02	**0.27**	**0.60**	-0.09	0.00	0.00	0.00	-0.05	-0.04	-0.03	-0.03	0.04	0.00	0.00	0.00	0.00	-0.01	0.00	0.00
Pork meat	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.69**	**0.85**	0.00	0.00	-0.01	0.00	0.00	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
Poultry meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	**0.30**	**1.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	-0.36	-0.26	-0.02	-0.03	-0.01	-0.01	0.00	-0.01	0.01	0.00	0.01	0.00	**0.77**	**0.77**	-0.09	-0.07	-0.01	-0.05	-0.03	-0.02	-0.03	-0.04	-0.01	-0.02
Barley	-0.44	-0.41	-0.02	-0.04	-0.01	-0.02	0.00	-0.01	0.02	0.00	0.01	0.00	-0.20	-0.19	**0.66**	**0.76**	-0.01	-0.05	-0.03	-0.02	-0.03	-0.05	-0.01	-0.02
Maize	-0.19	-0.30	0.00	-0.03	0.01	-0.02	0.02	-0.01	0.37	0.01	0.00	0.00	-0.05	-0.22	-0.03	-0.09	**0.23**	**0.76**	-0.04	-0.01	-0.01	-0.06	-0.01	-0.03
Potatoes	-0.02	-0.06	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.07	-0.05	0.00	-0.02	0.00	-0.01	**0.91**	**0.81**	-0.01	-0.01	0.00	-0.01
Rape	-0.07	-0.34	-0.05	-0.03	-0.02	-0.02	0.00	-0.01	-0.02	0.00	0.01	0.00	-0.26	-0.20	0.01	-0.09	0.00	-0.05	-0.04	-0.04	**0.84**	**0.80**	-0.02	-0.02
Fresh vegetables	-0.05	-0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.02	-0.01	-0.01	0.00	-0.01	0.00	0.00	0.00	-0.01	**1.01**	**1.08**
Regional own-price elasticities																								
Valley region	**0.34**	**0.50**	**0.54**	**0.54**	**0.72**	**0.83**	**0.24**	**0.56**	**0.67**	**0.84**	**0.29**	**1.01**	**0.77**	**0.77**	**0.68**	**0.77**	**0.25**	**0.79**	**0.90**	**0.80**	**0.85**	**0.80**	**1.01**	**1.08**
Hill region	**0.31**	**0.45**	**0.51**	**0.51**	**0.73**	**0.78**	**0.11**	**0.73**	**0.71**	**0.85**	**0.30**	**1.01**	**0.71**	**0.77**	**0.65**	**0.72**	**-0.61**	**0.00**	**1.03**	**0.91**	**0.77**	**0.88**	**1.02**	**1.10**
Mountain region	**0.33**	**0.49**	**0.57**	**0.53**	**0.78**	**0.79**	**0.35**	**0.56**	**0.71**	**0.85**	**0.33**	**1.02**	**0.45**	**0.77**	**0.01**	**0.71**	**-0.44**	**0.00**	**1.04**	**0.91**	**0.81**	**0.95**		

The price elasticities for the other animal products are mostly higher than the one for milk, but normally still lower than one percent. Most factors in animal production, in particular investments, are fixed over a period of time. A response to price changes therefore needs time. Furthermore, the product price is only one variable that influences production output. Non-economic factors such as the pleasure of applying acquired skills, are especially important in animal production, in particular in milk production which demands extensive knowledge and experience. These non-economic factors could also be the main reason for the quite low supply response in sheep production. In the case of poultry, the short term elasticity may be underestimated by the model; differences to the supply characteristics of egg or pork production are not evident. The cross-price elasticities between milk price and crop production are generally around -0.30, while those with meat are much lower. Milk production is an important activity in Swiss agriculture. An increase of production and therefore of demand for land has a higher impact on the other activities in percentage terms than in the case of meat production. The results support the argument that a large number, if not a majority, of agricultural economists still argue that aggregate animal supply response is very low, mainly because the use of primary factors, which usually account for 70 to 85 percent of the cost of agricultural production (Binswanger et al. 1993). In contrast, some economists have argued that the response is not negligible but takes time to materialize.

The estimated elasticites for the crop activities are within the same range as the ones for animal production, but the short term values are usually only slightly lower or even higher than the long term values. The lower part of fix factors in crop production and the bigger number of activities increase the possibilities to react. The cross-price elasticities of crop production are small, the highest values were found between wheat and other crops. This again can be explained by the large proportion of wheat on the arable land which in the case of a lower or higher wheat cultivation increases the percentage change of the less extensive activities. The cross-price elasticities between crop and animal activities are very small too. In the calculation process for the feed grain activities, the prices of concentrates were not adapted to the output prices. The impacts of a price change of only one single feed product on animal production would be small anyway because this single product can be replaced with other feed products.

