Cantonal and Regional Unemployment in Switzerland: A Dynamic Macroeconomic Panel Analysis*

LARS P. FELD** and MARCEL R. SAVIOZ

1. INTRODUCTION

Unemployment in Switzerland has not been a very interesting phenomenon until the end of the eighties.[1] The most important reason for the Swiss absence from one of the prominent developments in European economies is the extraordinarily low level of unemployment during that time period and its small variance both over time and across regions. In the seventies, the Swiss labor market was characterized by full employment and the unemployment rate was below one percent. The severe recession of 1975/76 after the first oil price shock was mainly absorbed by a reduction of the foreign work force.[2] But even in the eighties, unemployment remained at this full employment level. Only in 1982, the unemployment rate arrived at a 'peak' of 1.1 percent. The situation changed considerably since the most recent recession started in 1991/92. The unemployment rate increased from less than one percent in 1990 to 1.77 percent in 1991 and steadily increased to 4.7 percent in 1994, reached its maximum with 5.2 percent in 1997 and declined markedly to 2.8 percent in 1999. Meanwhile, the Swiss economy appears to be heading towards full employment again.

This development has been accompanied by a strong regional disparity of unemployment ranging from 1.9 percent of the workforce in Appenzell i. Rh. to 7.8 percent in

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** Mailing Address: Dr. Lars P. Feld, University of St. Gallen, SIAW, Institutsgebäude, Dufourstr. 48, CH-9000 St. Gallen, Switzerland, Lars.Feld@unisg.ch

1. This assessment holds despite several studies conducted already in the seventies and eighties by BLATTNER (1977), BLATTNER et al. (1981), MARELLI (1981), LEWIN (1983), SHELDON (1983), STOLZ (1985), FLÜCKIGER, SCHÖNENBERGER and ZARIN-NEJADAN (1986) and SHELDON (1989).
2. See OECD (1996) and GERFIN and LECHNER (2000) for such an assessment of Swiss unemployment and for the figures reported in this section.

Geneva in 1997. This is quite remarkable given the fact that the country is small and the labor market quite flexible by European standards.[3] The increased variance in Swiss unemployment in the last decade and in a regional perspective has induced economists to analyze the causes of unemployment (FLÜCKIGER, 1994; TILLE, 1999), of long-term unemployment (SHELDON, 1999), the success of active labor market policies in Switzerland (GERFIN and LECHNER, 2000), the performance of foreign workers (GOLDER, 1999), and the regional disparity of unemployment over time (DE COULON, 1999).

In this literature, many factors have been advanced to explain Swiss cantonal unemployment. The first group of explanatory variables is related to the structure of the active population. In a panel study of cantonal unemployment from 1977 to 1995, DE COULON (1999) finds that the share of foreigners with a permanent residence permit significantly increases unemployment rates while the share of temporary (seasonal) workers significantly decreases them. These results corroborate the time series analysis of SHELDON (1993) for the period from 1975 to 1992. In contrast to SHELDON, DE COULON does not obtain a significant negative impact of the female participation rate on unemployment.

The second group of factors is geographical in nature. FILIPPINI and ROSSI (1992) conclude that the proximity to the Swiss border explains the cantonal disparities in 1991 quite well. The final group of determinants are socio-economic factors. Two examples are the propensity to register as unemployed (DE COULON, 1999) or differences between German-speaking and French/ Italian-speaking cantons (FILIPPINI and ROSSI, 1992).

Following international studies which give explanations for geographic differences in unemployment rates, this catalogue of potential explanatory factors appears to be incomplete.[4] In particular, variables related to cantonal economic policy like the various fiscal differences across cantons (e.g. the level of taxation and public spending) have not been investigated yet. In addition, the skills of the active population, e.g. their formal education levels, may be prominent explanatory factors of differences in cantonal unemployment rates, especially since education in Switzerland is mainly in the competence of the cantons. Beside the variables proposed until now, our study takes these additional explanatory variables into account. The purpose is to check the robustness of the traditional explanatory variables and to find out whether other explanatory factors may have been neglected.

The focus of the study is to identify canton specific factors explaining the disparity of unemployment in a panel data set of the 26 Swiss cantons from 1983 to 1998. The cantonal level of unemployment and its evolution over time is explained by macroeconomic variables in order to control for business cycle effects, some indicators of economic policy and several structural variables. We estimate a dynamic panel using particularly suited estimation techniques in order to find out to what extent existing estimation results

3. See DE COULON (1999) for a careful description of the cantonal disparity of unemployment and an international comparison (p. 167–169).
4. For a recent survey see NICKELL and LAYARD (1999).

are robust to the econometric specification. The paper is organized as follows. The basic econometric model with the accompanying estimation results are presented in *Section 2*. In *Section 3*, econometric specifications are used correcting for first order autocorrelation, additionally using heteroscedasticity consistent standard errors, and correcting for the bias induced by the lagged endogenous variable in panels with small sample properties. Moreover, estimations of the growth of cantonal unemployment are presented in addition to the level of unemployment. In *Section 4*, the cantons are aggregated to labor market regions and the robustness of the model of growth rates of cantonal unemployment with respect to this aggregation is checked. In *Section 5*, the canton specific coefficients (fixed effects) are explained by human capital, tax burden indicators and regional dummies. We offer some tentative conclusions in *Section 6*.

