

**Who replaces agriculture's contribution to settlement in lagging rural areas?  
An integrated input-output and dynamic simulation analysis**

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**Abstract.** This paper develops an integrated model for analysing regional economic development and structural change in agriculture. The input-output method allows the detailed description of a regional economy. Based on this description, regional growth pole sectors can be identified that are potential leverage points for growth oriented development strategies. Dynamic simulation tests the long term effects of such a development strategy. Model results show that external demand is the main driving force behind regional economic growth. However, development strategies for lagging rural areas have to be coupled to development strategies for regional centres. Only if the rural areas surrounding regional centres become an important asset for the development of these centres can rural areas be stabilised.

**Keywords.** Rural regions, economic development, input-output, dynamic simulation

**JEL classification.** C6, R11, R15, R23, R58

## 1 Introduction

Swiss agriculture has experienced structural change of around 2.5% per year in the last decade (BLW 2004). This also has manifold effects on settlement in rural areas. Direct effects are caused by sectoral and regional out-migration of the agricultural workforce. Additional effects arise from indirect and induced effects of the agricultural sector on the regional economy and its population base. In remote micro-regions, population decline, demographic change and a narrowing economic base constrain future development perspectives and threaten the fulfilment of the national policy goal of a decentralised settlement. In the year 2000, the development perspectives of approximately 12% of the Swiss communities were at risk (Rieder et al., 2004).

Agriculture is, according to the Swiss Constitution (article 104), responsible for contributing substantially to a decentralised settlement of the country. In light of the ongoing structural change a first important question would be whether agriculture is still capable of fulfilling this policy goal. Regional policy, which is also explicitly concerned with spatial development, is currently undergoing fundamental changes. Instead of distributive measures aimed at attenuating regional socioeconomic disparities, emphasis is given to the competitiveness of rural localities (EVD 2004). The changes in the agricultural sector as well as in regional policy imply an increasing need for policy concepts and analyses of the question how lagging rural areas can meet the challenges of adaptation and structural adjustment (Kilkenny, 1998).

This paper develops an analytical framework for understanding the preconditions for a successful implementation of these challenges. It focuses on employment and population dynamics in lagging rural micro-regions. As a starting point, we analyse under which constellation of socioeconomic indicators the development perspectives of a community are at risk. We assume that the regional growth potential of agriculture is limited, even in regions where it contributes substantially to settlement. We therefore collect data about regional economic cycles and determine the economic linkages and dependencies of different economic sectors. Based on these analyses, we identify regional growth poles that are potentially suited to replace agriculture's role in the regional economy. In a last step, we investigate the preconditions for a successful growth oriented development strategy in the long run.

There are several analytical models that are useful in helping policy makers make regional economic development decisions and prioritise sectoral support policies. Each of these models provides important information about the problem at hand, but none of them can give a complete picture. Input-output (I-O) models are widely applied and useful tools for examining regional economic structure, and dynamic simulation models enable the assessment of the robustness and relative effectiveness of regional economic development strategies.

This paper offers an integrated methodology for providing decision support in the context of regional economic development and ongoing structural change in agriculture. We illustrate our approach with an application to two case study regions in the Swiss mountain area. For this purpose, the next section describes the procedure for determining the degree to which settlement is threatened in a region. It discusses the results from this analysis in general and agriculture's contribution to

settlement in specific. The following section describes the basics of input-output methods and dynamic simulation and develops the integrated approach. Section four discusses the data and the methodology. With this in mind, it also introduces the two case study regions. Section five applies the integrated methodology to two case study regions. The sixth section concludes with reflections on the methodology and policy implications.

## **2 Setting the scene: agriculture's contribution to settlement**

Rural communities have small, specialised economies that produce only a fraction of the goods and services their residents want to consume. The small size implies that rural communities cannot produce everything and the requirements of the market to produce efficiently mean that rural areas tend to be specialised in the goods and services they are able to produce and sell. This makes rural economies vulnerable to trade shocks (Krugman, 1991).

The economy of a rural community grows when local businesses sell goods and services of value to buyers elsewhere. Not every business produces for exportation, however. Local market businesses provide services inside the community. Their benefits to the community are that they employ people, attract tourists, pay taxes and provide many of the essential things that make life both possible and pleasant. Additionally, the co-existence of a variety of enterprises creates a beneficial agglomeration effect. Rural areas find themselves in a delicate balance between the necessity of specialisation to be competitive and the resulting exposure to external threats from changing terms of trade (Rizov, 2004).

Maintaining this balance is problematic for particularly vulnerable communities. For our purposes, we define a community to be particularly vulnerable if its population base becomes so narrow that it is no longer able to sustain the basic goods and services that are essential for daily life to function normally. As a consequence, settlement as a whole is threatened in the long run.

A study mandated by the Swiss Federal Office for Agriculture identified these particularly vulnerable communities in Switzerland. The analysis was based on a series of indicators that describe the development of the economically active population (Rieder et al., 2004): (1) long term (1970 to 2000) development of the 20 to 65 years old population; (2) short term (1990 to 2000) development of the 20 to 65 years old population; and (3) short term (1990 to 2000) development of the 20 to 39 years old population. According to this study, a community is particularly vulnerable if it corresponds to one of two criteria:

- The long term development of the 20 to 65 years old population shows a decline and the short term development of the average of the 20 to 65 years old population and the 20 to 39 years old population shows only very moderate growth.
- The long term development of the 20 to 65 years old population shows only very moderate growth but the short term development of the average of the 20 to 65 years old population and the 20 to 39 years old population shows a decline.

Depending on the choice of threshold values for the two criteria, between 8 and 12% of the communities in Switzerland are particularly vulnerable. Agriculture is considered to contribute substantially to settlement if a community becomes particularly vulnerable or more vulnerable than previously under the hypothetical situation that the agricultural employment share between 1990 and 2000 declined to zero. Table 1 lists the results of this analysis. It shows the number of communities in different categories of contribution and adds the population number and the agricultural land of these communities to the results. The table distinguishes between three categories of contribution. The second column indicates the cases where agriculture does not contribute to settlement. The third column contains the cases where agriculture's contribution is small whereas the fourth column shows the values for the category of communities where agriculture contributes substantially to settlement. The sum of the percentages per row in the table can deviate from 100% due to rounding errors.