The variation of the price elasticities between three regions are small. Usually, the values in the hill region are slightly lower than in the valley and mountain region. The difference between the valley and hill region can be explained by the smaller number of alternative activities in the hill region. In the mountain region, the use of marginal sites may play a role in the slightly higher impacts of price changes. The elasticities for crop activities in the hill and mountain region are less meaningful because of the small amount of arable land in these regions. The negative sign of the elasticity of maize in these regions can be explained by substitution effects: the rise in the price of maize leads to a slight shift in maize cultivation in favour of the valley region.

Table 2. Comparison of crops price elasticities of supply

Study	Country	Commodity	Own-price	Cross-price	Against
Jansson and Heckelei (2011)	France	Coarse grains	2.06	-0.02	Wheat
		Soft wheat	1.03	-0.41	Soya
		Maize	1.61	-0.34	Sunflower
		Barley	1.86	-0.12	Rapeseed
		Rapeseed	1.13	-0.02	Wheat
		Sunflower	2.12	-0.51	Rapeseed
		Soya	1.27	-0.03	Barley
Burton and Young (1992)	UK	Wheat	0.30	-0.20	Barley
		Barley	0.21	-0.21	Oilseed
		Oilseed	0.53	-0.27	Wheat
				-0.54	Barley
Jensen and Lind (1993)	Denmark	Cereals	0.36	-0.18	Rapeseed
		Rapeseed	1.28	-2.38	Wheat
Guyomard et al. (1996)	France	Wheat	0.72	-0.11	Coarse Grains
				0.00	Oilseed
		Coarse Grains	0.68	-0.36	Wheat
				-0.02	Oilseed
		Oilseed	0.23	-0.12	Wheat
				-0.03	Coarse Grains
Huang and Khanna (2010)	United States	Corn	0.51	-0.12	Soybeans
				-0.35	Wheat
		Soybeans	0.49	-0.30	Corn
				0.31	Wheat
		Wheat	0.70	-0.05	Soybeans
All studies	Mean	Wheat	0.60		
		Barley	0.80		
		Oilseed	0.91		
Our study	Switzerland	Soft wheat	0.77	-0.03	Soya
		Maize	0.76	-0.01	Sunflower
		Barley	0.76	-0.04	Rapeseed
		Rapeseed	0.81	-0.28	Wheat
		Sunflower	0.83	-0.12	Rapeseed
		Soya	0.79	0.01	Barley
		Oilseed (mean)	0.81		

Table 2 compares some medium-term supply response estimates for crop production from this study to estimates from selected studies for European and USA agricultural commodities. The elasticity estimates vary somewhat but not substantially, although the time period considered, level of disaggregation (county, state, regional, or national level), and the estimation techniques used were different. Most studies cited above apply the econometric approach. Generally, our elasticities are rather higher for cereals and smaller for oilseed. When making comparisons, one should bear in mind that these studies differ not only in functional form but also in data sources, observation period, estimation

method, maintained theoretical structure, inputs treated as variable, and point at which elasticities are computed. Empirical estimates of elasticities depend both on the methodology adopted and on country-specific factors relating to technology, economic structure and macro-constraints. In general, our results confirm the results of Chhibber (1989) who estimated elasticities ranged between 0.7 and 0.9. Regarding total cross-price elasticity measures, there are prior theoretical empirical expectations in terms of signs. Most commodities appear as competing in production. There are majority with negative cross price elasticity measures.

Comparing the estimated animal supply elasicities to estimates from literature (Table 3) shows that our animal supply elaticities tend to be smaller for pork (0.85) and poultry (1.01). For milk and beef the results are quite close and very similar to literature studies in the long term.

Table 3. Comparison of livestock price elasticities of supply

Author	Country	Commodity	Short term elasticity	Long term elasticity
Powell and Gruen (1967)	Australia	Milk	0.19	0.42
		Beef	0.16	-
Buttimer and Mac Airt (1986)	Ireland	Milk	0.25-0.30	-
		Beef	0.11	-
Gardner and Walker (1979)	United Kingdom	Milk	0.22	0.66
Jones (1986)	West of Germany	Beef	-	1.06
Jones (1986)	United Kingdom	Pork	0.40	2.00
		Poultry	1.00	2.50
Apostolopoulos and Stoforos (2007)	Greece	Beef	0.10	-
		Pork	0.15	-
		Poultry	0.15	-
Ball (1988)		Livestock		1.09
		Fluid milk		0.64
FAPRI (2011)	European Union - 15	Cattle & Calves	0.50	-
		Swine	0.50	-
All studies	Mean	Milk	0.20	0.55
		Beef	0.28	0.99
		Pork	0.39	1.43
		Poultry	0.69	1.76
Our study	Switzerland	Milk	0.07	0.48
		Beef	0.73	0.81
		Pork	0.49	0.85
		Poultry	0.91	1.01