2. A CLASSIC PANEL MODEL OF CANTONAL UNEMPLOYMENT

Since potential path dependency of cantonal unemployment in the sense of a hysteresis effect might exist, it is necessary to estimate a dynamic panel model. As a workhorse to investigate the impact of cantonal economic policy on cantonal unemployment, we start with the dynamic panel data model outlined by BALTAGI (1995, p. 125) which also serves as the basis of DE COULON's (1999) study,[5] i.e.

$$\ln u_{it} = \beta_0 - \beta_1 \ln u_{i,t-1} + x'_{it}\beta_3 + e_{it} \tag{1}$$

with $i = 1, \ldots, 26$ and $t = 1, \ldots, T$. $\ln u_{it}$ is the log of the number of unemployed persons in a canton i in period t and x_{it} is a vector of economic and socio-demographic variables. We assume that the e_{it} follow a one way error component model with

$$e_{it} = \mu_i + \nu_{it} \tag{2}$$

where $\nu_{it} \approx IID(0, \sigma_\nu^2)$. As a data generating process we use a fixed effects (FE) model. The advantage of using a FE model instead of a random effects model is according to JUDSON und OWEN (1999, p. 11): "The fixed effects model (...) is a common choice for macroeconomists, and is generally more appropriate than a random effects model for two reasons. First, if the individual effect represents omitted variables, it is likely that these country-specific characteristics are correlated with the other regressors. Second, it is also likely that a typical macro panel will contain most countries of interest and, thus, will not likely be a random sample from a much larger universe of countries (e.g. an OECD panel contains most OECD countries)." Conducting a within transformation eliminates the μ_i and the model can be written as

5. In contrast to De Coulon, we do not estimate a Beveridge Curve because data on vacancy rates or the number of available job openings are not reliable. The respective data collection method changed over time. The differences between both approaches should however not be too large.

$$\ln u_{it} = \beta_0 - \beta_1 \ln u_{i,t-1} + \sum_{i=2}^{26} \beta_{2i} D_i + x'_{it}\beta_3 + \nu_{it}. \quad (3)$$

with D_i capturing the fixed effects. A least squares estimation of the transformed model (3) provides the Least Squares Dummy Variables (LSDV) estimator.[6] The vector x_{it} contains macroeconomic variables, indicators of economic policy and demographic variables. Beside the lagged endogenous variable that measures hysteresis or persistence effects, two macroeconomic factors that contribute to the development of cantonal unemployment are cantonal GDP and the number of employed people in the canton. Cantonal GDP is an indicator of aggregate demand, while both variables together proxy wage effects, since GDP per employee equals labor productivity which, according to economic theory, is closely related to wages. A higher GDP leads to a reduction in unemployment if the demand effect dominates and to a negative impact if GDP is an indicator of higher productivity and thus of higher wages. Similarly, a higher number of employees has an ambiguous impact on unemployment.[7]

Demographic factors are divided into two parts. The Swiss recession of 1975/76 was absorbed by a reduction in foreign workers while a similar movement of work permits cannot be observed for the recession of the nineties. This hints towards the role of foreign employees in the Swiss labor market. Switzerland uses four kinds of work permits. Foreigners can live in a neighboring country and cross the border to work in Switzerland (border workers). Seasonal workers are allowed to work one or, with interruptions, several seasons in Switzerland and have to return to their home country after each season. Annual workers are allowed to live and work in Switzerland for one year. This status can be extended each year. After a certain number of years, annual workers can obtain a permanent work permit. Since Swiss immigration policy is known to allow less skilled workers to enter the country to a larger extent than skilled workers, we expect that the higher the number of annual and permanent foreign workers in a canton, the higher is cantonal unemployment. On the other hand, border workers and seasonal workers serve as a compensation for adverse developments in the Swiss labor market: If economic conditions in Swiss cantons deteriorate, less border workers and seasonal workers are hired. The higher the number of these two kinds of foreign workers, the lower cantonal unemployment should thus be. The second kind of demographic factors are the number of young and old people and population size. We have no clear predictions for the impact of these variables although it is necessary to allow for the impact of the demographic structure on unemployment.

Finally, four indicators of fiscal policy are included in the estimation. Cantonal public

6. Throughout the paper we use "fixed effects" for the statistical model and "fixed effect least square" or "least squares dummy variables" for the estimator as in BALTAGI (1995). The terminology is however not fully established (compare GREENE, 1990)
7. We do not include time dummies in the model. Business cycle developments are more adequately coped with by including cantonal GDP and employment than by the inclusion of time dummies which would restrict the time effects to be equal across cantons.

spending may have two opposing effects. The higher spending the higher may be unemployment if private activity is crowded out by public activity, assuming that wages in the lower skilled segment of the labor market are relatively higher in the public sector than in the private sector. A higher spending may however also compensate for a negative development of aggregate demand. In this case, higher cantonal spending should lead to a reduction in unemployment. Since public investment in infrastructure and education are usually supposed to be productive and to lead to higher economic growth, both variables are included as well and supposed to decrease unemployment.

Total public revenue is also included in the equation. Since public revenue is composed of revenue from taxes, user charges and grants from other jurisdictions, it indicates to what extent the public sector uses resources which are not available for private use anymore. The impact of taxes on unemployment is particularly discussed in the literature. In unionized labor markets, a higher labor tax burden leads to permanent increases in labor costs. On the one hand, higher labor costs reduce labor demand and increase unemployment. On the other hand, labor is substituted by capital inducing a lower marginal product of capital and hence lower investment and lower output growth. While NICKELL and LAYARD (1999) find only small tax effects on unemployment, DAVERI and TABELLINI (2000) report an important and statistically significant positive impact of labor taxes on unemployment in OECD countries.

