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Abstract

This paper analyses the importance of fiscal mechanisms for regional risk sharing and redistribution in Switzerland. Switzerland is a particularly interesting setting in this context because it features both a high level of fiscal autonomy for Swiss cantons and explicit fiscal transfers between the federal government and the cantons. Based on panel-data analysis we study the redistributive and stabilizing properties of fiscal equalization transfers, federal government transfers in general, direct federal taxation, the unemployment insurance scheme and the first pillar pension scheme. We find a combined redistributive effect of these mechanisms of about 20%. This means that long-run income differentials of 1 Swiss Franc between cantons translate into differences of long-run disposable income after taxes and transfers of about 80 cents. The combined contemporary stabilization effect with respect to short-term income fluctuations amounts to less than 10%, which is a small effect compared to previous findings for other countries.

JEL-Codes: E620, H100, H700.

Keywords: regional risk sharing, redistribution, fiscal transfers.

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1 Introduction

In monetary unions exchange rate adjustments are no longer available to absorb regional economic shocks. This raises the question as to how regions may insure against regional economic downturns. In theory, market mechanisms such as cross-regional labour and capital flows could provide for such insurance. These flows can however be limited in practice, for example because interregional labour and capital mobility is low. In this case institutional arrangements may be necessary to provide risk sharing (Sala-i-Martin and Sachs, 1991).

In order to gain insights regarding the necessity of fiscal institutional arrangements for the European Monetary Union, various authors have studied the importance of different private and public channels of risk sharing among states or regions.[1] Risk sharing in the united states has for example been analysed by Sala-i-Martin and Sachs (1991), Bayoumi and Masson (1995) and Asdrubali et al. (1996) with a substantial range of results. Sala-i-Martin and Sachs analysed the elasticity of federal taxes and transfers with respect to per capita income changes in the respective states. They found large smoothing effects of one third to one half of the initial shocks through federal taxes and transfers. Thereby taxes seem to play a more important role than transfers. From their analysis, the authors concluded that the introduction of a unified European currency without appropriate fiscal risk sharing mechanisms might endanger the project of a currency union. Bayoumi and Masson found a similar magnitude of overall stabilization in the United States. In contrast to Sala-i-Martin and Sachs however, Bayoumi and Masson find that transfers contribute considerably to this stabilization effect. In a very influential paper Asdrubali et al. consider the three main channels of risk sharing - the capital market channel, the federal government channel and the credit market channel - simultaneously. Based on their analysis for the United States between 1963 and 1990, they find that the federal tax and transfer system plays a less important role, only absorbing about 13% of initial regional shocks.

Based on these three studies, the magnitude of risk sharing through fiscal institutions in the United States varies between 13% and 50%. Mélitz and Zumer (2002) try to reconcile these differing results, emphasizing the distinction between stabilizing personal income of residents and stabilizing the gross product of a region. Depending on the variable of interest, the transfers to be looked at need to be chosen accordingly. The authors argue that the differences in results of previous studies stem from the fact that broad measures of regional income have been compared to narrow measures of transfers and vice versa, thereby exaggerating or understating stabilization effects. In their own analysis of redistributive and stabilizing effects of central budgets in the United States, Canada, the United Kingdom and France on personal income,

[1] Based on the influential analysis by Asdrubali et al. (1996), three channels of risk sharing are generally identified. The first channel is the so-called capital market channel, referring to cross-ownership of productive assets. Examples are individuals living in one region but earning capital or labour income from another region. The second channel relates to the tax-transfer-system of the central government (federal government channel). An example would be a proportional income tax whereby the federal government automatically collects less money from regions where income is reduced due to an adverse economic shock. The third risk sharing channel, the so-called credit market channel is based on borrowing and lending by individuals on national credit markets.

they find that redistribution differs substantially (from almost 40% in France to below 20% in the United States and Canada), while stabilization amounts to around 20% in all countries considered. If the focus lies on the stabilization of regional gross product, the estimated effects are somewhat smaller at around 15%.

Risk sharing has also been studied for Germany by Buettner (2002) and Hepp and von Hagen (2011, 2013). The authors argue that Germany is an interesting case because unlike the United States there are direct interstate transfers for redistribution purposes. Buettner (2002) analyses the extent of state-specific income shock smoothing in West Germany between 1970 and 1997 and finds that federal taxes and transfers smooth about 15% of state income shocks. Thereby the system of fiscal equalization accounts for half of this effect while federal tax receipts do not seem to play an important role at all. The studies by Hepp and von Hagen suggest that the fiscal mechanisms considered redistribute per-capita state income by almost 40%, both before and after German unification. At the same time the stabilization effect through fiscal mechanisms decreases from about 40% before unification to about 20% thereafter. In a second study, Hepp and von Hagen (2013) analyse the stabilizing effect of factor markets, credit markets and the public sector with respect to gross state product before and after German unification and report again considerable changes over time. While the public sector accounted for over 50% of risk sharing before unification, this share diminished to about 10% thereafter. Further within country analyses focus on Italy (Decressin, 2002), Sweden (Andersson, 2008) and Canada (Balli et al., 2012). An overview of the key results of the different studies can be found in table 1.

We add to this substantial body of literature by studying the Swiss case. Switzerland may provide important insights regarding the potential effects of direct fiscal transfers in the European Union. The country can be regarded as a small monetary union in which the 26 cantons enjoy substantial autonomy regarding both expenditures and taxation. As in other monetary unions there are no labour or capital market restrictions regarding cantonal borders. Consequently, by analysing Switzerland we are able to study the importance of direct intergovernmental transfers for risk sharing in a setting where a highly integrated market is combined with substantial tax autonomy of regional governments. Furthermore, Swiss fiscal federalism is sometimes seen as a possible direction for the further development of the European Union.[2] Therefore, it is important to know to what extent the specific fiscal mechanisms provide redistribution and insurance against regional economic shocks.

We also draw attention to the importance of the specific institutional design of fiscal mechanisms. In contrast to previous studies, we analyse the redistributive and stabilizing effects of fiscal mechanisms that react to changes in the economic development with a certain time lag. Our results show that the specific institutional design of a fiscal mechanism can affect its stabilizing properties to a large extent.

The analysis is based on the empirical framework proposed by Mélitz and Zumer (2002),

[2]This has for example been suggested in The Economist (2014) or Vallée (2014).

Table 1: Findings on redistributive and stabilizing effects of fiscal mechanisms in the literature

Paper	**Country**	**Time period**	**Exogenous Variable**	**Effects of fiscal mechanisms**	
				Redistribution	**Stabilization**
USA and Canada					
Sala-i-Martin and Sachs (1991)	USA (9 regions)	1970-1988	income	n.a.	30-50%
Bayoumi and Masson (1995)	USA (8 regions)	1969-1986	income	22%	30%
	Canada (9 provinces)	1965-1988	income	39%	17%
Asdrubali et al. (1996)	USA (50 states)	1963-1990	regional product	n.a.	13%
Mélitz and Zumer (2002)	USA (48 states)	1960-1994	income	16%	17%
	Canada (9 provinces)	1965-1988	income	16%	10%
Balli et al. (2012)	Canada (10 provinces)	1961-2006	regional product	n.a.	27%
Germany					
Buettner (2002)	West-Germany (10 Länder)	1970-1997	income	n.a.	15-25%
Hepp and von Hagen (2011)	West-Germany (10 Länder)	1970-1994	income	37%	47%
	Germany (16 Länder)	1995-2006	income	39%	19%
Hepp and von Hagen (2013)	West-Germany (10 Länder)	1970-1994	regional product	n.a.	54%
	Germany (16 Länder)	1995-2006	regional product	n.a.	11%
Other European countries					
Mélitz and Zumer (2002)	France (21 regions)	1973-1989	income	38%	17%
	England (12 regions)	1971-1993	income	26%	16%
Decressin (2002)	Italy (20 regions)	1983-1992	regional product	25-35%	10-15%
Andersson (2008)	Sweden (21 regions)	1985-2001	regional product	n.a.	20%

Table 2: Summary statistics on selected cantonal characteristics

	Mean	St.dev.	Min.	Max.
Inhabitants in thousands (2015)	320.3	341.0	16.0	1466.4
Cantonal income per capita in TCHF (2015)	59.6	11.8	48.9	98.7
Urban population in % (2015)	74.1	23.5	0.0	98.7
Primary sector workers in % (2013)	4.7	2.9	0.1	12.9
Secondary sector workers in % (2013)	26.6	6.5	13.9	38.4
Tertiary sector workers in % (2013)	68.7	8.4	54.8	85.6
Unemployment ratio in % (2015)	2.8	1.3	0.9	5.6

For more details on the distribution among cantons see figure 2 in the appendix. Data on the number of inhabitants, the share of urban population and the shares of workers by sector are provided by the Federal Statistical Office. Data on cantonal income is provided by BAK Basel and data on the unemployment ratio is provided by the Swiss State Secretariat for Economic Affairs.

who distinguish explicitly between redistributive and stabilizing effects. Thereby we consider the fiscal equalization scheme but also the effects of other federal government transfers, direct federal taxes, the mandatory first pillar pension scheme and the Swiss unemployment insurance. We analyse redistributive and stabilizing properties of these mechanisms with respect to gross cantonal income. The remainder of this paper is structured as follows: in section 2 we describe the institutional setting in Switzerland. Sections 3 and 4 specify the empirical strategy and the data used, along with some descriptive statistics. The results are presented in section 5 and conclusions are drawn in section 6.