6. Conclusions

Accurate and reliable information about the responsiveness of producers to changes in market prices is crucial if informed decisions are to be taken in various fields of policy. Modelling supply response has been one of the major concerns of agricultural economists in Switzerland and elsewhere. This article has used a dynamic and recursive sector agricultural approach for estimating supply response by deriving the implied supply elasticities of the resulting model, and those elasticities were compared with studies from literature. The results indicate significant economic interrelationships in the Swiss agricultural sector. The partial and total effects of price changes on production are examined and these results show that the quantity supplied of each of the commodities examined is positively related to its own price. Poultry and fresh vegetable production are the most price-elastic among the 22 commodities examined. The results of the price elasticities of supply suggest that the largest part of the estimated own-price supply elasticities are inelastic and, in general, all the short term price elasticities are inelastic. The long term price elasticities are almost all greater than their short term counterparts. The results are systematically compared to the outcomes of other studies. The estimated own price elasticities of supply are found to be in a plausible range.

One limitation of this study is that it does not consider the estimates of elasticities of substitution and factor supply. This application can be extended to better understand the short and long term dynamics in area, livestock and inputs response. It is also hoped that further improvements in methodology may help in producing a more accurate vision of the way agriculture responds to policy changes. For future research, it is suggested that the agent-based SWISSland model (Möhring et al. 2010) is employed.

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Appendix

A1: All regions / Short term

Change: Price / Quantity	Milk	Natura beef	Beef meat	Bull meat	Veal meat	Sheep meat	Goat meat	Pork meat	Poul. meat	Eggs	Wheat	Barley	Maize	Pota-toes	Rape	Soya	Sun-flower	Fresh veget.	App-les
Milk	**0.33**	-0.02	-0.01	-0.01	0.00	-0.01	0.00	-0.01	0.00	0.00	-0.04	-0.03	-0.01	-0.01	-0.01	0.00	0.00	-0.01	-0.01
Natura beef meat	-0.12	**0.54**	-0.01	-0.01	-0.03	0.00	0.00	0.00	0.00	0.00	-0.07	0.00	0.00	-0.01	-0.02	0.00	0.00	0.00	-0.01
Beef meat	-0.07	-0.02	**0.73**	0.00	-0.03	0.00	0.00	0.00	0.00	0.00	-0.03	0.00	0.01	0.00	-0.01	0.00	0.00	0.00	0.00
Bull meat	-0.05	-0.02	-0.01	**0.83**	-0.02	0.00	0.00	-0.01	0.00	0.00	-0.06	0.00	0.01	0.00	-0.01	0.00	0.00	0.00	0.00
Veal meat	-0.11	-0.13	-0.14	-0.14	**0.68**	-0.12	-0.12	-0.13	-0.12	-0.12	-0.14	-0.13	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12
Sheep meat	-0.73	-0.03	-0.01	-0.01	-0.02	**0.27**	0.00	-0.09	0.00	0.00	-0.05	-0.03	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Goat meat	-0.19	-0.01	0.00	0.00	-0.01	-0.01	**0.06**	-0.03	0.00	0.00	-0.02	-0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Pork meat	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	**0.69**	0.00	0.00	-0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Poultry meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	**0.30**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	**0.86**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	-0.36	-0.02	-0.01	-0.02	-0.02	0.00	0.01	0.01	0.01	0.01	**0.77**	-0.09	-0.01	-0.02	-0.03	0.01	0.00	-0.01	-0.01
Barley	-0.44	-0.02	-0.01	-0.02	-0.03	0.00	0.01	0.02	0.01	0.01	-0.20	**0.66**	-0.01	-0.02	-0.03	0.01	0.00	-0.01	-0.01
Maize	-0.19	0.00	0.01	0.03	0.00	0.02	0.00	0.37	0.00	0.00	-0.05	-0.03	**0.23**	-0.01	-0.01	0.00	0.00	-0.01	0.00
Potatoes	-0.02	-0.01	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	-0.07	0.00	0.00	**0.81**	-0.01	0.00	0.00	0.00	0.00
Rape	-0.07	-0.05	-0.02	0.01	-0.04	0.00	0.01	-0.02	0.01	0.01	-0.26	0.01	0.00	-0.04	**0.84**	0.00	-0.02	-0.02	-0.02
Soya	-0.08	-0.04	-0.03	0.08	-0.05	0.00	0.01	-0.01	0.01	0.01	-0.34	0.01	0.00	-0.06	-0.09	**0.71**	-0.02	-0.02	-0.02
Sunflowers	-0.14	-0.07	-0.03	-0.08	-0.05	0.00	0.01	-0.03	0.01	0.01	-0.52	0.00	-0.02	-0.07	-0.11	0.00	**0.84**	-0.03	-0.03
Fresh vegetables	-0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.01	0.00	0.00	0.00	0.00	0.00	**1.01**	0.00
Apples	-0.02	-0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	-0.03	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	**0.89**