According to Table 1, agriculture contributes to settlement in 21.5% of the Swiss communities. However, only 2.6% of the entire population live in these communities and farmers cultivate 16.6% of the overall agricultural land.

Table 1. Agriculture's contribution to settlement in the year 2000 (Rieder et al., 2004: 60).

	No contribution		Small contribution		Substantial contribution	
<b>Communities in the year 2000</b>	2'275	78.5%	262	9.1%	359	12.4%
<b>Population the year 2000</b>	7'091'661	97.3%	102'491	1.4%	89'858	1.2%
<b>Agricultural land [ha] in the year 2002</b>	885'714	83.4%	62'296	5.9%	113'786	10.7%

### 3 Methodological framework

Macro- and microeconomic theories put forward in the regional economics literature all focus on explaining growth of a region's output (Terluin, 2001). As rural development policy is not only concerned with output growth but with providing employment opportunities as well, a diagram of the interaction between a regions' product market and its labour market is introduced (Figure 1).

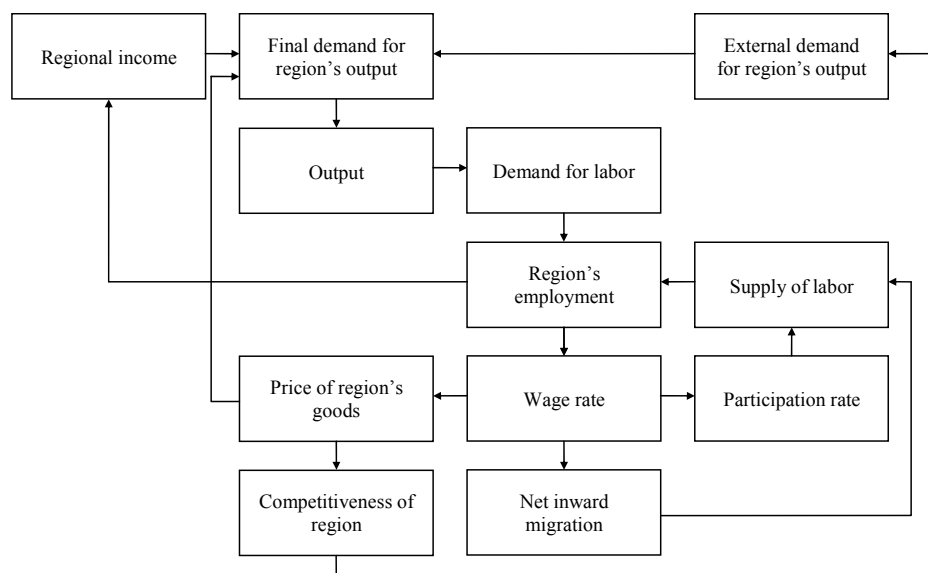


Figure 1. Basic scheme of a regional economy with linkages between the product market and the labour market (adapted from Armstrong and Taylor, 2000: 30).

The figure shows that employment growth depends on the growth of a region's output, which is itself determined by the competitiveness of its firms, i.e. the ability of these firms to produce a certain share to meet the region's own demand and the demand from other regions. These interdependencies and the details of industrial structure for a specific point in time are often best represented in the classic input-output framework. Dynamic simulation models, on the other hand, analyse the dynamic interplay of the regional labour and product market over time.

#### 3.1 Input-output

The input-output method and its applications are discussed in a number of books (Miller and Blair, 1985; Lahr and Dietzenbacher, 2001). In such an analysis, all economic activity is assigned to one of two sectors: production or final demand. All firms producing a specific product or service are allocated to the production sector. The final demand portion of the model includes households, government, tourism, and interregional or international trade. The amount of a product produced by a given sector is determined by the amount of demand for that product. The flow of products between sectors is measured in monetary terms and referred to as transactions between the various sectors ( $a_{ij}$ ). An important input-output assumption is that the transactions between sectors are a fixed and constant

proportion of the amount of product produced. The sectoral interrelation can be expressed as follows (Dinc et al., 2003):

$$x_i = x_{i1} + x_{i2} + x_{i3} + \dots + x_{in} + Y_i \quad i=1, \dots, n \quad (1)$$

$$\begin{aligned} x_i &= \text{total output from industry } i \\ x_{ij} &= \text{output sold from industry } i \text{ to regional industry } j \\ Y_i &= \text{output sold from industry } i \text{ to final demand} \end{aligned}$$

The relationship between the sectors is revealed by the pattern of expenditure as a portion of total expenditure made by a given sector for various inputs. This relationship can be described as:

$$r_{ij} = \frac{x_{ij}}{x_j} \quad (2)$$

The direct regional input coefficients,  $r_{ij}$ , are calculated from (1). By substituting equation (1) into equation (2) we get

$$x_i = r_{i1}x_1 + r_{i2}x_2 + r_{i3}x_3 + \dots + r_{in}x_n + Y_i \quad i=1, \dots, n \quad (3)$$

or in matrix notation

$$X = RX + Y \quad (4)$$

The solution of this matrix can be written as

$$X = (I - R)^{-1}Y \quad (5)$$

where  $(I - R)^{-1}$  is the Leontief inverse or the output multiplier matrix. Each element in this matrix can be interpreted as the direct and indirect output required from regional industry  $i$  per unit of output delivered as final demand from industry  $j$ .