In contrast to these studies, we do not have a single and consistent indicator for the effective labor tax burden in the Swiss cantons over time. The Swiss Federal Tax Administration computes an index of income and property tax burden for each year by taking the Swiss average tax burden as 100 and the respective deviations of the different cantons from it. Such a procedure renders an indicator of tax burdens which is purely cross sectional in nature and does not allow to observe the tax burden of one canton over time. We thus follow a different approach than DAVERI and TABELLINI (2000): We include public revenue in the panel estimates and regress the cantonal fixed effects obtained in this panel procedure on the tax burden index.

In particular with respect to public spending and public revenue, the causality between unemployment and the explanatory variable is theoretically undetermined. Following the reasoning above, higher spending may increase unemployment. On the other hand, unemployment leads to higher spending at least because of the unemployment insurance scheme and active labor market policies. Since the unemployment insurance scheme is administered, financed and regulated by the Swiss federal government, the positive impact of unemployment on cantonal public spending should not be exaggerated. However, the unemployed may qualify for social welfare payments when their unemployment compensation is finished and increase cantonal (and local) spending after a time lag. Similar considerations can be added for public revenue. If higher public revenue crowds out private activity, it increases unemployment. However, if cantonal unemployment is high, cantonal revenue from income taxes and hence total public revenue declines. This effect may be smoothed by the fact that in most cantons the periods of tax payment and assessment of taxable income differ. During the time period underlying

Table 1: Log of Cantonal Unemployment
LSDV-Estimator, Cross Section Weights, 1983–1998, 26 cantons, 416 observations

	(1) CPI	(2) GDPD	(3) Per Capita
Log Unemployed $_{t-1}$	0.605**	0.603**	0.629**
	(0.03)	(0.03)	(0.03)
Log Employed $_{t-1}$	1.536*	1.439(*)	0.958
	(0.74)	(0.74)	(0.73)
Log Cantonal GDP $_{t-1}$	–0.109	–0.137	–0.098
	(0.64)	(0.69)	(0.65)
Log Border Workers $_{t-1}$	0.045	0.026	0.081
	(0.07)	(0.07)	(0.07)
Log Seasonal Workers $_{t-1}$	–0.019	–0.019	–0.024
	(0.03)	(0.03)	(0.03)
Log Annual Workers $_{t-1}$	0.222*	0.189(*)	0.300**
	(0.11)	(0.11)	(0.11)
Log Permanent Workers $_{t-1}$	1.031**	1.010**	1.393**
	(0.26)	(0.27)	(0.24)
Log Total Cantonal Expenditure $_{t-1}$	3.379**	3.610**	3.580**
	(0.46)	(0.45)	(0.46)
Log Total Cantonal Revenue $_{t-1}$	–3.466**	–3.375**	–3.532**
	(0.33)	(0.33)	(0.33)
Log Expenditure for Education $_{t-1}$	–0.472(*)	–0.289	–0.327
	(0.28)	(0.28)	(0.28)
Log Capital Expenditure $_{t-1}$	–0.185*	–0.228**	–0.232**
	(0.09)	(0.09)	(0.09)
Log Young Population $_{t-1}$	–0.322	–0.065	–1.110(*)
	(0.62)	(0.61)	(0.57)
Log Old Population $_{t-1}$	–3.498**	–3.292**	–3.740**
	(0.65)	(0.65)	(0.66)
Log Population $_{t-1}$	4.898**	4.078**	
	(1.47)	(1.47)	
$\bar{R}^2$ (unweighted)	0.96	0.97	0.92
D.W.-statistics	1.155	1.144	1.184

Specifications: (1) The nominal explanatory variables are deflated with the national consumer price index. (2) The nominal explanatory variables are deflated with cantonal GDP deflators. (3) All variables are per capita and deflated with the national consumer price index. The numbers in parentheses are the standard errors of the estimated coefficients. '**', '*' or '(*)' show that the estimated parameter is significantly different from zero on the 1, 5, or 10 percent level, respectively. $\bar{R}^2$ is the adjusted coefficient of determination.

our data set, a taxpayer in the canton of Appenzell a. Rh. had to pay taxes in the period 1991/92 for income earned in 1989/90. Therefore, the reversed causation should not be too severe if the explanatory variables are lagged by one period. For a reversed causation to occur, public sector officials are required to expect future unemployment four years in advance.

Thus, we lag all explanatory variables by one period and compute them in logs. Moreover, we deflate nominal explanatory variables. Table 1 contains the results of the fixed effects model of cantonal unemployment for the period 1983 to 1998 using cross section weights in order to avoid heteroscedasticity. Three specifications are reported in Table 1: In the first specification, the nominal explanatory variables are deflated with the national consumer price index. In the second specification, the nominal explanatory variables are deflated with cantonal GDP deflators. In the third specification, all variables are per capita and deflated with the national consumer price index. Basically, the three specifications reported in Table 1 do not deviate very much from each other. Therefore, the first specification is used in order to summarize the first results only picking the most interesting ones.

We find a significant positive impact of lagged unemployment on current unemployment. Since the coefficient is significantly smaller than one, this result rather indicates persistence of cantonal unemployment than a hysteresis effect. The higher the number of annual and permanent foreign workers, the higher is unemployment. Basically, these results corroborate those of DE COULON (1999). The higher public spending and the lower public revenue, the higher is unemployment. Since both coefficients are not significantly different from each other, this result can be interpreted as showing the impact of the ratio of public spending to public revenue. The less fiscally conservative cantons are, i.e. the higher this ratio of spending to revenue, the higher unemployment appears to be. On the other hand, public education and infrastructural spending reduce unemployment. The positive impact of public spending on cantonal unemployment may be mainly attributed to the level of public consumption and public transfers. Since all variables are lagged by one period, these results may indicate that public spending leads to higher unemployment and with a lower probability the reversed causation might hold. The latter is however not totally excluded, if it is recognized that public decision-making may as well be the result of rational expectations. Public officials might forecast the reduction in revenue and the increase in public spending which is due to higher unemployment in the future. Moreover, the estimates obtained in the fixed effects model may be biased due to the dynamic nature of the panel with which we have not adequately coped yet. Hence, before we put too much emphasis on these results it is necessary to clarify some specific econometric issues.