A2: All regions / Long term

Change: Price / Quantity	Milk	Natura beef	Beef meat	Bull meat	Veal meat	Sheep meat	Goat meat	Pork meat	Poul. meat	Eggs	Wheat	Barley	Maize	Pota-toes	Rape	Soya	Sun-flower	Fresh veget.	App-les
Milk	**0.48**	-0.02	-0.01	-0.02	0.00	-0.01	0.00	0.00	0.00	0.00	-0.03	-0.02	-0.01	0.00	-0.01	0.00	0.00	0.00	0.00
Natura beef meat	-0.27	**0.53**	-0.01	-0.02	-0.03	-0.01	0.00	0.00	0.00	0.00	-0.03	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00
Beef meat	-0.24	-0.03	**0.81**	-0.03	-0.15	-0.01	0.00	0.00	0.00	0.00	-0.04	-0.03	-0.03	-0.01	-0.01	0.00	0.00	-0.01	0.00
Bull meat	-0.16	-0.02	-0.01	**0.90**	-0.04	-0.01	0.00	0.00	0.00	0.00	-0.03	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00
Veal meat	-0.01	-0.01	-0.01	-0.01	**0.68**	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sheep meat	-0.65	-0.08	-0.02	-0.03	-0.07	**0.60**	0.00	0.00	0.00	0.00	-0.04	-0.03	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
Goat meat	-0.15	-0.02	0.00	-0.01	-0.02	-0.01	**0.05**	0.00	0.00	0.00	-0.01	-0.01	-0.02	0.00	0.00	0.00	0.00	0.00	0.00
Pork meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.85**	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
Poultry meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.89**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	-0.26	-0.03	-0.01	-0.04	-0.03	-0.01	0.00	0.00	0.00	0.00	**0.77**	-0.07	-0.05	-0.03	-0.04	0.00	-0.01	-0.02	-0.01
Barley	-0.41	-0.04	-0.02	-0.05	-0.05	-0.01	0.00	0.00	0.00	0.00	-0.19	**0.76**	-0.05	-0.03	-0.05	0.00	-0.01	-0.02	-0.01
Maize	-0.30	-0.03	-0.02	-0.05	-0.04	-0.01	0.00	0.01	0.00	0.00	-0.22	-0.09	**0.76**	-0.04	-0.06	0.00	-0.02	-0.03	-0.01
Potatoes	-0.06	-0.01	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	-0.05	-0.02	-0.01	**0.91**	-0.01	0.00	0.00	-0.01	0.00
Rape	-0.34	-0.03	-0.02	0.01	-0.04	-0.01	0.00	0.00	0.00	0.00	-0.20	-0.09	-0.05	-0.04	**0.80**	0.00	-0.02	-0.02	-0.01
Soya	-0.41	-0.04	-0.02	0.11	-0.05	-0.01	0.00	0.00	0.00	0.00	-0.33	-0.13	-0.13	-0.07	-0.08	**0.79**	-0.03	-0.04	-0.01
Sunflowers	-0.35	-0.04	-0.02	-0.07	-0.05	-0.01	0.00	0.01	0.00	0.00	-0.33	-0.13	-0.10	-0.07	-0.08	-0.01	**0.82**	-0.04	-0.02
Fresh vegetables	-0.03	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.01	-0.01	0.00	-0.01	0.00	0.00	**1.08**	0.00
Apples	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.65**