### 3.2 Dynamic simulation

Dynamic simulation models are sets of equations that describe the behaviour of dynamic systems. The models study cause and effect. Given specified initial conditions and assumed behavioural parameters, the models trace the changes in key variables over time and allow seeing the dynamic implications of the assumptions (Ruth and Hannon, 1997). The literature on simulation for policy analysis and design from a feedback perspective is summarised in Richardson and Pugh (1989) and Sterman (2000). Mathematically, the basic structure of a formal dynamic simulation model consists of a system of coupled, nonlinear, first-order differential equations,

$$\frac{d}{dt}x(t) = f(x, p) \quad (6)$$

where  $x$  is a vector of state variables,  $p$  a set of parameters and  $f$  is a nonlinear vector-valued function (Richardson, 1991). Simulation of such systems is accomplished by partitioning simulated time into discrete time intervals of length  $dt$  and stepping the system through time one  $dt$  at a time. Each state variable is computed from its previous value and its net rate of change  $x'(t)$ ,

$$x(t) = x(t - dt) + dt * x'(t - dt) \quad (7)$$

By breaking the simulated time into discrete intervals  $dt$  simulation enables the creation and use of models that cannot be solved in closed form.

### 3.3 An integrated policy decision model

Because a regional economy is complex, dynamic and non-linear, no single model is appropriate to all systems. In this paper we apply a flexible framework within which we can characterise different aspects of a regional economy. I-O focuses on points 1, 2, 3, and 5 while dynamic simulation explores points 1, 2, 4, and 5 in detail.

1. The allocation of production factors in the regional factor market;
2. The output generated by these factors in the regional product market;
3. The characterisation of different economic sectors according to their role in the regional economy;
4. The interaction between the regional economy and population; and
5. The role of external influences on the development of production factors, output and population.

The application of the proposed decision model involves a two-stage process. In the first stage, the I-O analysis is employed. In the second stage, the outcomes of the first stage such as input-output relations between the different economic sectors as well as employment, income and output multipliers are integrated in the dynamic simulation model.

Our **I-O model** is in closed form, i.e. it also contains the wages that the firms pay to the private households in the year of the data collection. With a closed I-O model, induced effects can be calculated. Induced effects are caused by income changes that affect consumption. The structure of the I-O model for the region of 'Val Muestair' is shown in Figure 2. Apart from the private sector, the model distinguishes nine economic sectors and six categories of final demand. The values in the cells of the table correspond to the per mill parts of inputs and outputs relative to turnover. The I-O model for the region of 'Urserntal' differs only slightly from the model shown in Figure 2. It adds the economic sector 'armed forces and federal employers', but only distinguished five categories of final demand (no commuter demand). Regional I-O models, however, cannot be fully compared to each other as they reflect structural and geographical characteristics of the corresponding case study regions. A value of zero in the table does not necessarily mean that there are no economic connections. Instead, values of less than 0.005‰ are rounded down.

		Domestics										Exports			TC		TO				
		Industries									PC	EC			EX						
		Agriculture	Food / Retail	Industry	Construction	Energy	Services	Trade	Tourism	Public Sector	Private Sector	Processings	Public Consumption	Touristic Consumption	Frontier Commuter	Untereengadin	Vinschgau	RoW	Tot. Consumption	Turnover	
Domestics	Industries	Agriculture	0.0	6.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.3	7	14	0	0	0	0	4	17	25
		Food / Retail	0.2	1.0	0.1	0.1	0.1	0.2	0.1	6.9	0.4	23.7	33	1	12	1	0	16	15	44	77
		Industry	2.9	0.7	4.8	3.8	0.1	0.5	0.1	1.3	4.4	33.1	52	1	2	0	8	0	60	71	123
		Construction	1.0	0.0	0.6	0.0	0.6	0.0	0.0	0.2	4.7	9.9	17	9	0	0	44	0	0	53	70
		Energy	1.4	0.5	1.2	0.6	0.0	0.2	0.2	1.1	1.2	9.4	16	0	8	1	2	8	2	21	37
		Services	1.4	0.9	3.3	1.6	0.1	1.5	0.3	0.8	0.8	9.9	21	2	0	0	1	5	2	11	32
		Trade	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0	292	292	292
		Tourism	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.2	0.1	4.7	5	0	34	0	0	0	0	34	39
		Public Sector	0.1	0.2	0.3	0.1	0.1	0.1	0.0	0.0	8.8	22.2	21	40	0	0	0	0	16	36	88
		Private Sector	9.4	8.5	16.3	8.7	2.0	10.1	5.1	6.0	31.6	0.0	98	0	0	0	0	0	120	120	217
		Processings	16	18	27	13	3	13	6	17	32	113	239	67	37	2	55	30	511	721	1000
Gross value adds		14	22	53	49	10	24	31	24	55	0	282									
Gross production		21	27	54	35	11	26	23	29	72	113	411									
Total Imports		4	50	69	35	26	6	269	10	16	104	589									
Imports	Imports from Untereengadin	0	1	1	17	0	0	0	1	5	0	24									
	Imports from Vinschgau	0	4	11	15	0	1	8	3	3	0	45									
	Imports from RoW	4	45	57	3	26	5	261	8	8	0	417									
IO	Turnover	25	77	123	70	37	32	292	39	88	217	1000									

PC = Processings  
EC = Endconsumption  
EX = Exports  
TC = Total Consumption  
TO = Turnover

Identity

Figure 2. Input-output table in closed form of the region 'Val Muestair' in the year 2001.

The **dynamic simulation model** is less detailed than the I-O table. It only distinguishes four economic sectors: agriculture; manufacturing and industry; private services; and public services. In turn, it adds a population sector and nonlinear relationships to the model. Figure 3 gives an overview of the aggregated structure of the dynamic simulation model. The features of the model were selected on the basis of a detailed inventory of the feedback structure and simulation methods of theories

related to the purpose of this study and other regional economic models so that the model represents an integrated regional socioeconomic system.