3. A CONSISTENT AND EFFICIENT DYNAMIC PANEL MODEL OF CANTONAL UNEMPLOYMENT

The model specified in Section 2 is not satisfying for two reasons. First, there is first order autocorrelation of the error terms in the normal LSDV estimator according to the D.W.-statistics. Second, because $u_{i,t}$ is a function of $\mu_i, u_{i,t-1}$ is a function of μ_i as well. The lagged endogenous variable as a right hand regressor is correlated with the error term. Despite the LSDV estimator and even if the ν_{it} are not serially correlated, $(u_{i,t-1} - \bar{u}_{i.-1})$ are still correlated with $(\nu_{it} - \bar{\nu}_{i.})$ (BALTAGI, 1995, p. 126). The within estimator will be biased and its consistency depends upon T being large which is usually not the case. In the next step, it is thus necessary to check the robustness of the results obtained in the previous section with respect to a reasonable treatment of autocorrelation and potential inconsistency of the estimates.

These problems are taken into account in the estimation results shown in Table 2. In the second column, the results of the LSDV estimator are reported. These estimation results are corrected for first order autocorrelation of the error terms by using the Prais and Winsten transformation. In addition, heteroscedasticity consistent standard errors are not only derived with respect to the variation of the variance in the cross sectional dimension, but also over time.

The results reported in the third column are obtained from a different estimator in which the bias induced by the inclusion of a lagged endogenous variable is corrected by a method suggested by KIVIET (1995). Kiviet's LSDV correction (LSDVC) uses a consistent estimator in a first stage of the estimation procedure. This consistent estimator is obtained in our estimation model following ANDERSON and HSIAO (1981) who suggested to first differencing the model to get rid of individual effects and then using the difference of the two and three periods lagged endogenous variables as an instrument. This instrumental variable estimation method (AH-IV) leads to consistent (but not necessarily efficient) estimates.[8] The LSDVC corrects for the bias and is relatively efficient. Using a Monte Carlo study, JUDSON and OWEN (1999) show for typical macro panels with a small number of observations in the cross section and a relatively large time dimension that the LSDVC outperforms alternative estimators like the GMM or AH-IV estimator. Comparing the LSDV and LSDVC estimates, Table 2 shows that the bias due to the dynamic character of the panel does not appear to be considerably large indeed.[9]

8. Instead of taking a difference as an instrument, we follow the recommendation by ARELLANO (1989) and include the level of the two periods lagged endogenous variable. The inefficiency of this AH-IV estimator nevertheless holds although the two periods lagged endogenous variable is the best instrument that could be obtained. The one period lagged endogenous variable is already included as an explanatory variable and the more than two periods lagged endogenous variables contain even less information for cantonal unemployment. Using more lags decreases the efficiency of the estimates progressively.
9. The results obtained from the LSDVC equation do not appear to be sensitive to the specification of the AH-IV equation. – The significance of the LSDVC estimator is computed by using the

Table 2: Cantonal Unemployment. 1983–1998, 26 cantons, 416 observations.

	LSDV	LSDVC
Log Unemployed $_{t-1}$	0.587**	0.662**
	(0.06)	
Log Employed $_{t-1}$	2.229*	2.132*
	(0.98)	
Log Cantonal GDP $_{t-1}$	–0.443	–0.252
	(0.87)	
Log Border Workers $_{t-1}$	–0.266**	–0.256**
	(0.07)	
Log Seasonal Workers $_{t-1}$	–0.008	–0.007
	(0.03)	
Log Annual Workers $_{t-1}$	0.584**	0.578**
	(0.18)	
Log Permanent Workers $_{t-1}$	1.374**	1.281**
	(0.46)	
Log Total Cantonal Expenditure $_{t-1}$	2.603**	2.538**
	(0.63)	
Log Total Cantonal Revenue $_{t-1}$	–1.808**	–1.827**
	(0.50)	
Log Expenditure for Education $_{t-1}$	–0.058	–0.077
	(0.31)	
Log Capital Expenditure $_{t-1}$	–0.343**	–0.323**
	(0.11)	
Log Young Population $_{t-1}$	–1.359*	–1.390*
	(0.65)	
Log Old Population $_{t-1}$	–2.806**	–2.547**
	(0.74)	
Log Population $_{t-1}$	–0.458	–0.706
	(1.02)	
$\bar{R}^2$ (unweighted)	0.93	

LSDV: Least squares dummy variables estimator, Within estimator. LSDVC: Least squares dummy variables estimator corrected for the bias of the LSDV as proposed by KIVIET (1995). The results of the AH-IV were used to compute the correction. Heteroskedastic Consistent Standard Errors. Correction for cantonal autocorrelation using the Prais and Winsten transformation. The numbers in parentheses are the standard errors of the estimated coefficients. '**', '*' or '(*)' show that the estimated parameter is significantly different from zero on the 1, 5, or 10 percent level, respectively.

standard errors of the LSDV estimator because KIEVIET (1995) does not provide an analytical formula to compute standard errors. The LSDVC estimator is used in order to test to what extent the LSDV coefficients are robust to the bias.