A3: Valley region / Short term

Change: Price / Quantity	Milk	Natura beef	Beef meat	Bull meat	Veal meat	Sheep meat	Goat meat	Pork meat	Poul. meat	Eggs	Wheat	Barley	Maize	Pota-toes	Rape	Soya	Sun-flower	Fresh veget.	App-les
Milk	**0.34**	-0.02	-0.02	-0.02	0.02	-0.02	-0.01	-0.03	-0.01	-0.01	-0.05	-0.04	-0.02	-0.02	-0.02	-0.01	-0.02	-0.02	-0.02
Natura beef meat	-0.05	**0.54**	-0.01	-0.03	-0.04	0.00	0.01	0.00	0.01	0.01	-0.11	0.01	0.01	-0.01	-0.02	0.00	0.00	0.00	-0.01
Beef meat	-0.02	-0.02	**0.72**	-0.01	-0.02	0.00	0.00	0.00	0.00	0.00	-0.03	0.00	0.01	0.00	-0.01	0.00	0.00	0.00	0.00
Bull meat	-0.02	-0.01	-0.01	**0.81**	-0.02	0.00	0.00	0.00	0.00	0.00	-0.07	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
Veal meat	-0.06	-0.11	-0.15	-0.14	**0.68**	-0.11	-0.10	-0.12	-0.10	-0.10	-0.14	-0.12	-0.11	-0.11	-0.11	-0.10	-0.11	-0.11	-0.11
Sheep meat	-1.02	-0.01	0.00	-0.02	-0.03	**0.24**	0.01	-0.18	0.01	0.01	-0.13	-0.07	0.07	0.00	-0.01	0.01	0.00	0.00	0.00
Goat meat	-0.17	-0.01	0.00	-0.01	-0.01	0.00	**0.06**	-0.06	0.00	0.00	-0.04	-0.02	-0.03	0.00	-0.01	0.00	0.00	0.00	0.00
Pork meat	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	**0.67**	0.00	0.00	-0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Poultry meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	**0.29**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	**0.86**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	-0.36	-0.01	-0.01	-0.02	-0.02	0.00	0.01	0.01	0.01	0.01	**0.77**	-0.09	-0.01	-0.02	-0.03	0.01	0.00	-0.02	-0.01
Barley	-0.48	-0.01	-0.01	-0.02	-0.03	0.00	0.01	0.02	0.01	0.01	-0.26	**0.68**	-0.01	-0.02	-0.04	0.01	0.00	-0.02	-0.01
Maize	-0.18	0.00	0.01	0.03	0.00	0.02	0.00	0.37	0.00	0.00	-0.06	-0.03	**0.25**	-0.01	-0.01	0.00	0.00	-0.01	-0.01
Potatoes	-0.02	-0.01	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	-0.07	0.00	0.00	**0.80**	-0.01	0.00	0.00	0.00	0.00
Rape	-0.04	-0.05	-0.02	0.01	-0.04	0.00	0.01	-0.02	0.01	0.01	-0.28	0.00	0.00	-0.04	**0.85**	0.00	-0.02	-0.02	-0.02
Soya	-0.08	-0.04	-0.03	0.08	-0.05	0.00	0.01	-0.01	0.01	0.01	-0.34	0.01	0.00	-0.06	-0.09	**0.71**	-0.02	-0.02	-0.03
Sunflowers	-0.12	-0.07	-0.03	-0.08	-0.05	0.00	0.01	-0.03	0.01	0.01	-0.53	0.00	-0.02	-0.07	-0.11	0.00	**0.84**	-0.03	-0.03
Fresh vegetables	-0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.01	0.00	0.00	0.00	0.00	0.00	**1.01**	0.00
Apples	-0.01	-0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	-0.03	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	**0.89**