2 Institutional setting

Switzerland consists of 26 cantons with a large degree of autonomy that is guaranteed by the Swiss federal constitution.[3] All tasks that are not explicitly assigned to the confederation are within cantonal responsibility, whereby shared responsibilities between the federation and cantons are possible too (Häfelin et al., 2008). A similar rule applies to taxes: cantons are allowed to levy any type of tax that is not exclusively claimed by the federation (Federal Tax Administration, 2014).[4]

Table 2 illustrates differences among Swiss cantons with respect to size and economic structure. It can be seen that cantons differ substantially in the number of inhabitants and per capita income. At the same time, shares of the population living in urban areas vary from zero to almost one hundred and the ratio of the lowest and highest unemployment rate in 2015 was about 1:6. Furthermore, the share of workers employed in the primary sector varies from

[3]Various aspects of Swiss fiscal federalism have already been discussed for example in Feld and Kirchgässner (2001), Feld and Kirchgässner (2002), Feld et al. (2008) and Feld et al. (2010).

[4]Each canton is again partitioned into several municipalities. As municipal tasks and tax competences are determined by the respective cantonal laws, we do not distinguish between these two government levels.

Table 3: Overview on the federal fiscal mechanisms included

	Total transfers in billions of CHF 2014	Share of total income in % 2014
Direct federal taxes	17.7	3.7
Fiscal equalization transfers	3.1	0.7
General federal transfers	14.7	3.1
Unemployment insurance contributions	6.5	1.4
Old age insurance contributions	29.4	6.1

All variables are defined in billions of Swiss francs at the price level prevailing in december 2015 (based on the Swiss national consumer price index). Tax revenues of the direct federal tax scheme include taxes from individuals and companies and exclude source taxes from foreigners. See table 8 in the appendix for data sources.

almost zero to 13%. Accordingly, it seems very likely that cantons are affected differently by economic shocks.

Table 3 lists the fiscal mechanisms that are considered in this analysis. In order to illustrate their relative importance we state the total tax and transfer sum as well as the ratio of this sum to total income. We describe the separate fiscal mechanisms in more detail in the following sections.

2.1 Direct federal taxes

One potential mechanism to stabilize and redistribute cantonal income are direct federal taxes. The direct federal tax scheme includes a progressive income tax for individuals and a proportional profits tax for corporations. In 2011 federal tax revenues amounted to about 37% of total revenues of the federal government (Federal Finance Administration, 2014).

Since the tax receipts are directly linked to the economic state of individuals and firms, lower amounts of taxes are collected in cantons that suffer from an adverse economic shock. There are however potential time lags between gaining income or profits and paying the taxes. Since the year 2003 income of individuals is registered for each year t in all cantons. The tax payment is then due in the following year $t+1$. This system is called one-year *Postnumerando* method. Accordingly, if an individual is hit by a negative economic shock in year t, the tax bill will be reduced only in year $t+1$, but not immediately. Prior to the year 2001, the tax liability was registered in most cantons according to the two-year *Praenumerando* method. Based on this method income is registered only every two years, whereby average income over the preceding two years is accounted for. The tax payments are then due in the tax year and the following year. Regarding profit taxes for companies the change in the system was implemented for all cantons in the year 1995 already.

2.2 Inter-cantonal fiscal equalization

The fiscal equalization scheme among Swiss cantons aims at reducing fiscal disparities and guaranteeing a minimum endowment with financial resources (Federal Finance Administration, 2016). The current system has been introduced in 2008 and contains mainly two elements: it partially equalizes fiscal resources and accounts for special burdens due to geographic and socio-demographic characteristics of cantons.[5] For the equalization of resources the fiscal potential of each canton is calculated based on income and wealth of inhabitants as well as profits of firms. Cantons with a fiscal potential below average receive unconditional grants, which are financed by the federal government and cantons with a fiscal potential above average.[6]

There are two channels for economic shocks to influence these transfers. First of all there is the direct effect that an adverse economic shock is likely to lower individuals' income, wealth and company profits. This reduces a canton's fiscal potential leading to higher benefits or lower contributions. An indirect effect further occurs due to the fact that the total amount of money to be redistributed is determined in advance. Therefore, if one recipient canton suffers from an adverse economic shock resulting in a much lower fiscal potential, other recipient cantons might receive less transfers without having changed their fiscal status in absolute terms. The analogous applies for contributing cantons. The link between income changes and a change in transfers includes some time lags however. In order to grant cantonal governments some stability for budgetary planning, the fiscal resources index is not calculated based on the income and profits earned in the respective year. Instead, fiscal resources are calculated based on a three-year average, starting six years prior to the current year.

The introduction of this new scheme in 2008 was the product of a fundamental reform. Before 2008 a large share of transfers from the federation to the cantons were earmarked and applying to around fifty fields of public activity. Furthermore, cantons contributed to the federal social security system and received non-earmarked transfers from federal tax revenues and central bank profits. Parts of these transfers were calculated using a fiscal strength index based on aggregate cantonal income, fiscal capacity, the tax burden and an index based on the cantons' shares of mountainous area (Fischer et al., 2003). This old scheme included substantial time lags too, since the underlying fiscal strength index was based on values dating back four to six years.

[5] Based on the so-called *Lastenausgleich*, specific geographic and socio-demographic burdens are equalized. These burdens are calculated based on altitude, population density as well as above average population shares of poor, elderly and foreigners not originating from one of the neighbouring states. We do not expect economic shocks to directly impact on these transfers.

[6] The current fiscal equalization scheme is based on the *Bundesgesetz über den Finanz- und Lastenausgleich* of 3 october 2003 which can be found on https://www.admin.ch/opc/de/classified-compilation/20012239/index.html and the *Verordnung über den Finanz- und Lastenausgleich* of 7 november 2007 which can be found on https://www.admin.ch/opc/de/classified-compilation/20071271/index.html.

2.3 Federal government transfers

In addition to explicit fiscal equalization transfers other transfers between the federal level and the cantons or the cantons' inhabitants are in place. This category combines a variety of transfers that are not particularly designed for risk sharing or redistribution, but might nevertheless have such effects.

A first category of transfers are revenue sharing schemes whereby the cantons receive a share of federal revenues. Examples are federal excise duties on alcohol or mineral oil, the federal withholding tax, federal heavy vehicle charges or the military service exemption tax. The base of these revenue streams may to varying degrees be correlated with the general economic situation. In general however, federal revenue streams are less likely to be severely affected by one single canton's economic downturn. In that sense, some risk sharing might be provided through these revenue sharing schemes.[7]

In this category of general transfers we also include compensations and contributions from the federal government. Examples are federal contributions to cantonal health care premium subsidy or supplementary benefit schemes, federal agricultural subsidies as well as federal contributions to road infrastructure (Swiss Federal Finance Administration, 2016). These contributions and compensations may have some risk sharing elements in that they provide income for certain groups of cantonal inhabitants (for example in the case of agricultural subsidies) and means for certain tasks (such as the maintenance of roads) unrelated to the current state of the cantonal economy.

Finally, we also account for the cantonal shares of profits from the Swiss National Bank, of which currently two thirds are distributed to cantons based on their population size.[8] Under the old fiscal equalization scheme three eights of this cantonal profit share were distributed to cantons based on their fiscal strength.[9] These fiscal strength related transfers are accounted for by the explicit fiscal equalization mechanism.

2.4 Federal social security scheme

The federal social security scheme may contribute to the redistribution and stabilization of regional economic shocks too. Directly related to economic shocks is the unemployment in-

[7] Cantons also keep a proportional amount of direct federal tax revenues (currently 17%). This amount directly depends on the economic situation in the respective canton, so that this particular mechanisms is very unlikely to provide any risk-sharing. Under the old fiscal equalization scheme a part of the share on federal tax revenues was distributed to cantons based on their fiscal strength. These cantonal revenues are measured by the fiscal equalization mechanism. Only the amount that is shared based on population size is accounted for in the category of general federal government transfers.

[8] *Bundesgesetz über die Schweizerische Nationalbank* of 3 october 2003, which can be found on https://www.admin.ch/opc/de/classified-compilation/20021117/index.html

[9] *Verordnung über die Verteilung der den Kantonen zufallenden Anteile am Bilanzgewinn der Schweizerischen Nationalbank* of 7 december 1992, which can be found on https://www.admin.ch/opc/de/classified-compilation/19920321/200408010000/951.181.pdf and is no longer into effect

surance scheme, existing in its current form since 1983.[10] Each employed individual is obliged to contribute a proportional amount of his salary to the unemployment insurance. In case of unemployment, individuals receive insurance payments of up to 80% of their pre-unemployment income for a maximum duration of 520 days. The unemployment insurance also provides further assistance, such as active labour market measures (training schemes or work programs) or short-time work allowances. Since contributions depend on earned income and more benefits are paid out in regions with higher unemployment rates, regional economic shocks are expected to be smoothed to some degree by the unemployment insurance.

A second potential channel of risk sharing is the old age insurance. The old age insurance is the so-called first pillar of the Swiss pension system and is effective since 1948.[11] It is a pay-as-you-go insurance scheme and also includes elements of redistribution since individuals with high income pay more than they receive in terms of future pensions. The scheme covers all individuals that either live or work in Switzerland. Contributions are generally a proportional amount of individuals' wages. Eligible for old age pensions are men above 65 and women above 64 years old.[12] Pension payments are calculated based on the average annual income during an individual's work life whereby there are both a lower and upper limit. An adverse economic shock would lead to lower old age insurance contributions in a given region while pensions are not directly affected by the economic downturn. Therefore, we expect the old age insurance to contribute to the smoothing of regional economic shocks.