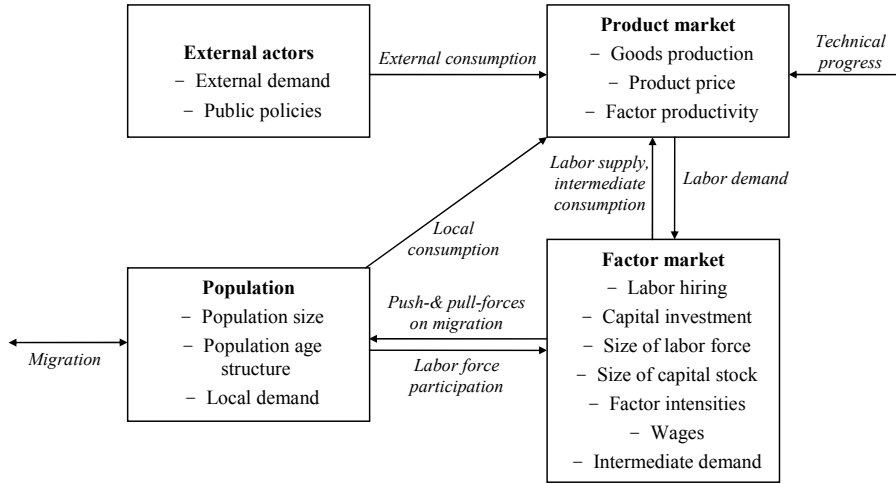


Figure 3. Aggregated structure of the dynamic simulation model.

As an example of the details of the dynamic simulation model, the time path for population can be written as follows:

$$\frac{dPop}{dt} = nmr + nbr \quad (8)$$

where  $nbr = br - dr$  (9)

$$nmr = imr - omr \quad (10)$$

$$imr = imr_{normal} * f\left(\frac{ls}{ld}\right) * f\left(\frac{ss}{sd}\right) \quad (11)$$

$$ls = Pop * lpf \quad (12)$$

$$ld = X * lprod \quad (13)$$

$Pop$	population	$imr$	normal in-migration rate
$nmr$	net migration rate	$f(ls/ld)$	effect of labour market on in-migration
$nbr$	net birth rate	$f(ss/sd)$	effect of goods provision on in-migration
$br$	birth rate	$lpf$	labour participation fraction
$dr$	death rate	$X$	regional output
$imr$	in-migration rate	$lprod$	labour productivity
$omr$	out-migration rate		

Integrating equation (8) generates the population number over time. The normal in-migration rate in equation (11) is the average in-migration rate in the past five years. In-migration changes when either labour supply or labour demand change relative to the past. This is captured by the function ‘effect of labour market on in-migration’ which represents a nonlinear function. This function, which is shown in Figure 4, describes the reaction of population to changes in the labour market. In-migration is the result of a decision-making process in which one region is preferred to another. The preferences critically depend on the local characteristics. The provision with consumer goods and services limits the attractiveness of a region’s residence function (equation 11).

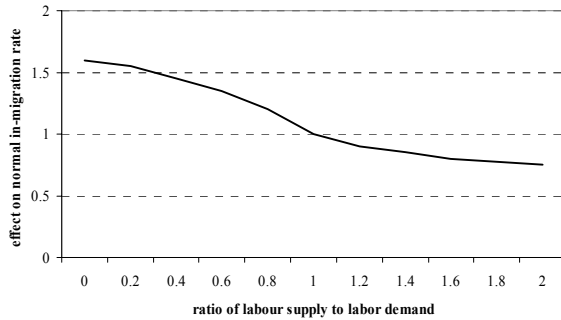


Figure 4. Functional relationship between the labour market and the in-migration rate.

There are two major assumptions embodied in the relationship shown in Figure 4. First, the effect of labour market conditions on in-migration slopes downward – the less favourable the labour market the less in-migration. Second, the s-shape represents the assumption that near the right and the left limits, small changes in labour market conditions have little effect on in-migration. If employment conditions are extremely unfavourable, small changes do not change the attractiveness of the region for potential in-migrants. Similarly, if employment conditions are extremely favourable, small changes in job availability do not substantially alter the region’s attractiveness. In the centre of the curve, where the ratio of labour supply and labour demand equals 1.0, employment conditions within the area are normal and the multiplier on in-migration also equals 1.0. When the multiplier equals 1.0, the normal rate of migration into the area is neither restricted nor augmented (Alfeld and Graham, 1976). The dynamic simulation model contains a number of additional nonlinear functions such as: effect of labour market on out-migration; effect of goods provision on in-migration; effect of labour market on wages; effect of demand-supply ratio on price; multiplier from factor cost on capital intensity; multiplier from factor cost on labour intensity.

The purpose of the dynamic simulation model is to identify the processes and critical factors that cause the decline of employment and population in rural micro-regions and to evaluate the policy implications of development strategies derived from I-O analysis. The time horizon of the model is 1985 to 2050. The period since the beginning of the 1980s is considered as the period in which rural regions have completed their transition from an agrarian economy to a modern industrial or services economy (Terluin, 2003). The historical period of 20 years provides a useful test of model behaviour. The long simulation period of 50 years is necessary for gaining insight into system behaviour and stability. It is not the purpose to make accurate predictions for a specific point in time. Much rather, the length of the time horizon results from the fact that regions are complex socioeconomic systems with partly long adaptation times. One example can be found in the age structure of the population (lag between birth and entrance into the labour market, average length of stay in the labour market). A long time horizon for the simulations allows capturing delayed reactions and effects of policy measures or a change in external conditions.

#### 4 Data and application

For the I-O models, detailed surveys of regional purchases, by sector, and of regional sales, by sector, were undertaken in the year 2002 (‘Val Muestair’) and 2004 (‘Urserntal’). In the course of these surveys, all the relevant actors were interviewed. Information for agriculture and the public sector was complemented by statistical data. The survey corresponds to a primary data collection for an average of the past four years. Primary data covered 96% of regional output in ‘Val Muestair’ and 80% of regional output in ‘Urserntal’.

I-O data also served as a basis for the dynamic simulation model. They were used as initial values for the production function, the production factor stocks, the different categories of final demand, and for calculating factor productivity. Secondary data were used for quantifying the relationships in the population sector. The specification of the nonlinear relationships was taken from related regional economic studies (e.g. Deller et al., 2001; Huang et al., 2002).