A4: Valley region / Long term

Change: Price / Quantity	Milk	Natura beef	Beef meat	Bull meat	Veal meat	Sheep meat	Goat meat	Pork meat	Poul. meat	Eggs	Wheat	Barley	Maize	Pota-toes	Rape	Soya	Sun-flower	Fresh veget.	App-les
Milk	**0.50**	-0.02	-0.01	-0.02	0.02	-0.01	0.00	0.00	0.00	0.00	-0.04	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00
Natura beef meat	-0.23	**0.54**	-0.01	-0.03	-0.02	0.00	0.00	0.00	0.00	0.00	-0.05	-0.03	-0.02	-0.01	-0.02	0.00	0.00	-0.01	0.00
Beef meat	-0.18	-0.02	**0.83**	-0.04	-0.15	0.00	0.00	0.00	0.00	0.00	-0.06	-0.03	-0.04	-0.01	-0.02	0.00	-0.01	-0.01	0.00
Bull meat	-0.13	-0.01	-0.01	**0.89**	-0.04	0.00	0.00	0.00	0.00	0.00	-0.04	-0.02	-0.01	-0.01	-0.01	0.00	0.00	-0.01	0.00
Veal meat	0.08	-0.01	-0.02	-0.02	**0.65**	0.00	0.00	0.00	0.00	0.00	-0.02	-0.01	-0.01	0.00	-0.01	0.00	0.00	0.00	0.00
Sheep meat	-0.46	-0.03	-0.01	-0.03	-0.03	**0.56**	0.00	-0.01	0.00	0.00	-0.05	-0.03	-0.01	-0.01	-0.01	0.00	0.00	0.00	-0.01
Goat meat	-0.16	-0.01	0.00	-0.01	-0.01	0.00	**0.05**	0.00	0.00	0.00	-0.02	-0.01	-0.09	0.00	-0.01	0.00	0.00	0.00	0.00
Pork meat	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	**0.84**	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00
Poultry meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.89**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	-0.24	-0.02	-0.01	-0.04	-0.03	-0.01	0.00	0.00	0.00	0.00	**0.77**	-0.07	-0.05	-0.04	-0.05	0.00	-0.02	-0.02	-0.01
Barley	-0.35	-0.03	-0.02	-0.05	-0.04	-0.01	0.00	0.00	0.00	0.00	-0.21	**0.77**	-0.06	-0.04	-0.06	0.00	-0.02	-0.03	-0.01
Maize	-0.29	-0.03	-0.02	-0.05	-0.04	-0.01	0.00	0.01	0.00	0.00	-0.23	-0.09	**0.79**	-0.04	-0.06	0.00	-0.02	-0.03	-0.01
Potatoes	-0.05	-0.01	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	-0.05	-0.02	-0.02	**0.90**	-0.01	0.00	0.00	-0.01	0.00
Rape	-0.29	-0.03	-0.02	0.01	-0.04	-0.01	0.00	0.00	0.00	0.00	-0.21	-0.09	-0.06	-0.04	**0.80**	0.00	-0.02	-0.03	-0.01
Soya	-0.40	-0.04	-0.02	0.11	-0.05	-0.01	0.00	0.00	0.00	0.00	-0.33	-0.13	-0.13	-0.07	-0.08	**0.78**	-0.03	-0.04	-0.01
Sunflowers	-0.32	-0.04	-0.02	-0.07	-0.05	-0.01	0.00	0.01	0.00	0.00	-0.34	-0.13	-0.10	-0.07	-0.09	-0.01	**0.82**	-0.04	-0.02
Fresh vegetables	-0.03	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.01	-0.01	0.00	-0.01	0.00	0.00	**1.08**	0.00
Apples	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.67**

A5: Hill region / Short term

Change: Price / Quantity	Milk	Natura beef	Beef meat	Bull meat	Veal meat	Sheep meat	Goat meat	Pork meat	Poul. meat	Eggs	Wheat	Barley	Maize	Pota-toes	Rape	Soya	Sun-flower	Fresh veget.	App-les
Milk	**0.31**	-0.02	0.00	-0.01	-0.03	0.00	0.00	0.00	0.00	0.00	-0.03	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natura beef meat	-0.21	**0.51**	-0.01	-0.02	-0.02	0.00	0.00	0.00	0.00	0.00	-0.06	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
Beef meat	-0.20	-0.04	**0.73**	-0.02	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.06	0.00	0.01	0.00	-0.01	0.00	0.00	0.00	0.00
Bull meat	-0.10	-0.02	-0.01	**0.83**	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.05	0.00	0.01	0.00	-0.01	0.00	0.00	0.00	0.00
Veal meat	-0.14	-0.12	-0.12	-0.12	**0.82**	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12
Sheep meat	-0.68	0.00	0.00	0.00	0.00	**0.11**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Goat meat	-0.26	-0.01	0.00	-0.01	-0.01	0.00	**0.06**	-0.01	0.00	0.00	-0.03	-0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Pork meat	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	**0.71**	0.00	0.00	-0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Poultry meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.30**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.86**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	-0.35	-0.05	-0.01	-0.03	-0.03	0.00	0.01	0.00	0.01	0.01	**0.71**	-0.05	0.00	0.00	-0.02	0.01	0.00	0.00	0.00
Barley	-0.29	-0.05	-0.01	-0.03	-0.03	0.00	0.01	0.02	0.01	0.01	0.02	**0.65**	0.01	-0.01	0.00	0.01	0.01	0.01	0.01
Maize	-0.50	-0.03	0.00	0.02	-0.01	0.02	0.01	0.39	0.01	0.01	0.05	-0.02	**-0.61**	0.01	0.01	0.01	0.01	0.01	0.01
Potatoes	-0.09	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	-0.04	0.00	0.00	**0.91**	-0.01	0.00	0.00	0.00	0.00
Rape	-0.37	-0.08	-0.02	0.02	-0.03	0.00	0.01	-0.01	0.01	0.01	-0.13	0.01	0.00	-0.01	**0.77**	0.01	0.00	0.00	-0.01
Soya	-0.57	-0.12	-0.03	0.10	-0.05	0.00	0.01	-0.02	0.01	0.01	-0.17	0.02	0.00	-0.01	-0.05	**0.83**	0.00	0.00	-0.02
Sunflowers	-0.58	-0.13	-0.03	-0.07	-0.05	0.00	0.01	-0.02	0.01	0.01	-0.28	0.02	0.00	-0.02	-0.06	0.01	**0.88**	0.00	-0.02
Fresh vegetables	-0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	**1.02**	0.00
Apples	-0.03	-0.01	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.90**