2.5 Further potential mechanisms for risk sharing and redistribution

There are further public sector mechanisms that could provide risk sharing but are not included in our analysis. Most importantly, a mechanism that we are not able to account for is the federal value added tax. Unfortunately there is no adequate cantonal data on the value added tax in Switzerland. Value added tax revenues could theoretically be linked to a company's tax domicile. In that case however, the tax revenues would only be counted at the head office location of a company and not where the sales have actually occurred.

We further do not account for the second-pillar pension scheme or cantonal debt. For the second-pillar pension scheme no cantonal data exist. Cantonal debt data is generally available. However, both these mechanisms are more closely related to the credit market channel rather than the federal government channel, which is the main focus of this paper.

[10] The unemployment insurance scheme is based on the *Bundesgesetz über die obligatorische Arbeitslosenversicherung und die Insolvenzentschädigung* of 25 june 1982, which can be found on https://www.admin.ch/opc/de/classified-compilation/19820159/index.html

[11] The old age insurance scheme is based on the *Bundesgesetz über die Alters- und Hinterlassenenversicherung* of 20 december 1946, which can be found on https://www.admin.ch/opc/de/classified-compilation/19460217/index.html

[12] The age of pension eligibility has been changed several times for women. In the time range considered in this paper it changed twice: from 62 to 63 years in 2001 and from 63 to 64 years in 2005. We account for these changes when we calculate the number of pensioners per canton.

3 Empirical strategy

Our empirical strategy is based on the econometric approach as proposed by Mélitz and Zumer (2002).[13] The advantage of this approach is that it provides a framework to differentiate between long-run redistribution and short-run stabilization. Furthermore, since the method has been used by several other authors and the links to other specifications (such as in Asdrubali et al. (1996) or Buettner (2002)) are established, we can easily compare our results to previous work.

The baseline equation relates disposable cantonal income after taxes and transfers of canton i in year t, denoted by DY_{it}, to the long-run average of cantonal income (permanent income $\overline{Y_i}$) and the yearly deviations of cantonal income from its long run average (transitory income $\left[Y_{it} - \overline{Y_i}\right]$). The coefficient β_d measures the impact of permanent income on disposable income through redistribution mechanisms. Stabilization mechanisms are expected to drive the impact of transitory income on disposable income. Their effect is measured through coefficient β_s.

$$DY_{it} = \alpha_d + \beta_d \overline{Y_i} + \beta_s \left[Y_{it} - \overline{Y_i}\right] + \varepsilon_{it} \tag{1}$$

$$i = 1, 2, \ldots, C; \qquad t = 1, 2, \ldots, T \qquad \text{with} \quad \overline{Y_i} = \frac{1}{T} \sum_{t=1}^{T} Y_{it}$$

All variables are measured in real per capita terms. Furthermore, in order to be able to abstract from movements in national aggregates, all variables are divided with national per capita values:

$$DY_{it} = \left[\frac{DY_i}{DY_N}\right]_t \qquad \text{and} \qquad Y_{it} = \left[\frac{Y_i}{Y_N}\right]_t$$

For the estimation of the two separate but simultaneous effects Mélitz and Zumer (2002) decompose the baseline equation further as follows:[14]

$$\overline{DY}_i = \alpha_d + \beta_d \overline{Y}_i + \eta_i \tag{2}$$

$$\left[DY_{it} - \overline{DY}_i\right] = \beta_s \left[Y_{it} - \overline{Y}_i\right] + \mu_{it} \tag{3}$$

Equation 2 describes how long-run cantonal disposable income depends on permanent cantonal income. A coefficient value $\beta_d = 0$ implies complete redistribution because a change in

[13] There are basically two main approaches used in the literature. The other approach was proposed by Asdrubali et al. (1996) and has for example been applied in Buettner (2002) or Hepp and von Hagen (2013). This approach does not generally distinguish between stabilization and redistribution effects. Mélitz and Zumer (2002) show that the results do not crucially depend on the choice between one of these two methods.

[14] Equation 2 is obtained by taking the average of the baseline equation over the whole time period. Equation 3 can be obtained by subtracting equation 2 from the baseline equation.

permanent income of a canton does not affect long-run disposable income. A coefficient value $\beta_d = 1$ on the other hand implies that each change in permanent income of a canton is fully mirrored in long-run disposable income, so no redistribution is taking place. The actual degree of redistribution is therefore given by $(1 - \beta_d)$. We estimate equation 2 using pooled ordinary least squares, which corresponds to the between estimator in ordinary panel data analysis.[15]

Equation 3 describes how transitory disposable income varies with transitory income. A coefficient value $\beta_s = 0$ implies complete stabilization, since in that case a deviation of short-run income from its long-run mean does not affect short-run disposable income. A coefficient value $\beta_s = 1$ implies that each change in transitory income of a canton is fully mirrored in short-run disposable income, so no stabilization is taking place. The actual degree of stabilization is therefore again given by $(1 - \beta_s)$. We also estimate equation 3 using pooled ordinary least squares. This procedure then corresponds to the fixed effects estimator in ordinary panel data analysis. The fixed effects estimator relies on *strict exogeneity* as the key identifying assumption. Strict exogeneity demands that the error term μ_{it} is uncorrelated with the explanatory variables Y_{it} across all time periods:

$$E\left[\mu_{it}|Y_{i1}, ..., Y_{iT}\right] = 0 \qquad \text{for all} \qquad t = 1, ..., T$$

The strict exogeneity assumption therefore rules out any feedback or lagged effects. Ruling out lagged effects is very implausible in our setting, where especially for the two mechanisms of direct federal taxes and the fiscal equalization scheme, time lags between earning income and paying taxes or receiving transfers exist by construction. A somewhat weaker exogeneity assumption is required by the first differences estimator. The estimation equation and the identifying exogeneity assumption can be stated as follows:

$$\Delta DY_{it} = \alpha_s + \beta_s \Delta Y_{it} + u_{it} \tag{4}$$

$$E\left[\mu_{it} - \mu_{it-1}|Y_{it} - Y_{it-1}\right] = 0$$

Furthermore, as a last step we explicitly estimate the lagged influences in order to directly control for these lags and to be able to explicitly analyse the time pattern of the contributions of the separate mechanisms to risk sharing:

$$\left[DY_{it} - \overline{DY}_i\right] = \sum_{j=0}^{L} \beta_{s,t-j} \left[Y_{it-j} - \overline{Y}_i\right] + \mu_{it} \tag{5}$$

One potential threat to the consistency of our results are feedback effects from the fiscal mechanisms considered on cantonal income. As an example it could be possible that receiver cantons in the fiscal equalization scheme might use these transfers to lower the tax burden

[15] See for example Cameron and Trivedi (2010) for an extensive discussion on panel data analysis.

in their canton or build productive infrastructure, thereby attracting new companies and inhabitants which in turn may affect income levels in these cantons. While this is a plausible example, we think that such feedback effects would occur with some considerable time lag only. Therefore, the results of the first-difference estimation method would not be affected.

When estimating the stabilization effects based on equation 3 or 4, it seems plausible that the error terms μ_{it} are correlated both over time for each canton and contemporaneously across cantons. We therefore estimate our standard errors based on the method proposed by Driscoll and Kraay (1998), that are robust to both types of correlations.[16]

4 Data and descriptives

The key explanatory variable is gross cantonal income. It captures all income earned by individuals and companies of a canton in a given year. This income is not only the base for private consumption but also for cantonal (and municipal) taxes and therefore public consumption. The data on gross cantonal income (*Volkseinkommen*) has been provided by the private economic research and consultancy company *BAK Basel Economics AG* and is available from 1980 to 2015. Overall disposable cantonal income is calculated through the following steps:

	Cantonal income, Y
$-$	Federal taxes by individuals and companies
$+$	Net transfers from the federal fiscal equalization scheme
$+$	Net federal transfers in general
$-$	Social security contributions (unemployment and old age insurance)
$+$	Social security transfers to individuals
$=$	**Disposable cantonal income**, DY

In order to be able to analyse not only the overall redistribution and stabilization effects, but also the separate effects of the respective mechanisms, we further define the following five disposable income variables:

$$
\begin{aligned}
DY_{Tax} &= Y - \textit{federal taxes} \\
DY_{Equal} &= Y + \textit{net fiscal equalization transfers} \\
DY_{Transfers} &= Y + \textit{net general federal transfers} \\
DY_{Old-age} &= Y - \textit{old-age insurance contributions} + \textit{old-age insurance benefits} \\
DY_{Unemployment} &= Y - \textit{unempl. insurance contributions} + \textit{unempl. insurance benefits}
\end{aligned}
$$

[16] For the implementation in Stata we follow Hoechle (2007).

The Federal Finance Administration provides cantonal data on direct federal taxes paid to the central government and both general transfers and fiscal equalization transfers. Data on the Swiss social security scheme is not generally available on a cantonal level but only aggregated to the whole of Switzerland. Therefore, we need to approximate cantonal social security benefits and contributions.

As a baseline approach, we approximate social security contributions (unemployment insurance and old age insurance) by total contributions to the respective social security scheme, multiplied with the respective shares of cantonal income. This approximation is not entirely accurate since cantonal income includes not only labour income but also company profits. If these company profits are more volatile than labour income, the risk sharing effects of social security contributions will be overstated. An alternative approximation could be to multiply total social security contributions with income shares based on the data from the direct federal taxes. The problem here is that for the earlier years federal tax income data is only available as two-year averages. Accordingly, the approximated social security contributions are already smoothed and the stabilizing effect understated. Due to the lack of better data, we use the approximation based on cantonal income data as a baseline, being aware that the resulting stabilization effects may constitute an upper bound estimate. In the robustness checks in section 5.3 we also display the results using the approximation based on tax data, constituting a lower bound estimate.