Like in Table 1, the LSDV and LSDVC estimators reveal a persistence effect of cantonal unemployment in Switzerland. Cantonal GDP has a negative sign, but does not reach any conventional significance level. The more people are employed in a canton the higher is cantonal unemployment. This relationship is significant at the 5 perçent level. It may capture a demographic effect in the sense of an increase in participation rates. A higher number of foreigners as annual or permanent workers significantly increases cantonal unemployment while the number of border workers significantly decreases it. Both influences correspond to the conjectures made above. As expected, foreign workers which usually are less skilled become unemployed and were not send to their home countries during the eighties and nineties like they were in the seventies. In contrast, border workers appear to serve as a compensation device for unemployment. Thus, the results of DE COULON (1999) are corroborated to some extent.

Even more pronounced than the estimates in Table 1, fiscal policy influences unemployment. The higher public spending and the lower public revenue, the higher is unemployment. Since both coefficients are significantly different from each other, it can be concluded that the more cantons spend unproductively, the higher is unemployment. Infrastructural spending remains significantly negative, i.e. it reduces unemployment. The positive impact of public spending on cantonal unemployment may be mainly attributed to the level of public consumption and public transfers. And again keeping in mind the possibility of rational expectations of public officials and the caveat following for this interpretation: since all variables are lagged by one period, these results indicate to a higher probability that public spending leads to higher unemployment and with a lower probability vice versa. Finally, the higher the number of young and old people, the lower is unemployment. That the number of young people do not increase but reduce unemployment may be a human capital effect. However, such evidence cannot be clearly obtained without a more persuasive education variable.

A specific problem of these estimation results consists in the time series properties of unemployment and several explanatory variables. It may be that these are not stationary, I(0), but integrated of order 1, I(1).[10] This would make it necessary to estimate the model reported in Table 2 with the growth rate instead of the level of unemployment and the growth rates of the explanatory variables.[11] Moreover, an explanation of the growth rate of unemployment is a harder test on the impact of cantonal fiscal variables on unemployment. It thus adds additional explanatory power. The LSDV and LSDVC in growth rates are reported in Table 3.

The results obtained for the cantonal growth rate of unemployment in Table 3 are consistent with the results for the level of unemployment. The bias of the LSDV estimator indicated by its difference to the LSDVC estimator is not considerable although a bit higher than in the case of the level of cantonal unemployment. The most interesting dif-

10. On the other hand, it should be reminded that the coefficient of the lagged endogenous variable is significantly smaller than one.
11. We do not conduct (panel) unit root tests, but decided to estimate the model in growth rates anyway in order to check the robustness of the results obtained up to now.

ferences between the results of the cantonal growth rate and the level of cantonal unemployment occur with respect to foreigners in the Swiss labor force and fiscal policy variables. In contrast to the impact of the level of seasonal workers on unemployment, the growth rate of seasonal workers now has a significant negative impact on the growth of unemployment while the growth of border workers is significant at the 10 percent level only. The growth rate of annual foreign workers and foreign permanent workers increases the growth of cantonal unemployment significantly. This also corroborates the results obtained for the level of unemployment.

Table 3: Cantonal Growth Rate of Unemployment. 1984–1998, 26 cantons, 390 observations.

	LSDV	LSDVC
Growth Rate of Unemployment $_{t-1}$	0.232**	0.359**
	(0.05)	
Growth Rate of Employed $_{t-1}$	1.891(*)	1.880
	(1.15)	
Growth Rate of Cantonal GDP $_{t-1}$	–0.594	–0.617
	(0.91)	
Growth Rate of Border Workers $_{t-1}$	–0.198(*)	–0.195(*)
	(0.11)	
Growth Rate of Seasonal Workers $_{t-1}$	–0.045*	–0.052*
	(0.02)	
Growth Rate of Annual Workers $_{t-1}$	1.068**	1.049**
	(0.33)	
Growth Rate of Permanent Workers $_{t-1}$	6.561**	6.589**
	(1.39)	
Growth Rate of Total Cantonal Expenditure $_{t-1}$	1.250*	1.255*
	(0.53)	
Growth Rate of Total Cantonal Revenue $_{t-1}$	–0.420	–0.424
	(0.36)	
Growth Rate of Expenditure for Education $_{t-1}$	0.085	0.066
	(0.28)	
Growth Rate of Capital Expenditure $_{t-1}$	–0.314**	–0.311**
	(0.12)	
Growth Rate of Young Population $_{t-1}$	–2.933	–0.867
	(1.79)	
Growth Rate of Old Population $_{t-1}$	–4.371*	–4.359*
	(1.92)	
Growth Rate of Population $_{t-1}$	9.108*	6.888(*)
	(4.18)	

LSDV: Least squares dummy variables estimator, Within estimator. LSDVC: Least squares dummy variables estimator corrected for the bias of the LSDV as proposed by KIVIET (1995). The results of the AH-IV were used to compute the correction. Heteroskedastic Consistent Standard Errors. Correction for cantonal autocorrelation using the Prais and Winsten transformation. The numbers in parentheses are the standard errors of the estimated coefficients. '**', '*' or '(*)' show that the estimated parameter is significantly different from zero on the 1, 5, or 10 percent level, respectively. Growth rates are computed as the difference of the logs of the dependent (independent) variable(s) at t and t-1 (t-1 and t-2).