The integrated methodology was applied in two case study regions. The region of ‘Urserntal’ in the canton of Uri consists of three communities, two of which belong to the second category in Table



1 (small contribution). The valley is situated at the foot of three major passes, the Gotthard which links the North of Switzerland and Europe to the South, and the Oberalp as well as the Furka which constitute the east-west transit route of Switzerland. The armed forces and tourism are the two most important economic sectors of this region.

A second case study region is the ‘Val Muestair’ in the canton of Grisons. A majority of the communities in this valley belongs to the category where agriculture contributes substantially to settlement. The ‘Val Muestair’ is situated in the south eastern part of Switzerland. It is delimited by the Italian border to the south, high mountains or to the east, and two passes to the west and north, thus forming a well-marked regional system with easily definable exchange relations to adjacent regions and the rest of the world. The regional economy is characterised by a high share of the manufacturing and industry sectors.

## 5 Results

### 5.1 Regional economic structures

I-O analysis generates a variety of results. Buser (2005) distinguishes the calculation of output multipliers (backward linkages), endogenous growth potentials, and dependencies of economic sectors from changes in final demand (forward linkages). Output multipliers add the direct, indirect and induced effects on total turnover of a change in final demand. The value of an output multiplier is the total change in output divided by the original change in output. Endogenous growth potentials indicate the change in total turnover as a consequence of an incremental output change in one economic sector. Forward linkages on the other hand, correspond to the output change in one economic sector as a consequence of an incremental change in total turnover.

Table 2 shows the effects of total direct payments to agriculture on the regional value added for the two case study regions. According to the table, the direct payments have a major influence on the agricultural sector itself. 33% (‘Urserntal’) to 42% (‘Val Muestair’) of the agricultural value added depend on these transfer payments. The regional economy, however, only depends to a very small degree (1% to almost 3%) on the payments. Agriculture obviously contributes only little to regional economic power.

Table 2. Dependence of regional value added on direct payment for agriculture.

	Agriculture	Retail	Manufacturing, industry	Building industry	Energie	Services	Trade	Tourism	Hotels and restaurants	Armed forces, federal employers	Public sector	Total
<b>Val Muestair (%)</b>	41.9	0.9	1.7	1.1	2.2	2.5	0	0.3		--	0.7	<b>2.7</b>
<b>Urserntal (%)</b>	33	0.5	0.5	0.5	0.6	0.7	--	0	0.1	0	0.4	<b>1</b>

In addition to the analysis of the forward linkages of the agricultural sectors, we summarise insights from the other calculations in an integrative characterisation of the two regional economies. A regional economy can be characterised by a combined linkage analysis (Buser, 2005). Every economic sector is analysed for its impact on regional economic growth and its dependence on the regional economy. Figure 5 and Figure 6 illustrate the integrated characterisation of the regional economy in the two case study regions. The degree of endogenous growth potential and influence on the regional economy always refer to the relative potential or influence regarding regional added value.

Economic sectors belonging to the category of nodes (Q1) react directly to positive and negative developments in the regional economy. However, nodes sectors mainly produce for the regional market. As regional markets are already saturated, the potential for demand growth is limited. Growth

oriented development strategies have to improve factor productivity in these sectors so that their competitiveness on external markets increases.

Economic sectors belonging to the growth poles (Q2) have high endogenous growth potential and a big impact on the regional economy. They transfer external growth impulses and sell their products on export markets and for final demand. Growth poles are only little affected by processes in the regional economy. Regional economic growth depends on the competitiveness of the growth pole sectors.

The economic sectors of the following category (Q3) have little impact on the regional economy. Their growth potential is limited because they import a majority of their intermediate inputs. As they mainly produce goods and services for the regional households, policy measures have to secure supply.

The autonomous sectors (Q4) have little influence and are little influenced by the regional economy. Their development usually follows the development on the export markets. Growth oriented development strategies have to reduce the barriers to tap the full endogenous growth potential. The potential is often limited due to capacity limitations, outdated infrastructure and a high share of in-commuters in the regional labour force.

		Degree of dependence on regional economy	
		High (forward-linkage above average)	Low (forward-linkage below average)
Degree endogenous growth potential	High (>1)	<b>Nodes (Q1)</b> Manufacturing, industry Public sector	<b>Growth poles (Q2)</b> Building industry
	Low (<1)	<b>Following (Q3)</b> Agriculture Energy Services	<b>Autonomous (Q4)</b> Retail Trade Tourism, hotels and restaurants

Figure 5. Regional economic portfolio for the region of ‘Val Muestair’.

		Degree of dependence on regional economy	
		High (forward-linkage above average)	Low (forward-linkage below average)
Degree endogenous growth potential	High (>1)	<b>Nodes (Q1)</b> (none)	<b>Growth poles (Q2)</b> Tourism Hotels and restaurants Armed forces, federal employers
	Low (<1)	<b>Following (Q3)</b> Agriculture Retail Manufacturing, trade, reparation Building industry Energy Services Public sector	<b>Autonomous (Q4)</b> (none)

Figure 6. Regional economic portfolio for the region of ‘Urserntal’.

Figure 5 and Figure 6 illustrate that the two case study regions differ considerably in their economic structure. The growth pole sector in the region ‘Val Muestair’ is the building industry which has long been competitive due to cheap in-commuting labour from the Italian border regions. With

stagnation in tourism, investments in the building industry also decline. For this reason, considerable demand growth in this sector cannot be expected.

Tourism as well as hotels and restaurants have become growth poles in the 'Urserntal' region because of the suitability of the region as a skiing area and the accessibility of the region for tourists. Additionally, the valley has long been a location for training related activities in the armed forces so that this sector has also become a growth pole. The future of this sector is, however, very uncertain, as employment has continually decreased in the course of reforms in the defence policy. The externally oriented sectors tourism, hotels and restaurant, as well as armed forces and federal employers are so dominant in the 'Urserntal' that the regional economy consists only of growth poles and following sectors.