Contributions to the unemployment insurance include some non-proportionality since income above a certain threshold (for example CHF 148'201 as of 2016) is either not taken into account or - in some years - taken into account at a lower rate when calculating the contributions.[17] Not accounting for this non-proportionality would be a problem mainly if incomes above the threshold behaved very differently across cantons over time. It is our impression that this is not generally the case as can be seen in figure 3 in the appendix. Therefore we abstract from this non-proportionality in our results.

Unemployment insurance transfers are approximated by the total unemployment insurance transfers multiplied with the respective cantonal shares in the number of unemployed for each year. There exists a dataset on the actual unemployment benefits paid to inhabitants of the respective cantons, but only for the years between 2004 and 2014. As a plausibility test for our approximation of the benefits paid out, we compare the approximated transfers (which contain not only the actual unemployment benefits to individuals but also for example active labour market measures) to the actual unemployment benefits paid out. In figure 4 in the appendix we show that as it was to be expected, the approximated transfers are generally higher than the actual unemployment benefits distributed. At the same time, the approximated transfers mirror the dynamics over time of the actual unemployment benefits convincingly.

Old age insurance transfers are approximated based on the total amount of old age insurance

[17] The development of the income range and the contributions applicable over time are summarized in table 9 in the appendix. Contributions to the old age insurance are fully proportional to labour income and have not been adjusted in the period considered.

transfers paid out in Switzerland multiplied with the cantonal shares of pension age inhabitants on the total number of pension age inhabitants in Switzerland.[18] There is a dataset available on old age insurance transfers paid in December each year by canton, but unfortunately only for the years 2001 to 2014. Therefore, in order to check the plausibility of our approximation, we compared the cantonal shares of pensioners to the share of actual rents paid to the inhabitants of each canton. As can be seen in figure 5 in the appendix, no major differences between the two measures can be observed.

All financial data is converted into per capita values at the price level prevailing in December 2015 (based on the national consumer price index). A table with an overview on the variables used and their sources can be found in table 8 in the appendix. In the following analysis we limit ourselves to the time period from 1993 to 2014, since only for this time period all variables are available. Table 4 provides some descriptive statistics of the key variables used. The average real cantonal income per capita amounts to about 56'800 Swiss francs. Disposable cantonal income per capita is on average somewhat higher with about 57'600 Swiss francs. Regarding social security contributions and benefits it is apparent that old-age insurance contributions and benefits are substantially higher in total than unemployment contributions and benefits.

Figure 1 shows the development of real cantonal income per capita over time. It is clearly visible that there are some outliers (red dots). In the time period considered here these outliers all belong to the canton of Zug. As a robustness check of our results in section 5.3, we therefore analyse whether the inclusion of the canton of Zug is important for our findings.

5 Results

5.1 Baseline results

The baseline results are summarized in table 5. Thereby we directly display the redistributive and stabilizing effects of the respective mechanisms $(1-\beta)$ and the corresponding p-values indicating whether the regression coefficients are statistically significantly different from 1 ($H_0: \beta = 1$). Coefficients equal to 1 would imply no redistribution or stabilization at all. The separate β-coefficients and corresponding standard errors are displayed in tables 10 and 11 in the appendix. Each row of table 5 stands for a separate regression with the respective disposable cantonal income after the specific fiscal mechanism as the dependent variable. In the last row we display the cumulative effect of the considered fiscal mechanisms. The first column shows the redistributive effects based on equation 2. The other columns estimate different models of the stabilization effect. Column (2) estimates the fixed effects model of equation 3, column (3) the first differences model of equation 4. Columns (4) and (5) display the results of the distributed

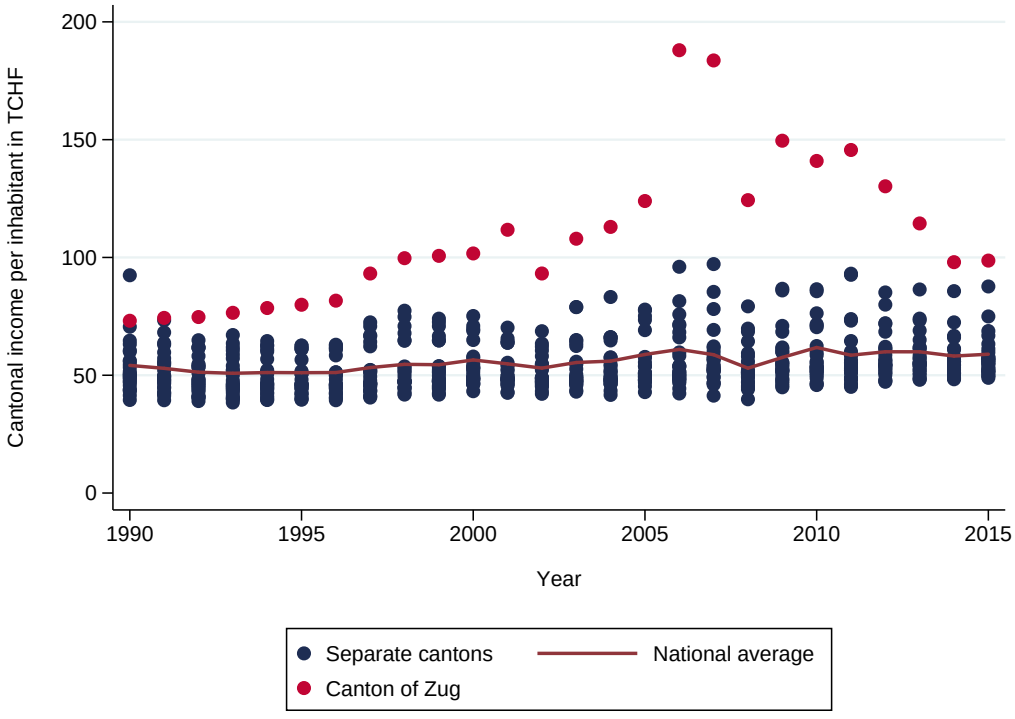
[18] Before multiplying the sum of all transfers with the respective cantonal shares of inhabitants above pension age, we subtracted the share of total transfers that are paid to insured individuals living abroad. Since data on the total transfers going abroad are available after the year 1998 only, we approximated the respective shares for the earlier years by linear extrapolation.

Table 4: Descriptive Statistics (1993-2014)

	Obs.	Mean	Stdev	Min	Max
Cantonal Income	540	56788	16834	38424	187958
Revenues income taxes	540	955	527	387	5023
Revenues profits taxes	540	969	1378	94	10085
Fiscal equalization transfers	540	418	825	-2300	2383
Federal transfers	540	1896	649	106	4669
Old-age insurance contributions	540	3241	973	2171	10416
Unemployment insurance contributions	540	726	232	396	1871
Old-age insurance transfers	540	3774	481	2662	5071
Unemployment insurance transfers	540	595	305	55	1655
Disposable Cantonal Income	540	57580	13929	40678	171526

All variables are defined in Swiss francs per inhabitant at the price level prevailing in december 2015 (based on the Swiss national consumer price index). The 540 observations are based on observing 26 cantons between 1993 and 2014. Thereby data is missing for all cantons in the year 1996 as well as for three cantons in 2002 and 2003 due to the change in the federal tax scheme from the two-year *praenumerando* to one-year *postnumerando*-method (see section 2.1).

Figure 1: Real cantonal income over time



lags model in equation 5, whereby column (4) displays the immediate effect $(1 - \beta_{t-0})$ and column (5) shows the aggregate effect over the six lags considered: $(1 - \sum_{j=0}^{6} \beta_{t-j})$. The choice of six lags in the distributed lags model is motivated by the time lag of six years in the fiscal equalization scheme.

The overall redistributive effect amounts to more than 20% and is statistically significantly different from zero. This means that if cantonal income lies 1 Swiss franc below the Swiss national average income, disposable income of that canton is only about 80 cents lower than the national average of disposable income. About 20% of the initial income difference of 1 Swiss franc is therefore redistributed through the fiscal mechanisms we considered. The largest contributors to this redistribution effect seem to be the federal tax scheme and the old age insurance scheme with about eight percentage points and seven percentage points respectively. The fiscal equalization scheme redistributes almost five percentage points of long run cantonal income deviations from national long run income. The estimated coefficients are statistically significantly different from 1 at the 1%-significance level. The redistributive effects of the unemployment insurance and the general transfers are estimated to be about one percentage point each. The effect of the general transfers is however not statistically significant at the 5%-significance level.

Regarding the stabilizing effects of the various fiscal mechanisms it can be seen that the estimated stabilizing properties of the unemployment insurance, the old age insurance and the ordinary federal transfers remain robust to the different estimation specifications. There also seem to be no major lagged effects since the aggregate effect and the immediate effect in the distributed lag model are basically identical. The largest contributor among these three mechanisms is the old age insurance scheme with about six percentage points, followed by general federal transfers with an immediate redistributive effect of two to three percentage points. The unemployment insurance scheme stabilizes about one percentage point of cantonal income fluctuations.