In contrast to the impact of the level of total public revenue on unemployment, the growth rate of cantonal total public revenue does not exert a significant impact on cantonal unemployment growth while the impact of cantonal public spending growth increases cantonal unemployment growth significantly. Again, it is not total cantonal spending that matters, but unproductive public spending that is not used for public education or public investment. Similar to the level estimates, the growth rate of public capital spending in a canton significantly reduces cantonal unemployment growth. These results for the growth rate of unemployment accentuate the results obtained for the level of unemployment. In the case of growth rates lagged by one period, a reversed causation in the relationship between unemployment and public spending is even less plausible than in the case of levels of unemployment. Why should the growth rate of public spending from 1989 to 1990 for example be influenced by the growth rate of unemployment from 1990 to 1991? Public sector officials must have very accurately predicted the growth of (involuntary) unemployment in the last Swiss recession if this reversed causation were to hold. Such a construction of rational expectations does not seem to be plausible if it is considered that the beginning, the severance and the duration of the last recession was a relative surprise for Swiss people (and Swiss public officials).

4. AN ANALYSIS OF UNEMPLOYMENT IN LABOR MARKET REGIONS

We are still reluctant to take the results obtained in Section 3 for granted. The reason can be found in a particular feature of the Swiss labor market that challenges a cantonal perspective: The regional separation in Swiss labor markets does not follow along the lines of cantonal borders. Some cantons serve as labor market centers and experience a permanent inflow of employees and unemployed seeking for better job opportunities. A good example is Geneva. The canton more or less consists of the city of Geneva and its suburbs. In addition to these local jurisdictions, people from the cantons of Vaud and Valais (and from France) commute or move to Geneva in order to work there. The labor market region with the center Geneva thus comprises three Swiss cantons (and some French jurisdictions).

This regional concentration of labor market opportunities might have an impact on two different kinds of variables in our setting. First, the impact of the foreign work force on unemployment might be affected. The higher unemployment rates in cantons with higher numbers of foreigners with an annual or with a permanent work permit may simply reflect the concentration of foreigners in labor market centers. People from foreign countries move to centers where they expect job opportunities to occur, just like commuters or migrants from other cantons. The concentration of foreigners becomes however obvious in the statistics because they will not move to cantons with less job opportunities. In this case, the impact of foreigners on cantonal unemployment is simply a statistical artefact and should become insignificant if cantons are aggregated to labor market regions.

Table 4: Growth Rate of Unemployment in Swiss Labor Market Regions. 1984–1998, 7 labor market regions, 105 observations.

	LSDV	LSDVC
Growth Rate of Unemployment $_{t-1}$	0.266**	0.355**
	(0.07)	
Growth Rate of Employed $_{t-1}$	3.603*	4.409*
	(1.77)	
Growth Rate of Cantonal GDP $_{t-1}$	–3.760**	–3.751**
	(1.24)	
Growth Rate of Border Workers $_{t-1}$	–0.080	–0.049
	(0.27)	
Growth Rate of Seasonal Workers $_{t-1}$	–0.041	–0.050
	(0.03)	
Growth Rate of Annual Workers $_{t-1}$	1.329**	1.425**
	(0.39)	
Growth Rate of Permanent Workers $_{t-1}$	9.997**	9.981**
	(1.56)	
Growth Rate of Total Cantonal Expenditure $_{t-1}$	2.922**	2.992**
	(1.00)	
Growth Rate of Total Cantonal Revenue $_{t-1}$	–1.818**	–1.736**
	(0.46)	
Growth Rate of Expenditure for Education $_{t-1}$	0.355	0.292
	(0.52)	
Growth Rate of Capital Expenditure $_{t-1}$	–0.663**	–0.662**
	(0.20)	
Growth Rate of Young Population $_{t-1}$	1.030	2.269
	(2.40)	
Growth Rate of Old Population $_{t-1}$	–5.447	–6.027
	(3.34)	
Growth Rate of Population $_{t-1}$	–5.029	–7.975
	(6.22)	

LSDV: Least squares dummy variables estimator, Within estimator. LSDVC: Least squares dummy variables estimator corrected for the bias of the LSDV as proposed by KIVIET (1995). The results of the AH-IV were used to compute the correction. Heteroskedastic Consistent Standard Errors. Correction for cantonal autocorrelation using the Prais and Winsten transformation. The numbers in parentheses are the standard errors of the estimated coefficients. '**', '*' or '(*)' show that the estimated parameter is significantly different from zero on the 1, 5, or 10 percent level, respectively. Growth rates are computed as the difference of the logs of the dependent (independent) variable(s) at t and t-1 (t-1 and t-2).

Second, the impact of public revenue and public spending on unemployment might be affected by the regional aggregation. Suppose unemployed from the Valais move to Geneva in order to find a new job. They will increase the unemployment rate in Geneva

and decrease the one in Valais. But their migration will also lead to a more favorable fiscal stance in the Valais, because they will obtain social benefits in Geneva without paying additional taxes as long as they remain unemployed. In the cantonal estimates, the higher ratio of public spending to public revenue in cantons like Geneva are associated with higher unemployment. Aggregating the cantons to labor market regions, this effect is averaged out and fiscal policy will not affect cantonal unemployment any more.

In order to test the robustness of our results with respect to the aggregation of cantons, we follow the Swiss Federal Statistical Office by constructing the following seven regions:

1. The region of the lake of Geneva comprising the cantons Vaud, Valais and Geneva.
2. The region 'espace' with Bern, Fribourg, Solothurn, Neuchâtel and Jura.
3. The Northwest region with Basel-Stadt, Basel-Landschaft and Aargau.
4. The region of Zurich containing the canton of Zurich only.
5. The Eastern region with Glarus, Schaffhausen, Appenzell A. Rh., Appenzell I. Rh., St. Gallen, Graubünden and Thurgau.
6. The Central region with Luzern, Uri, Schwyz, Obwalden, Nidwalden and Zug.
7. The region of Ticino containing the canton of Ticino only.[12]

The robustness test of the estimation results to the aggregation to labor market regions is performed for the growth rates of unemployment because the integration properties of the time series may influence these results the least. Again, the procedure of Section 3 is adopted by first estimating the AH-IV estimator and using the estimator of KIVIET (1995) in a second step to correct the bias of the LSDV estimator. This procedure finally provides the LSDVC estimator. The LSDV and LSDVC models for these seven regions are reported in Table 4. A look at Table 4 reveals two basic results. First, the LSDV and LSDVC estimators show that the foreign work force with annual and permanent work permits still has a significant positive impact on the growth of unemployment while the compensating impact of border workers and seasonal workers vanishes. This result is no surprise because an averaging of cantons close to the border with cantons which have no border workers necessarily reduces the significance of this variable.