The growth pole sectors of both case study regions are confronted with major future challenges such as nationally declining investments in the building industry, liberalisation of electricity markets, globalisation of competition in tourism, and political reforms. The general suitability of tourism as growth pole has to be challenged.

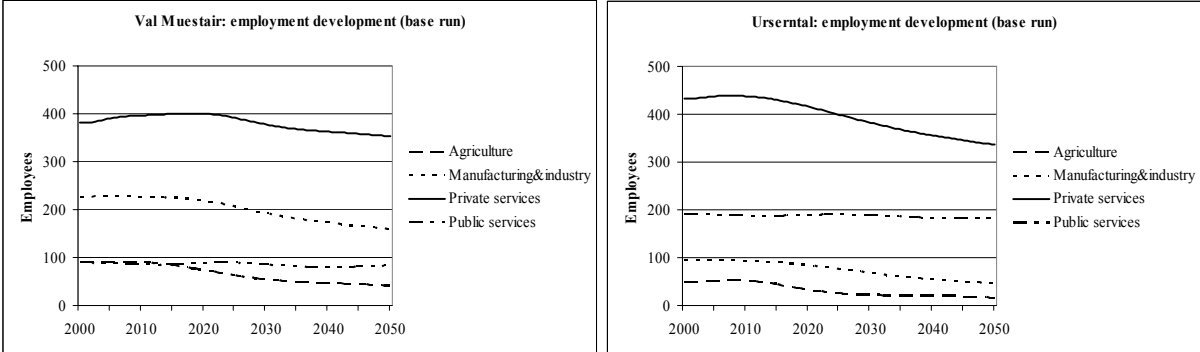
The sectors agriculture, building industry, services, hotels and restaurants, tourism as well as the public sector mainly purchase goods and services in the region. On the other hand, trade related sectors are only loosely connected to the regional economy. Indirect and induced effects of these sectors become most relevant in external regions.

The major challenge for inducing regional economic growth is to increase factor productivity. This is a precondition for raising the competitiveness of regional sectors on external markets and thus external demand. Due to their structural characteristics, nodes and autonomous sectors have the potential to transform into growth poles in the course of such a strategy. Nodes become growth poles through entering external markets and thus raising export activities. Autonomous sectors, on the other hand, have to expand their export activities on external markets in order to increase the volume of their sales. The sectors in the following category have little potential for inducing regional economic growth. For these sectors it is much rather important to stabilise the production of goods and services for private households. The next section analyses the long term perspectives of strategies directed at regional economic growth and at stabilising supply for daily purposes.

*5.2 Dynamic implications of growth oriented regional development strategies*

The dynamic simulation model explores the evolution of the regional economy over time for a growth oriented strategy. It analyses how robust these strategies are and how a region's economy and population interact over time. Finally, it also allows identifying potential socioeconomic trade-offs related with growth oriented strategies. Among the various available socioeconomic indicators, only results for the population and labour stocks of the two case study regions will be shown.

I-O analysis repeatedly referred to the need of increasing factor productivity for regional economic sectors to remain or become competitive on external markets. Figure 7 shows the development of the regional population base for a scenario where productivity grows at an exogenous fractional rate. The growth rate itself (0.02 for agriculture, 0.01 for manufacturing and industry, 0.005 for private services) declines exogenously to a constant asymptotic value (base run scenario).



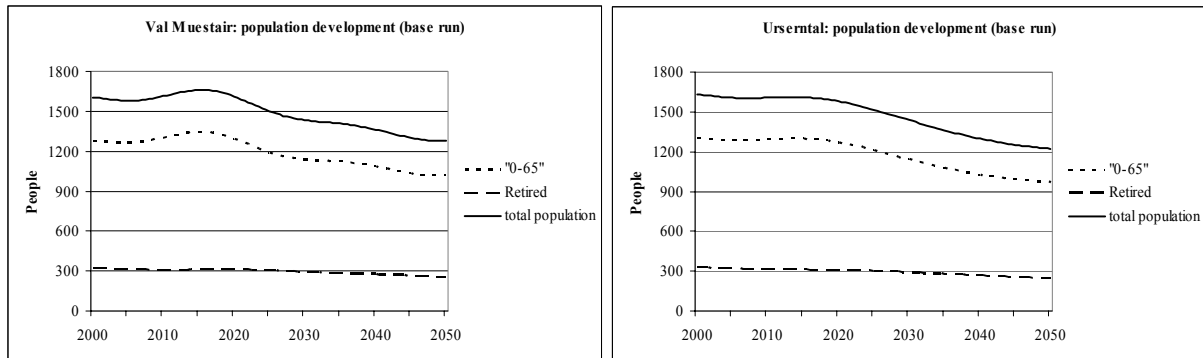


Figure 7. Population and employment development for the base run scenario in ‘Val Muestair’ (left) and ‘Urserntal’ (right).

Population development, especially the development of the 0 to 65 years old population, is characterised by periods of equilibrium, transition and equilibrium again in the base run scenario. This is especially the case for the region ‘Urserntal’. At the outset of the simulation, population remains stable because initially, structural change in agriculture can be compensated by productivity increases in the manufacturing and industry sector and to a smaller degree in the private services. In a transition phase, people leaving the regions reduce local demand further which leads to less employment and even more out-migration. As the ratio between local and external demand decreases, this process slows down and employment as well as population losses are absorbed by external demand. The system reaches an almost equilibrated state again. The retired population, on the other hand, experiences only slight changes. This confirms the stabilising effect of the retired population in a region. The share of the retired population on total population increases over the time horizon. It continuously leads to the familiar phenomenon of an ever growing share of retired people in lagging rural areas.

Figure 8 shows the development space of the total population when the fractional change rate in external demand is varied from -3% to +3% per year. The purpose of this experiment is to analyse under which conditions growth in external demand is sufficient to bring about population growth. It also shows how sensitive population reacts to reductions in external demand.