The coefficient relating to the federal tax scheme is not statistically significantly different from 1 in the fixed effects specification and is even statistically significantly negative in the first difference and the distributed lag model specification. Since income changes from one year to the next affect the tax load with a delay of one year, a destabilizing effect seems plausible. In the case of the federal fiscal equalization scheme the estimated effect is not robust to the particular estimation model either, potentially due to the time lags involved. The results of the first differences and the distributed lag model imply an immediate stabilizing effect of less than one percentage point, whereby the immediate effect is not statistically significant at conventional significance levels neither in the first differences model nor in the distributed lag model.

Fiscal equalization transfers seem to provide some stabilization of about tree percentage points over a time horizon of up to six years. Thereby several time lags contribute in a statistically significant way (see table 11 in the appendix). It is however questionable how useful an effect with a time lag of up to six years actually is for risk sharing. Therefore we would conclude

from our baseline results that the overall immediate stabilization effect of fiscal mechanisms with respect to short-run deviations of cantonal income from their long-run average amounts to below 10%. Therefore, a short run reduction in cantonal income of 1 Swiss francs leads to a short run reduction in disposable cantonal income of more than 90 cents.

5.2 Changes in the institutional setting

Two of the fiscal mechanisms considered in this analysis experienced some major changes in their institutional set up. The fiscal equalization scheme was fundamentally reformed in 2008 and the federal tax scheme changed in terms of how income is assessed from a two-year praenumerando to a one year postnumerando scheme in 1996 for companies and around 2000 for individuals. In order to analyse to what extent changes in the institutional features of fiscal mechanisms affect their redistributive and stabilizing properties, we re-estimate the first differences model of equation 4 separately for the respective time spans before and after the respective reforms. The reason why we focus on the first differences model only is that there are not enough observations in each time span to estimate the distributed lag model with six lags as in the baseline results. Furthermore, as we have already seen, the fixed effects model is unlikely to provide consistent estimates due to the time lags involved.

Table 6 displays the comparison of the separate estimates by time period for the fiscal equalization channel (upper panel) and the direct federal taxes (lower panel). Regarding fiscal equalization, both the redistributive and stabilizing effects are very similar under both schemes. In terms of the old and new income assessment scheme for direct federal taxes we can again see in column one and two that the redistributive properties of the federal tax mechanism were not affected by the income assessment change. In terms of the stabilization effects however, the coefficients differ. The estimated stabilization effect under the two-year praenumerando scheme is zero and not statistically significant. In contrast, the stabilization effect of the new scheme is negative at about 4% and the β-coefficient statistically significantly different from 1 at the 5%-significance level. The difference between the coefficients is however not statistically significantly different from zero, which might be due to the comparatively low number of observations.

5.3 Robustness

As could be seen in figure 1, the canton of Zug is a clear outlier regarding per capita cantonal income. In order to analyse the robustness of our results regarding this outlier, we repeated the above estimations without the canton of Zug as a robustness check. The results are summarized in table 13 in the appendix. Excluding the canton of Zug from the analysis does not change our results in a significant way.

In order to analyse the robustness of our results to the approximation of social security contributions and benefits (see discussion in section 4), we re-estimate our results using an

Table 5: Baseline results

	(1)	(2)	(3)	(4)	(5)
	Redistribution	**Stabilization**			
Cantonal disposable income after...		Fixed Effects	First Differences	Distributed Lag Model	
				Immediate Effect	Aggregate Effect
	$(1-\beta)$	$(1-\beta)$	$(1-\beta)$	$(1-\beta)$	$(1-\sum\beta)$
...federal taxes	0.078***	0.004	-0.037*	-0.034**	0.022
	(0.000)	(0.614)	(0.010)	(0.003)	(0.204)
...fiscal equalization	0.047***	0.011**	0.003	0.003	0.034***
	(0.000)	(0.009)	(0.119)	(0.102)	(0.000)
...federal transfers	0.013	0.026***	0.024***	0.022***	0.026***
	(0.074)	(0.000)	(0.000)	(0.000)	(0.000)
...unempl. insurance	0.011*	0.010***	0.011***	0.010***	0.009***
	(0.021)	(0.000)	(0.000)	(0.000)	(0.000)
...old-age insurance	0.072***	0.061***	0.062***	0.059***	0.060***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Overall	0.216***	0.112***	0.064***	0.060***	0.150***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	540	540	485	291	291
Time period	1993-2014	1993-2014	1993-2014	1993-2014	1993-2014
	Eq. 1	*Eq. 2*	*Eq. 3*	*Eq. 4*	*Eq. 4*

Stars indicate significance levels: * p < 0.05, ** p < 0.01, *** p < 0.001. The OLS-estimations are based on the following equations:

$$(1) \quad \overline{DY}_i = \alpha_d + \beta_d \overline{Y}_i + \nu_i$$

$$(2) \quad \left[DY_{it} - \overline{DY}_i\right] = \beta_s \left[Y_{it} - \overline{Y}_i\right] + \mu_{it}$$

$$(3) \quad \Delta DY_{it} = \alpha_s + \beta_s \Delta Y_{it} + u_{it}$$

$$(4) \quad \left[DY_{it} - \overline{DY}_i\right] = \sum_{j=0}^{6} \beta_{s,t-j} \left[Y_{it-j} - \overline{Y}_i\right] + \eta_{it}$$

The coefficients $(1-\beta)$ measure the separate redistributive / stabilizing effects of the respective mechanisms. The p-values in parentheses relate to the null hypothesis $H_0 : \beta = 1$. It indicates whether the regression coefficients are statistically significantly different from 1. If the coefficient is equal to 1 this would imply no redistribution / stabilization. The p-values for equation 1 are based on heteroskedasticity-robust standard errors. The p-values for equations 2 to 4 are based on standard errors that are robust to temporal and spatial correlations as well as heteroskedasticity (Driscoll-Kraay standard errors). The β-coefficients and the corresponding standard errors are displayed in tables 10 and 11 in the appendix. The choice of six lags in the distributed lag model is motivated by the time lag of six years inherent in the fiscal equalization scheme.

Table 6: Changes in the institutional setting

Systems change in fiscal equalization

	(1)	(2)	(3)	(4)
Cantonal disposable income after...	**Redistribution** *(Eq.1)* **old scheme** $(1-\beta)$	**new scheme** $(1-\beta)$	**Stabilization** *(Eq.3)* **old scheme** $(1-\beta)$	**new scheme** $(1-\beta)$
... fiscal equalization	0.043**	0.053***	0.006***	0.004***
	(0.002)	(0.000)	(0.000)	(0.001)
Observations	358	182	303	156
Time period	1993-2007	2008-2014	1993-2007	2008-2014

Systems change in federal tax scheme

	(1)	(2)	(3)	(4)
Cantonal disposable income after...	**Redistribution** *(Eq.1)* **old scheme** $(1-\beta)$	**new scheme** $(1-\beta)$	**Stabilization** *(Eq.3)* **old scheme** $(1-\beta)$	**new scheme** $(1-\beta)$
... federal taxes	0.081***	0.074***	0.000	-0.039*
	(0.000)	(0.000)	(0.993)	(0.011)
Observations	200	340	148	314
Time period	1993-2002*	2003*-2014	1993-2002*	2003*-2014

* Not all cantons changed their tax scheme in the same year.

Stars indicate significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The OLS-estimations are based on the following equations:

$$(1) \qquad \overline{DY}_i = \alpha_d + \beta_d \overline{Y}_i + \nu_i$$

$$(3) \qquad \Delta DY_{it} = \alpha_s + \beta_s \Delta Y_{it} + u_{it}$$

The coefficients $(1-\beta)$ measure the separate redistributive / stabilizing effects of the respective mechanisms. The p-values in parentheses relate to the null hypothesis $H_0 : \beta = 1$. It indicates whether the regression coefficients are statistically significantly different from 1. If the coefficient is equal to 1 this would imply no redistribution / stabilization. The p-values for equation 1 are based on heteroskedasticity-robust standard errors. The p-values for equation 3 are based on standard errors that are robust to temporal and spatial correlations as well as heteroskedasticity (Driscoll-Kraay standard errors). The β-coefficients and the corresponding standard errors are displayed in table 12 in the appendix.

alternative approximation based on income shares from the direct federal tax statistics. As we already discussed in section 4 we estimate this specification to provide a lower bound to our estimates. Table 7 displays the respective results based on this alternative data approximation. Since income data from the statistics on direct federal taxes is currently only available until 2013, the results could only be estimated for the period of 1993 until 2013, which leads to minor changes also for the mechanisms unaffected of this change in data approximation. The estimated redistributive effect of the old age insurance drops from around 7% in our baseline specification to almost 5%. In terms of redistribution this estimate might actually be more convincing than the baseline specification since redistribution through the old age insurance only includes labour income, while in the baseline specification company profits are included in the approximation too. Even with this drop in the size of the effect, the redistributive effect of the old age insurance remains sizeable compared to other fiscal mechanisms such as federal transfers or the unemployment insurance.

In terms of stabilization the estimated effects of the two social security mechanisms are reduced to a large extent. The change for the old age insurance is from about 6% in the baseline results of table 5 to 1-2%. The coefficients remain still statistically significantly different from 1 at the 1% significance level and they remain robust across different estimation specifications. The latter is not surprising since at least for the contribution side the link between payments and income is instantaneous. Since the income shares based on direct federal tax data are artificially smoothed for the early years these estimates can be expected to constitute a lower bound for the stabilizing effects of these two social security mechanisms.

We further analysed whether our results are robust to the transformation of all variables into logarithms. Since authors following the approach by Asdrubali et al. generally use log-transformations, we want to make sure that our results do not depend on this choice.[19] As can be seen in table 14 in the appendix, the results are indeed robust to this change in functional form.