Second, the fiscal variables, public spending and public revenue gain in importance. Both parameter estimates increase considerably as compared to the cantonal regressions, in both cases the coefficient is more than doubled. The same holds true with respect to cantonal capital spending. Most strikingly, the negative impact of public revenue on unemployment growth is significantly negative. Since both coefficients differ

12. It can be debated extensively whether this classification is useful. Some people might insist having Solothurn in the Northwestern region with Basel or the Aargau to Zurich. Definitely, the separation of Zurich from Zug and Schwyz is problematic particularly having the tax competition game between these three cantons in mind. We attempted other classifications, reclassifying Solothurn as a canton of the Northwest region as well as Schwyz and Zug as belonging to the Zurich agglomeration. The basic results remained the same.

significantly from each other and the impact of public revenue does not overcompensate the impact of public spending, we are back to the interpretation brought forward in Table 2 with respect to the level of unemployment: Unproductive spending in less fiscally conservative cantons appears to lead to higher unemployment growth. The results of cantonal unemployment remain relatively robust to regional aggregation.

5. AN ANALYSIS OF THE FIXED EFFECTS

This is of course still not the end of the story. Economically, it is not the status of being a foreigner that increases the probability of a person of becoming unemployed. It is the fact the foreigners in Switzerland usually are less skilled, have a lower human capital and thus a higher probability of becoming unemployed. Similarly, it is not public expenditure as such that leads to higher unemployment. It could be a higher labor or income tax burden that can be accused of doing so. The analysis of Section 3 thus offers two ways of further investigation. First, the impact of human capital is not really discussed. The foreign work force is supposed to be less skilled and the positive impact of annual and permanent foreign workers is interpreted as the result of their low education levels. Including human capital or schooling indicators is certainly more promising. Second, the impact of public revenue on cantonal unemployment too crudely captures the impact of the labor tax burden on unemployment..The inclusion of the average income tax burden in a canton would be more promising. Unfortunately, however, Swiss statistics do not offer consistent time series of the number of people with different education levels at the cantonal level. This information is only derived every ten years. In addition, an overall indicator of tax burdens is only computed by excluding the time series variation. The index of cantonal and (weighted) local income and property tax burdens is obtained by giving the Swiss average an index value of 100 and determining the cantonal deviations from this average. Thus, it is not possible to follow the change in the tax burden of one canton over time.

In order to exploit the cross sectional variation of unemployment to that end, the individual effects from the LSDVC estimation from Table 2 are regressed on the number of people with different kinds of education, i.e. those with compulsory schooling (only), professional education, higher education, university degrees and so on, as well as on the tax burden index and regional dummies for border cantons and the French or Italian-speaking cantons. We would expect that the higher education the lower is cantonal unemployment and the higher the cantonal tax burden the higher is cantonal unemployment. The results of these estimates are presented in Table 5. Only the number of people with professional training, university degrees, the tax burden index and the dummy variable for border cantons have significant impacts on the individual effects. The more people have university education, the lower is cantonal unemployment. Professional training appears to be a low education device already: The higher the number of people with professional training, the higher is cantonal unemployment. The higher the income tax

burden the higher is cantonal unemployment. This result clearly corroborates those obtained by DAVERI and TABELLINI (2000) though with a different econometric model. While the dummy variable for French or Italian-speaking cantons is not significant, border cantons have a significantly higher unemployment.

Table 5: Fixed Effects of Cantonal Unemployment. 1980 and 1990, 52 observations, Cross Section Weights

Constant	–3.735**
	(0.48)
Compulsory Schooling	0.092
	(0.07)
Professional Training	0.368**
	(0.11)
Higher Professional Training	–0.062
	(–0.05)
High School (Maturity)	0.043
	(0.15)
University Education	–0.297**
	(0.10)
Index of Cantonal and Local Income and Property Tax Burden	0.455**
	(0.11)
Dummy Variable for French or Italian-Speaking Cantons	–0.092
	(0.08)
Dummy Variable for Border Cantons	0.474**
	(0.04)
$\bar{R}^2$ (unweighted)	0.48

Individual effects from LSDVC estimation of *Table 2* in two waves. The numbers in parentheses are the standard errors of the estimated coefficients. '**', '*' or '(*)' show that the estimated parameter is significantly different from zero on the 1, 5, or 10 percent level, respectively. $\bar{R}^2$ is the adjusted coefficient of determination.

6. CONCLUSIONS

In this paper, the cantonal dispersion of unemployment in Switzerland from 1983 to 1998 is explained by a persistence effect, by the number of foreigners with different work permits and by fiscal policy. Using estimation techniques for dynamic fixed effect

panels, we obtain the results that cantonal unemployment is the higher, the higher unemployment of the former period, the higher the number of annual and permanent foreign workers, the lower the number of foreigners living abroad and crossing the border to work in Switzerland, and the higher unproductive public spending in less fiscally conservative cantons. It is unproductive public spending that appears to increase cantonal unemployment because cantonal capital spending reduces unemployment. These results are corroborated by an analysis of the growth rate of cantonal unemployment. Similarly to the level of unemployment, the growth of workers with annual and permanent work permits increases the growth of unemployment, the growth of border workers and seasonal workers reduces unemployment growth, while the growth of unproductive public spending increases unemployment growth. Cantonal capital spending growth reduces unemployment growth.