A6: Hill region / Long term

Change: Price / Quantity	Milk	Natura beef	Beef meat	Bull meat	Veal meat	Sheep meat	Goat meat	Pork meat	Poul. meat	Eggs	Wheat	Barley	Maize	Pota-toes	Rape	Soya	Sun-flower	Fresh veget.	App-les
Milk	**0.45**	-0.03	-0.01	-0.02	-0.01	-0.01	0.00	0.00	0.00	0.00	-0.02	-0.02	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
Natura beef meat	-0.38	**0.51**	-0.01	-0.02	-0.04	-0.02	0.00	0.00	0.00	0.00	-0.03	-0.02	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
Beef meat	-0.40	-0.04	**0.78**	-0.02	-0.14	-0.02	0.00	0.00	0.00	0.00	-0.03	-0.03	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
Bull meat	-0.22	-0.01	0.00	**0.87**	-0.04	-0.01	0.00	0.00	0.00	0.00	-0.02	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Veal meat	-0.06	-0.01	-0.01	-0.01	**0.69**	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sheep meat	-1.26	-0.10	-0.03	-0.04	-0.10	**0.73**	0.00	0.00	0.00	0.00	-0.09	-0.07	-0.01	-0.01	-0.03	0.00	0.00	0.00	-0.01
Goat meat	-0.22	-0.02	-0.01	-0.01	-0.02	-0.01	**0.05**	0.00	0.00	0.00	-0.02	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pork meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.85**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Poultry meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.89**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	-0.41	-0.05	-0.02	-0.03	-0.05	-0.03	0.00	0.00	0.00	0.00	**0.77**	-0.06	0.00	-0.01	-0.02	0.00	0.00	0.00	-0.01
Barley	-0.60	-0.07	-0.02	-0.04	-0.07	-0.04	0.00	0.00	0.00	0.00	-0.10	**0.72**	-0.01	-0.01	-0.03	0.00	0.00	0.00	-0.01
Maize	-0.73	-0.06	-0.02	-0.04	-0.06	-0.03	0.00	0.00	0.00	0.00	-0.10	-0.08	**0.00**	-0.01	-0.03	0.00	0.00	0.00	-0.01
Potatoes	-0.19	-0.02	-0.01	-0.01	-0.02	-0.01	0.00	0.00	0.00	0.00	-0.02	-0.02	0.00	**1.03**	-0.01	0.00	0.00	0.00	0.00
Rape	-0.80	-0.07	-0.02	0.03	-0.07	-0.04	0.00	0.00	0.00	0.00	-0.11	-0.08	-0.01	-0.01	**0.88**	0.00	0.00	0.00	-0.01
Soya	-1.69	-0.14	-0.04	0.17	-0.13	-0.07	0.00	0.00	0.00	0.00	-0.22	-0.17	-0.07	-0.03	-0.06	**1.08**	-0.01	-0.01	-0.01
Sunflowers	-1.32	-0.11	-0.03	-0.07	-0.10	-0.06	0.00	0.00	0.00	0.00	-0.18	-0.14	-0.01	-0.02	-0.05	0.00	**0.98**	-0.01	-0.01
Fresh vegetables	-0.06	-0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	**1.10**	0.00
Apples	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.57**