6 Conclusion

In this paper we analyse the role of fiscal mechanisms for interregional redistribution and stabilization in Switzerland. Swiss regional governments enjoy substantial autonomy regarding both their expenditures and taxation. At the same time substantial fiscal transfers between the federation and the regional governments are in place in order to partially equalize fiscal

[19] Buettner (2002) for example specifies the regression equation in his analysis as follows:

$$\Delta log Y_{i,t} - \Delta log \tilde{Y}_{i,t} = \alpha_t + \beta \Delta log Y_{i,t} + u_{i,t}$$

with $Y_{i,t}$ being cantonal income and $\tilde{Y}_{i,t}$ being disposable cantonal income. This regression formulation can be rewritten as:

$$\Delta log \tilde{Y}_{i,t} = -\alpha_t + (1-\beta) \Delta log Y_{i,t} - u_{i,t}$$

This makes clear that Buettner's specification is equivalent to our results in column (3) of table 14.

Table 7: Baseline results (data approximation based on tax data)

	(1)	(2)	(3)	(4)	(5)
	Redistribution	**Stabilization**			
Cantonal disposable income after...		Fixed Effects	First Differences	Distributed Lag Model Immediate Effect	Distributed Lag Model Aggregate Effect
	$(1-\beta)$	$(1-\beta)$	$(1-\beta)$	$(1-\beta)$	$(1-\sum\beta)$
...federal taxes	0.075***	0.007	-0.037*	-0.026**	0.032*
	(0.000)	(0.216)	(0.012)	(0.009)	(0.018)
...fiscal equalization	0.045**	0.012**	0.003	0.005**	0.035***
	(0.004)	(0.005)	(0.130)	(0.002)	(0.000)
...federal transfers	0.012	0.027***	0.024***	0.022***	0.027***
	(0.097)	(0.000)	(0.000)	(0.000)	(0.000)
...unempl. insurance	0.005	0.002	0.001	0.001	0.003*
	(0.366)	(0.091)	(0.362)	(0.337)	(0.044)
...old-age insurance	0.046***	0.017***	0.012**	0.013***	0.028***
	(0.000)	(0.001)	(0.010)	(0.000)	(0.000)
Overall	0.180***	0.065***	0.005	0.016	0.125***
	(0.000)	(0.000)	(0.751)	(0.076)	(0.000)
Observations	514	514	459	265	265
Time period	1993-2013	1993-2013	1993-2013	1993-2013	1993-2013
	Eq. 1	*Eq. 2*	*Eq. 3*	*Eq. 4*	*Eq. 4*

Stars indicate significance levels: * p < 0.05, ** p < 0.01, *** p < 0.001. The OLS-estimations are based on the following equations:

$$(1) \quad \overline{DY}_i = \alpha_d + \beta_d \overline{Y}_i + \nu_i$$

$$(2) \quad \left[DY_{it} - \overline{DY}_i\right] = \beta_s \left[Y_{it} - \overline{Y}_i\right] + \mu_{it}$$

$$(3) \quad \Delta DY_{it} = \alpha_s + \beta_s \Delta Y_{it} + u_{it}$$

$$(4) \quad \left[DY_{it} - \overline{DY}_i\right] = \sum_{j=0}^{6} \beta_{s,t-j} \left[Y_{it-j} - \overline{Y}_i\right] + \eta_{it}$$

The coefficients $(1-\beta)$ measure the separate redistributive / stabilizing effects of the respective mechanisms. The p-values in parentheses relate to the null hypothesis $H_0 : \beta = 1$. It indicates whether the regression coefficients are statistically significantly different from 1. If the coefficient is equal to 1 this would imply no redistribution / stabilization. The p-values for equation 1 are based on heteroskedasticity-robust standard errors. The p-values for equations 2 to 4 are based on standard errors that are robust to temporal and spatial correlations as well as heteroskedasticity (Driscoll-Kraay standard errors).

resources. Therefore, we add to the existing body of literature the analysis of a setting where substantial fiscal autonomy of regions is combined with explicit fiscal transfers.

Our analysis is based on the empirical framework proposed by Mélitz and Zumer (2002), allowing for an explicit distinction between redistribution and stabilization. Furthermore, since these methods have already been used by other authors we can compare our results with previous findings for other countries and institutional settings. Our analysis shows that the combined redistributive effect of federal taxes and transfers amounts to up to 20%. The size of this effect is similar to what has been found in previous research for example for the United States, Canada or the United Kingdom. A long-run change in gross cantonal income of 1 Swiss franc therefore leads to a redistribution of up to 20 cents, such that long-run disposable income only changes by about 80 cents. The largest redistributive effect can be attributed to direct federal taxes with about eight percentage points, followed by the old age insurance and the fiscal equalization scheme, each contributing about four to five percentage points.

Stabilization effects of fiscal mechanisms to gross cantonal income are however comparatively low with at most 10%. In our baseline results, the largest stabilization effect stems from the old age insurance (six percentage points), followed by general federal transfers (two to three percentage points) and the unemployment insurance (one percentage point). The estimated stabilization effect of these three mechanisms is robust with respect to the exclusion of outliers and variations in the estimation method or the functional form. The results for the old age and the unemployment insurance do however vary with the specific data approximation method. A lower bound estimate for the old age insurance scheme would be a stabilization effect of about one to two percentage points. The estimated immediate stabilization effect of the fiscal equalization scheme is low and the immediate stabilizing properties of direct federal taxes is either negative or statistically insignificant, depending on the estimated model.

These results regarding fiscal equalization and federal taxes are somewhat surprising given previous research. The reason for the lacking immediate stabilization properties is very likely to be found in the specific institutional features of these two mechanisms. Both include time lags in the reaction of taxes and transfers to changes in gross cantonal income. If we focus on the aggregated lagged effects, the reaction of fiscal mechanisms to cantonal income changes are considerably higher with about 13% to 15%. Our results therefore show the importance of the specific institutional features of fiscal mechanisms. It is not only relevant whether or not fiscal mechanisms are in place, but also how these mechanisms are designed and what they have been intended for.

Comparatively low stabilizing effects of fiscal mechanisms need not necessarily be problematic, since fiscal mechanisms are only one set of potential stabilizing mechanisms. Given that Switzerland is a comparatively small country, capital markets might be much more integrated such that they already stabilize a large share of regional productivity shocks. This would imply that large stabilizing properties of fiscal mechanisms are not necessary in the first place. Normative statements regarding the stabilizing properties of fiscal mechanisms are therefore not possible without a further analysis of stabilizing properties of other potential channels.