These results are more or less robust to the aggregation of cantons to seven labor market regions. Only the impact of the growth of the foreign workforce crossing the border or working seasonally vanishes while the negative impact of public revenue growth on unemployment growth becomes significant. Investigating the individual cantonal fixed effects, we are able to find evidence that the higher the number of people with university degrees, the lower is cantonal unemployment, while high tax cantons and border cantons have higher unemployment. It is not the status of being a foreigner but human capital that has an impact on unemployment. Similarly, it is not public spending as such but a high income tax burden that is associated with higher unemployment.

Of course, there are several caveats of the econometric analysis that suggest to interpret the results cautiously. In particular, a few potentially interesting additional explanatory variables are not included in the study. For example, we have not investigated the impact of wages on cantonal unemployment because of the lack of consistent cantonal figures over time. Moreover, the impact of the industrial structure, the skill and age composition of the unemployed and the existence as well as the generosity of supplementary unemployment payments ('Arbeitslosenhilfe'), that could be obtained in some cantons after the period of unemployment insurance benefits is finished, have to be left for future research. In addition a more useful investigation of human capital on unemployment would be possible if annual data instead of two cross sections within ten years could be used. As well, the progressivity of cantonal income taxes would be a useful measure to capture tax incentives more precisely and on an annual basis. Nevertheless, the results reported in this study corroborate the results of preceding analyses. In a macroeconomic cantonal perspective, human capital, that is usually supposed to be low in the case of foreigners with an annual or permanent work permit, is crucial in explaining the regional dispersion of unemployment and unemployment growth in Switzerland. But in addition, cantonal policy variables like fiscal policy or the average income tax burden play a non-negligible role.

APPENDIX: DATA SOURCES

Number of unemployed;
Source: SECO, personal correspondence with Mrs. Gauggel, and BUNDESAMT FÜR STATISTIK, personal correspondence with Mrs. Lässig.

Number of employed persons;
Cantonal GDP;
Source: BAK BASEL, personal correspondence.

Number of border workers;
Number of seasonal workers;
Number foreign workers with an annual work permit;
Number foreign workers with a permanent work permit;
Source: BUNDESAMT FÜR AUSLÄNDERFRAGEN, Die Ausländer in der Schweiz, Retrospektive Bestandsergebnisse, August 1999, Table 2.13R – 2.16R, pp. 14–16.

Cantonal public expenditure;
Cantonal capital expenditure;
Source: EIDGENÖSSISCHE FINANZVERWALTUNG, Öffentliche Finanzen der Schweiz, Table D.2, Bern, various years.

Cantonal education expenditure;
Source: EIDGENÖSSISCHE FINANZVERWALTUNG, Öffentliche Finanzen der Schweiz, Table D.4, Bern, various years.

Cantonal public revenue;
Source: EIDGENÖSSISCHE FINANZVERWALTUNG, Öffentliche Finanzen der Schweiz, Table D.3, Bern, various years.

Index of cantonal and (weighted) local income and property tax burden;
Source: EIDGENÖSSISCHE STEUERVERWALTUNG, Steuerbelastung in der Schweiz, Table 36, Bern, various years.

People with different formal education levels, 1970, 1980, 1990;
Source: BUNDESAMT FÜR STATISTIK, personal correspondence with Dominik Ullmann.

Population;
Share of people with age above 65 years;
Share of young people not over 20 years old;
Source: BUNDESAMT FÜR STATISTIK, Informationsdienst, Sektion Bevölkerungsentwicklung, personal corrspondence with Ursula Wegmüller.

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SUMMARY

In this paper, factors explaining the regional disparity of unemployment in Switzerland at the level of the Swiss states (cantons) and labor market regions over time are examined. We estimate a dynamic panel using particularly suited estimation techniques in order to find out to what extent existing estimation results are robust to the econometric specification. We find that particularly high tax burdens increase cantonal unemployment, the number of foreign workers is positively correlated with unemployment and human capital investment reduces unemployment.

ZUSAMMENFASSUNG

In dieser Studie werden Ursachen für die regionalen Unterschiede der Arbeitslosigkeit in der Schweiz auf der Ebene der Schweizer Kantone und Arbeitsmarktregionen untersucht. Mit Hilfe einer dynamischen panel-ökonometrischen Analyse werden bisherige Erklärungsfaktoren auf ihre Robustheit hinsichtlich der ökonometrischen Spezifikation getestet. Es stellt sich heraus, dass eine weniger konservative Fiskalpolitik insbesondere aber eine hohe kantonale Einkommensteuerbelastung die kantonale Arbeitslosigkeit erhöhen, während ein höheres kantonales Humankapital die Arbeitslosigkeit reduziert. Dies erklärt auch, warum die Anzahl ausländischer Erwerbstätiger positiv mit der kantonalen Arbeitslosigkeit korreliert ist.

RESUME

Cette étude analyse l'évolution temporelle des disparités cantonales et régionales du chômage en Suisse. Un panel dynamique est estimé en utilisant des méthodes adaptées afin de s'assurer que les résultats existants sont robustes. Les trois résultats principaux sont les suivants: Une importante charge fiscale accroît le chômage. L'étude confirme qu'une corrélation positive existe entre le nombre de travailleurs étrangers et le chômage. Enfin, les investissements dans le capital humain réduisent le chômage.