A7: Mountain region / Short term

Change: Price / Quantity	Milk	Natura beef	Beef meat	Bull meat	Veal meat	Sheep meat	Goat meat	Pork meat	Poul. meat	Eggs	Wheat	Barley	Maize	Pota-toes	Rape	Soya	Sun-flower	Fresh veget.	App-les
Milk	**0.33**	-0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	-0.01	-0.01	0.02	0.01	0.01				0.01
Natura beef meat	-0.11	**0.57**	0.00	0.03	-0.03	-0.01	0.00	0.00	0.00	0.00	-0.02	0.00	-0.02	0.00	-0.01				-0.01
Beef meat	-0.10	0.00	**0.78**	0.04	-0.07	0.00	0.01	0.00	0.01	0.01	-0.02	0.01	0.00	0.00	0.00				0.00
Bull meat	-0.08	-0.01	0.00	**0.91**	-0.03	-0.01	0.00	-0.02	0.00	0.00	-0.03	0.00	0.05	-0.01	-0.01				0.00
Veal meat	-0.16	-0.15	-0.16	-0.15	**0.55**	-0.15	-0.15	-0.15	-0.15	-0.15	-0.16	-0.15	-0.15	-0.15	-0.15				-0.15
Sheep meat	-0.62	-0.04	-0.01	-0.02	-0.02	**0.35**	0.00	-0.08	0.00	0.00	-0.03	-0.02	0.05	0.00	0.00				0.00
Goat meat	-0.17	-0.01	0.00	0.00	-0.01	-0.01	**0.06**	-0.03	0.00	0.00	-0.01	-0.01	0.02	0.00	0.00				0.00
Pork meat	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	**0.71**	0.00	0.00	-0.01	0.00	0.03	0.00	0.00				0.00
Poultry meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.33**	0.00	0.00	0.00	0.00	0.00	0.00				0.00
Eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.88**	0.00	0.00	0.00	0.00	0.00				0.00
Wheat	-0.03	0.01	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	**0.45**	0.00	0.00	0.00	0.00				0.00
Barley	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	**0.01**	0.00	0.00	0.00				0.00
Maize	-0.32	-0.01	0.01	0.03	-0.01	0.00	0.00	0.30	0.00	0.00	0.08	0.01	**-0.44**	0.00	0.01				0.01
Potatoes	-0.05	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	**0.91**	0.00				0.00
Rape	-0.33	-0.05	-0.02	0.07	-0.03	-0.01	0.00	0.01	0.01	0.00	-0.05	0.01	-0.01	-0.02	**0.81**				-0.01
Soya																			
Sunflowers																			
Fresh vegetables																			
Apples	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	0.01	0.00	0.00	0.00				**0.91**

A8: Mountain region / Long term

Change: Price / Quantity	Milk	Natura beef	Beef meat	Bull meat	Veal meat	Sheep meat	Goat meat	Pork meat	Poul. meat	Eggs	Wheat	Barley	Maize	Pota-toes	Rape	Soya	Sun-flower	Fresh veget.	App-les
Milk	**0.49**	-0.03	-0.01	-0.01	-0.03	-0.02	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00				0.00
Natura beef meat	-0.20	**0.53**	-0.01	-0.01	-0.04	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00
Beef meat	-0.26	-0.05	**0.79**	-0.01	-0.14	-0.02	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00				0.00
Bull meat	-0.18	-0.03	-0.01	**0.96**	-0.04	-0.02	0.00	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00				0.00
Veal meat	-0.12	-0.02	-0.01	-0.01	**0.73**	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00
Sheep meat	-0.50	-0.08	-0.02	-0.03	-0.07	**0.56**	0.00	0.00	0.00	0.00	-0.02	-0.02	0.00	0.00	0.00				0.00
Goat meat	-0.12	-0.02	0.00	-0.01	-0.02	-0.01	**0.05**	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00				0.00
Pork meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.85**	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00
Poultry meat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.02**	0.00	0.00	0.00	0.00	0.00	0.00				0.00
Eggs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.91**	0.00	0.00	0.00	0.00	0.00				0.00
Wheat	-0.43	-0.03	-0.01	-0.01	-0.04	-0.02	0.00	0.00	0.00	0.00	**0.77**	-0.06	0.00	-0.01	-0.01				0.00
Barley	-0.84	-0.06	-0.02	-0.02	-0.08	-0.04	0.00	0.00	0.00	0.00	-0.07	**0.71**	-0.01	-0.02	-0.02				-0.01
Maize	-0.43	-0.04	-0.01	-0.01	-0.05	-0.02	0.00	0.00	0.00	0.00	-0.03	-0.05	**0.00**	-0.01	-0.01				0.00
Potatoes	-0.13	-0.01	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	-0.01	-0.02	0.00	**1.04**	0.00				0.00
Rape	-0.85	-0.06	-0.02	0.05	-0.08	-0.04	0.00	0.00	0.00	0.00	-0.08	-0.13	-0.01	-0.02	**0.95**				-0.01
Soya																			
Sunflowers																			
Fresh vegetables																			
Apples	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				**0.36**

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