7 Appendix

Figure 2: Overview on selected cantonal characteristics

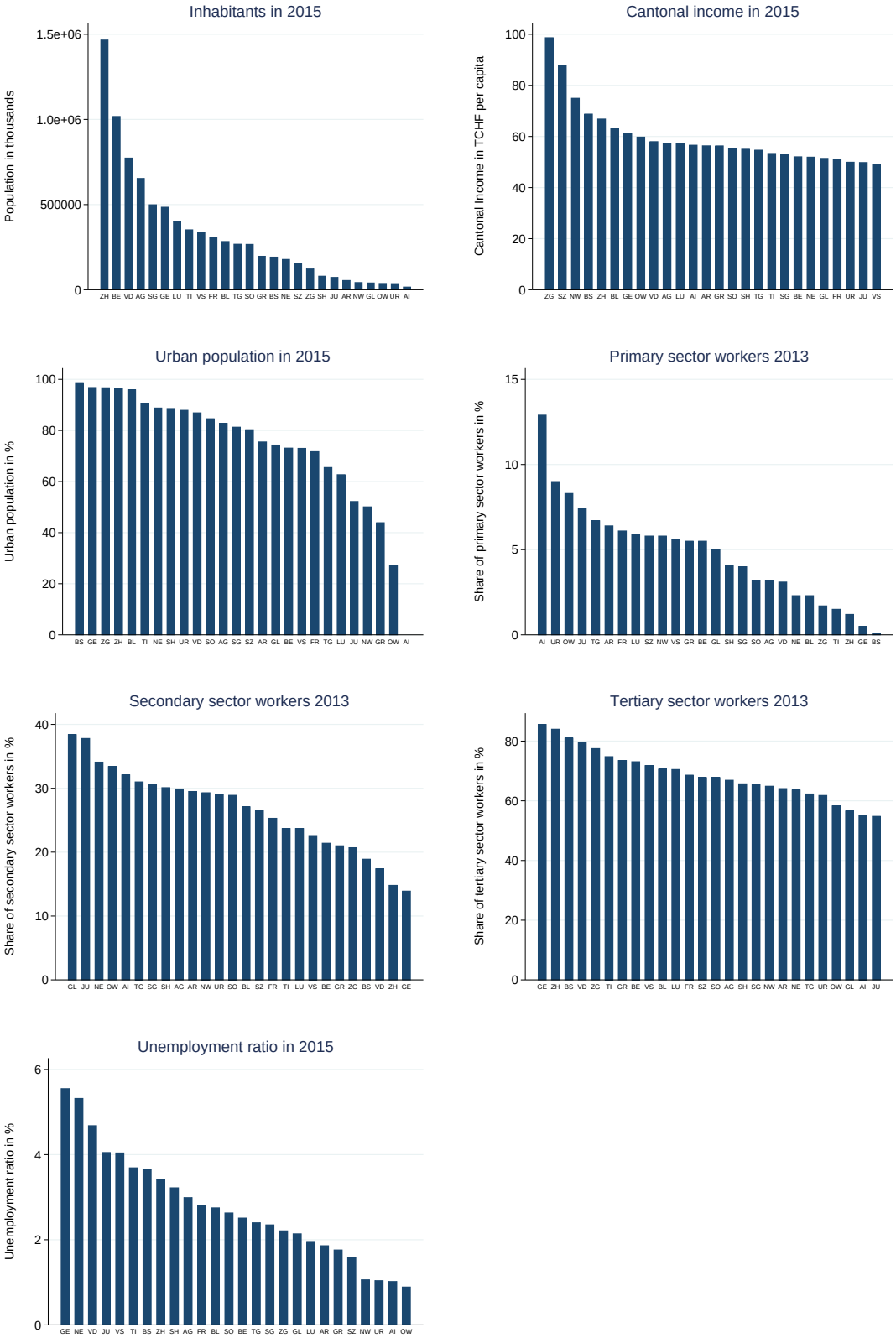


Table 8: Data Sources

Variable	**Source**	**Description**
Cantonal income	BAK Basel	1980-2015. Since the data provided by BAK Basel (*kantonale Volkseinkommen*) already contains contributions to and transfers from the national social security scheme, social security transfers (from old-age and unemployment insurance) are subtracted and contributions to old-age and unemployment insurance are added.
Direct federal taxes	FTA	Tax revenues by canton from federal income taxes and federal company taxes in the respective due year. Source taxes from foreigners are excluded. 1973-2013. Change in tax system from two-year praenumerando-scheme to one-year postnumerando-scheme. The change occurred in 1995 for company taxes in all cantons (consequently the data are missing for the year 1996). The change occurred between 1999 and 2003 for income taxes, so that data is missing at different points in time between 1999 and 2003 for different cantons. In order to be able to divide the variables with national values for all years, the total tax revenues for the whole of Switzerland have been interpolated linearly for the years between 1999 and 2003.
Old-age insurance contributions	FSO, BAK Basel	Own calculations: Total of old-age insurance contributions $*$ cantonal income shares. 1980-2014
Old-age insurance benefits	FSO	Own calculations: Total of old-age insurance benefits $*$ cantonal shares of inhabitants above pension age $= \frac{\text{pensioners in canton i}}{\text{pensioners in CH}}$. 1980-2014
Unemployment insurance contributions	FSO, BAK Basel	Own calculations: Total of unemployment insurance contributions $*$ cantonal income shares. 1980-2014
Unemployment insurance benefits	FSO, SECO	Own calculations: Total of unemployment insurance benefits $*$ cantonal shares of unemployed. 1973-2014
Fiscal equalization transfers	FFA	1993-2016. Systems change in 2008.
General federal transfers	FFA	1990-2014. Included in this category are shared federal revenues, compensations and contributions from the federal level as well as cantonal shares of profits from the Swiss National Bank. Up to 2007 some of these general transfers were allocated based on cantons' fiscal strength. In that case these transfers are accounted for in the category of *fiscal equalization transfers*.

All variables are measured on the cantonal level. Monetary variables are deflated to the price level prevailing in december 2015, based on the Swiss national consumer price index. Abbreviations: BAK Basel = BAK Basel Economics AG; FSO = Federal Statistical Office; FFA = Federal Finance Administration; FTA = Federal Tax Administration; SECO = State Secretariat for Economic Affairs

Table 9: Changes in social security contributions over time

Year	Contribution rates*	Upper income bound	Additional contributions
Unemployment insurance			
until 1983	below 1%	CHF 46'800.-	none
since 1983	below 1%	CHF 69'600.–	none
since 1987	below 1%	CHF 81'600.–	none
since 1991	below 1%	CHF 97'200.–	none
since 1993	2%	CHF 97'200.–	none
since 1995	3%	CHF 97'200.–	none
since 1996	3%	CHF 97'200.–	1% up to CHF 243 000.–
since 2000	3%	CHF 106'800.–	2% up to CHF 267 000.–
since 2003	2.5%	CHF 106'800.–	1% up to CHF 267 000.–
since 2004	2%	CHF 106'800.–	none
since 2008	2%	CHF 126'000.–	none
since 2011	2.2%	CHF 126'000.–	1% up to CHF 315 000.–
since 2014	2.2%	CHF 126'000.–	1% above
since 2016	2.2%	CHF 148'200.–	1% above
Old-age insurance			
since before 1980	8.4%	none	none

Source: Federal Social Insurance Office (2017)
* Contribution rates for labour income of employed individuals (different rates apply for example for self-employed).

Figure 3: Share of income above the upper limit of the unemployment insurance scheme

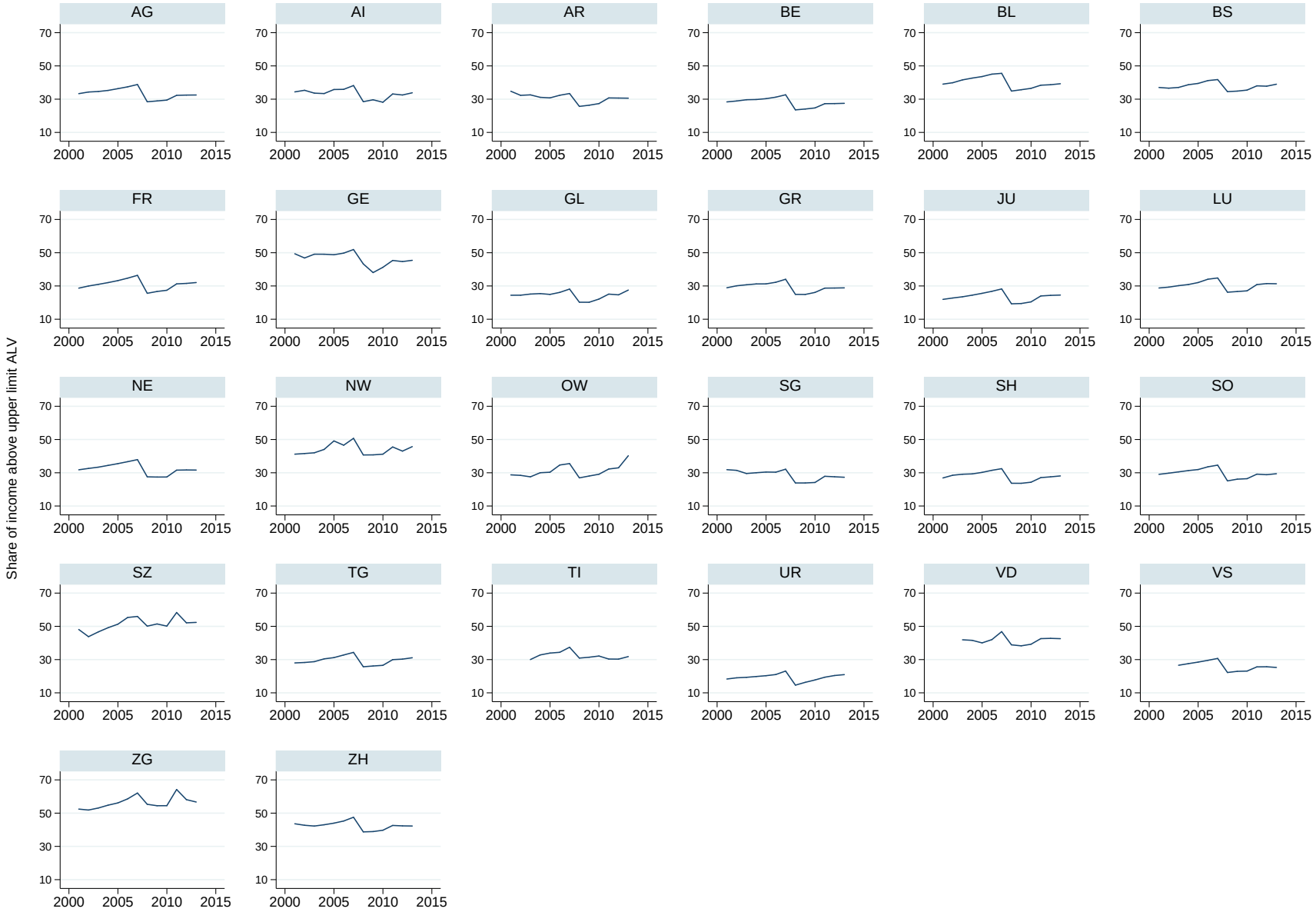


Figure 4: Unemployment insurance transfers approximated based on shares of uneployed vs. actual benefit payments