Regional policy options to stimulate growth in external demand are mostly financial incentives targeted at firms. Changes in external demand are, however, mainly caused by developments in the national and international sociopolitical realm. Important determinants of external demand on the national level are the preferences and purchasing power of the national population. International trade-related negotiations such as the negotiations with the European Community or the World Trade Organisation determine the export potential for national and therefore also for regionally produced goods. The exchange rate controls the purchasing power of international stakeholders such as tourists.

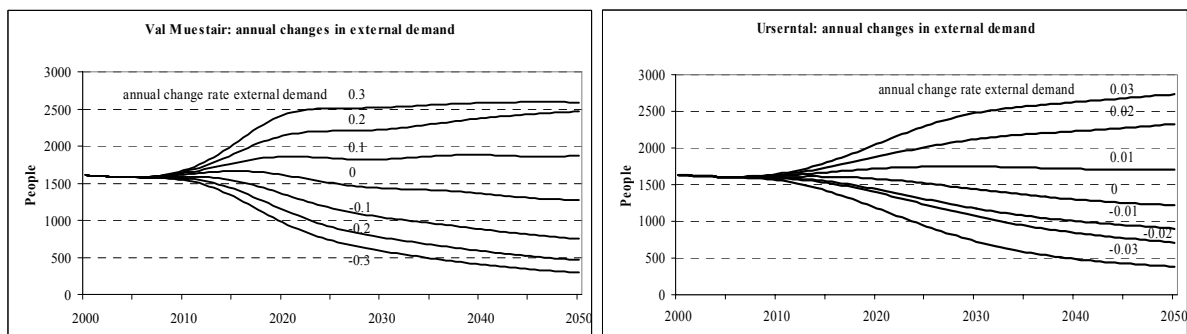


Figure 8. Population development as a reaction to changes in external demand in ‘Val Muestair’ (left) and ‘Urserntal’ (right).

Figure 8 illustrates that population reacts differently to increases and decreases in external demand. If population grows, it does so by following the equilibrium – transition – equilibrium pattern identified before. For population to grow over the entire time horizon external demand has to grow at

least 1% per year (2% in ‘Urserntal’). A decline of 1% per year, on the other hand, already leads to a distinct decline of the entire population.

The system therefore needs considerable demand growth for population growth while at the same time, a much smaller loss in demand is sufficient to produce a collapse. One reason for these differences is the existence of nonlinear relationships in the model. In this case, the nonlinear relationships governing migration decisions are particularly important.

Figure 8 showed that there is no combination of a given growth rate in external demand and a given growth rate in factor productivity that results in a perfect equilibration of population. A dynamic system is in equilibrium when the inflows of each stock variable equal the outflows of the same stock. Figure 9 shows the necessary variations in the fractional growth rate in external demand for keeping population development in steady state. The vertical axis in the figure represents the annual growth rate in external demand which is necessary to stabilise population over the entire simulation period.

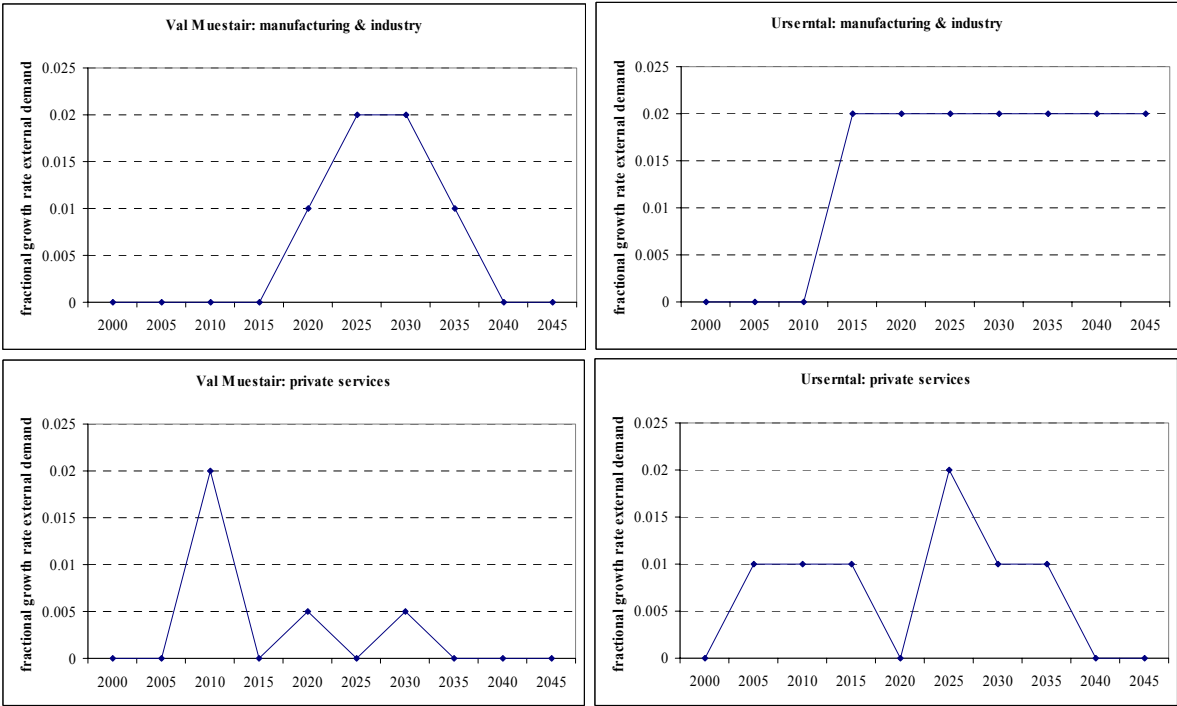


Figure 9. Optimal development of external demand growth for population steady state in ‘Val Muestair’ (left) and ‘Urserntal’ (right).

According to Figure 9, productivity growth is sufficient for keeping population and employment on a constant level in an initial phase. However, external demand has to be raised while employment is still constant. Without this increase, further productivity growth induces the transition phase exhibited in the base run situation. Once the transition phase sets in, growth in external demand cannot compensate this development fast enough even if external demand grows at extreme values. In the further course of the simulation, growth in external demand does not have to be that high anymore. For population to remain constant, the growth rate in external demand has to be adjusted regularly. In addition, these adjustments have to be made in an early stage of development. Changes in external demand only have the desired stabilising effect after a delay of five to ten years. Generally, necessary growth is higher in the ‘Urserntal’ region than in the ‘Val Muestair’.

The existence of this delay explains another source of policy failure in regional economic development policy. Development strategies based on increasing export activities prove to have very high leverage. Policy failure arises when investment in strengthening export activities are stopped after too short a time. Policy failure also arises when export activities are only strengthened after employment and population decline have set in. A critical success factor for export activities is therefore a long term perspective.

Figure 10 illustrates employment development and changes in the sectoral composition of the economy in the two case study regions for the case of constant population levels over the entire simulation time.

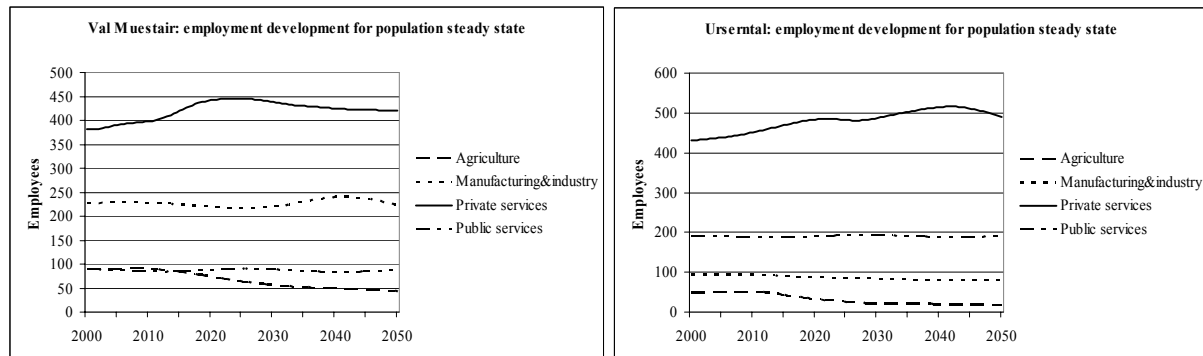


Figure 10. Employment development for population steady state in 'Val Muestair' (left) and 'Urserntal' (right).

The comparison of employment in the four economic sectors under base run (Figure 7) and equilibrium conditions (Figure 10) shows that in the second case a shift in the relative shares of the individual sectors occurs. Agriculture continues to lose jobs while employment decline in the manufacturing sector can be decelerated and employment in the private services grows. Employment in the public services remains relatively constant which confirms the stabilising effect of this economic sector.

## 6 Conclusions

In this paper we analysed agriculture's contribution to settlement in lagging rural areas. We introduced an analytical framework for assessing the relative importance of different economic sectors in a regional economy both from a static and a dynamic point of view. The framework was based on input-output (I-O) analysis and dynamic simulation and applied to two case study regions in the Swiss mountain area. I-O allowed a detailed description of the regional economy for a specific point in time. Based on this description, regional growth pole sectors could be identified that are potential leverage points for growth oriented development strategies. Dynamic simulation tested the long term effects and the stability of such a development strategy.

According to our definition, agriculture contributes substantially to settlement if the population base in a region would be threatened without the agricultural employment share. This is the case for some 21.5% of the approximately 3'000 communities in Switzerland. However, these communities only comprise 2.6% of the Swiss population.

Lagging rural micro-regions vary in terms of their locational characteristics, their economic and demographic structure. Depending on the combination of these features, different development patterns and potentials can be observed. I-O analysis showed that the two case study regions differ considerably in their economic structure. One important finding, however, was that agriculture's role in the regional economy is very limited. Increasing final demand in agriculture, which could be reached by augmenting direct payments, proves only little effective. The effect of the direct payments only has a direct effect in the agricultural sector and no additional indirect or induced effects. Investing public means would therefore be more effective in other economic sectors.

Static as well as dynamic model simulations confirmed the vulnerable nature of lagging rural micro-regions to national and international market forces. External demand is the main driving force behind regional rural development strategies that are based on local economic activities.

Demand results from willingness to pay and from preferences. External demand is influenced by policies on the local level. However, important determinants of external demand are on the national and international level. In order to meet the preferences of external stakeholders, rural micro-regions have to be competitive as well as to produce goods that are unique and exhibit high income elasticity of demand. Unique goods arise from the assignment of values to regional resources. Effective regional policy strategies have to address these leverage points. New regional policy emphasises especially the

local and regional level. It is therefore important that integrated development policies account for the spatial implications of economic policy, international negotiations and monetary policy.

Development strategies in regions with predominant agriculture are of special delicacy. Diversifying the local economy implies substantial expansion of export activities in the manufacturing sector and in the private services. Long-term support of these activities is equally necessary as careful monitoring because economic development is particularly sensitive to changes in external demand. Accompanying agrarian communities in this process implies a transformation of the economic character of these communities. In the course of a combined export and capital investment strategy, agrarian communities develop into either rural communities with strong manufacturing and industry or into tourist communities.

Stabilising employment and population in all particularly vulnerable communities through local economic activities is not possible without very high public support. The necessary support is so high that it is unlikely that every community be maintained.

Where locational characteristics allow commuting, local economic activities have to be combined with attracting newcomers who work in other communities and especially in regional centres. This implies strengthening regional centres to create and maintain employment possibilities while at the same time raising the attractiveness of the surrounding rural areas as residential places. In any case, development strategies for lagging rural areas have to be coupled to development strategies for regional centres. Only if the rural areas surrounding regional centres become an important asset for the development of these centres can rural areas be stabilised.

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