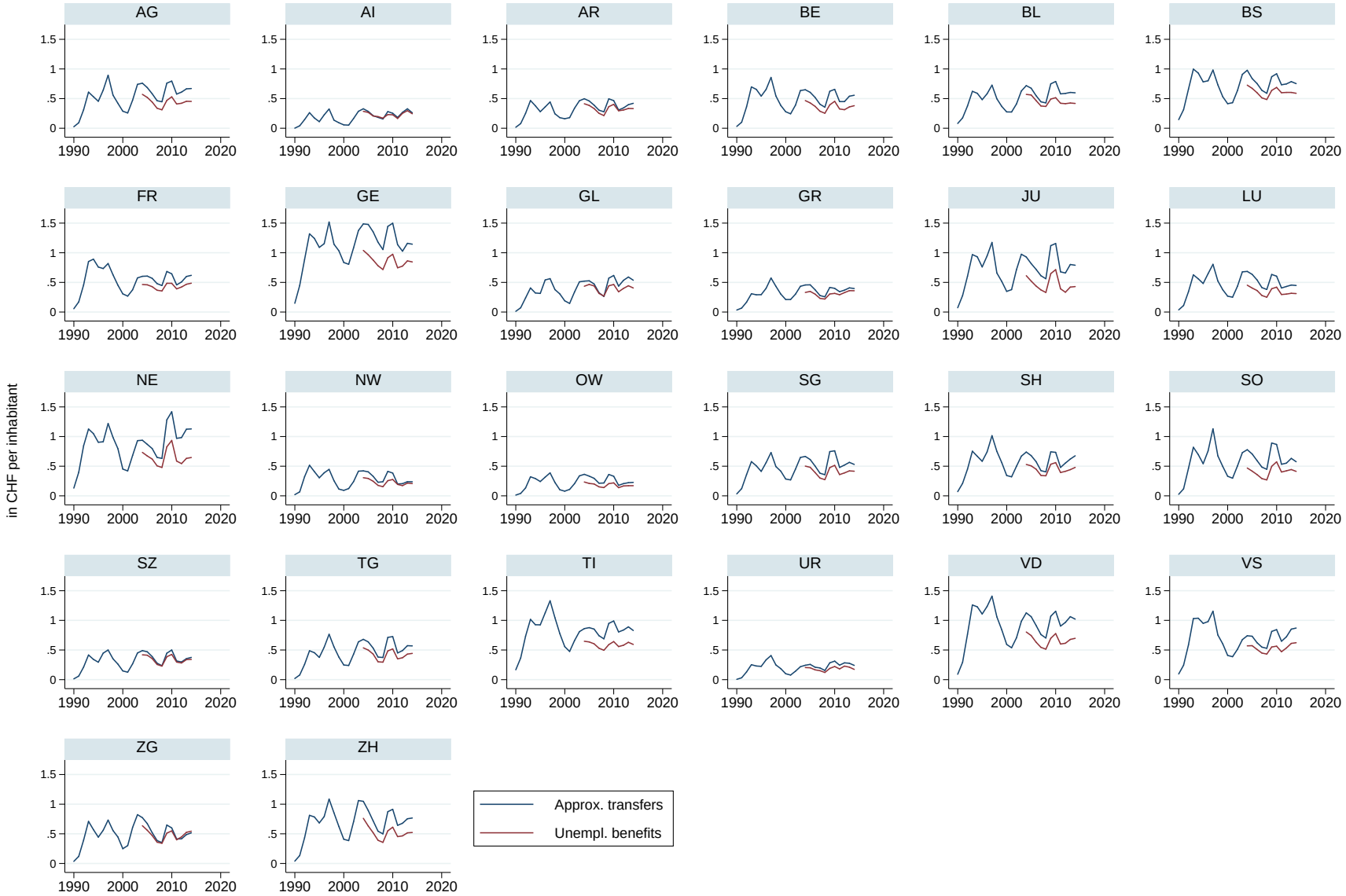


Figure 5: Cantonal shares of pensioners / cantonal shares of rent payments

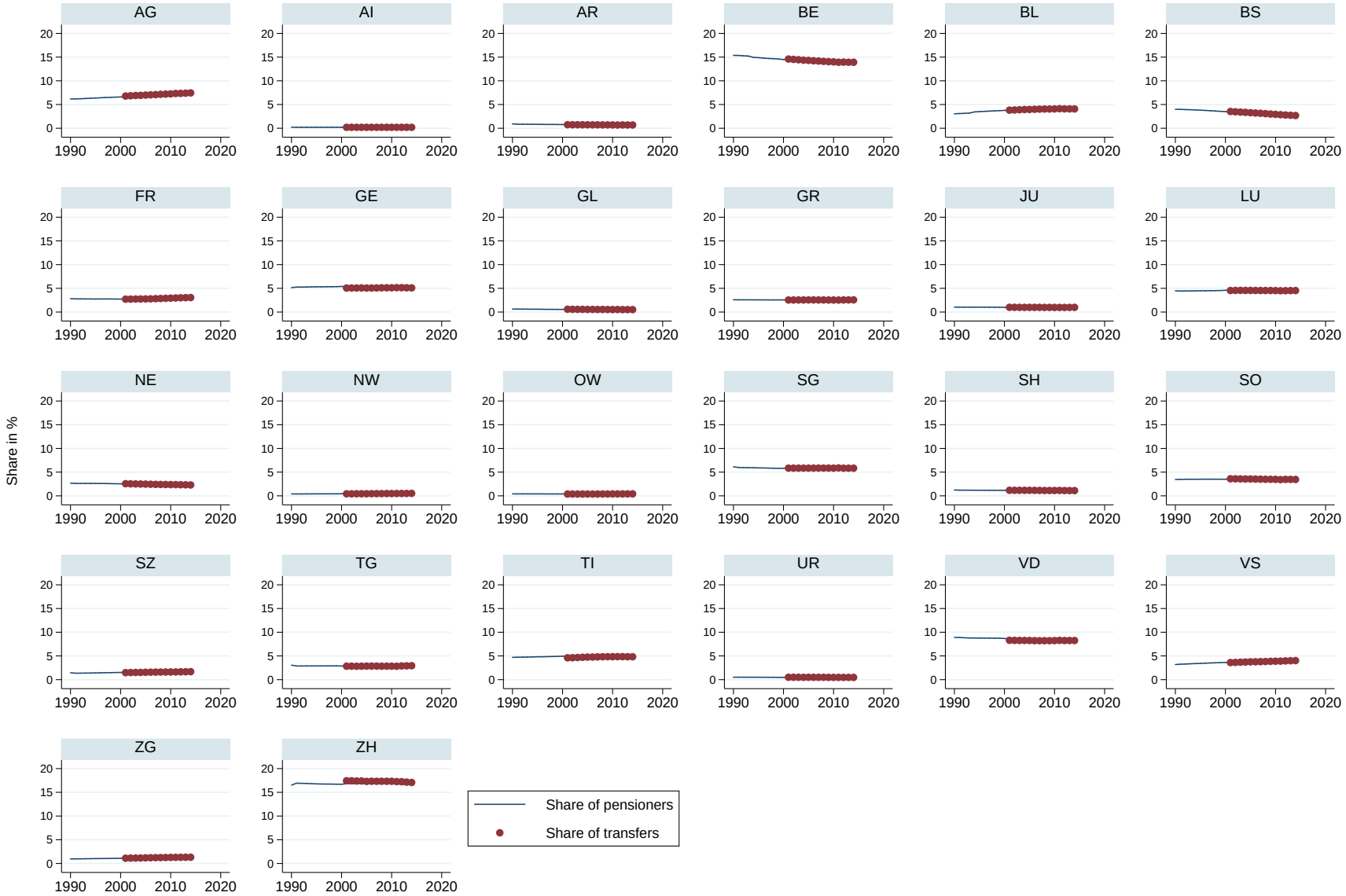


Table 10: Baseline results (β-coefficients and standard errors)

	(1)	(2)	(3)
	Redistribution	**Stabilization**	
Cantonal disposable income after...		Fixed Effects	First Differences
	β	β	β
...federal taxes	0.922***	0.996***	1.037***
	(0.010)	(0.007)	(0.013)
...fiscal equalization	0.953***	0.989***	0.997***
	(0.014)	(0.004)	(0.002)
...federal transfers	0.987***	0.974***	0.976***
	(0.008)	(0.003)	(0.003)
...unemployment insurance	0.989***	0.990***	0.989***
	(0.004)	(0.001)	(0.001)
...old-age insurance	0.928***	0.939***	0.938***
	(0.009)	(0.001)	(0.002)
Overall	0.784***	0.888***	0.936***
	(0.009)	(0.013)	(0.014)
Observations	540	540	485
Time period	1993-2014	1993-2014	1993-2014
	Eq. 1	*Eq. 2*	*Eq. 3*

Stars indicate significance levels: * p $<$ 0.05, ** p $<$ 0.01, *** p $<$ 0.001. The OLS-estimations are based on the following equations:

$$(1) \quad \overline{DY}_i = \alpha_d + \beta_d \overline{Y}_i + \nu_i$$

$$(2) \quad \left[DY_{it} - \overline{DY}_i\right] = \beta_s \left[Y_{it} - \overline{Y}_i\right] + \mu_{it}$$

$$(3) \quad \Delta DY_{it} = \alpha_s + \beta_s \Delta Y_{it} + u_{it}$$

Standard errors in parentheses are heteroskedasticity-robust (equation 1) and robust to temporal and spatial correlations as well as heteroskedasticity (Driscoll-Kraay standard errors) (equation 2 and 3).

Table 11: Detailed results of the distributed lag model (β-coefficients and standard errors)

	(1)	(2)	(3)	(4)	(5)	(6)
	Federal taxes	Fiscal equalization	Federal transfers	Unempl. ins.	Old-age ins.	Overall
no lag	1.034***	0.997***	0.978***	0.990***	0.941***	0.940***
	(0.011)	(0.002)	(0.002)	(0.001)	(0.002)	(0.011)
first lag	-0.0339***	-0.00257	0.00197	0.00228*	-0.00132	-0.0326***
	(0.007)	(0.001)	(0.001)	(0.001)	(0.002)	(0.008)
second lag	-0.0143**	-0.00610***	-0.00234	-0.000494	-0.00330*	-0.0261***
	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)	(0.007)
third lag	-0.00203	-0.00386	-0.00300	-0.00261*	0.00144	-0.00988
	(0.008)	(0.002)	(0.002)	(0.001)	(0.002)	(0.010)
fourth lag	0.0177***	-0.00452***	-0.00455**	-0.000212	0.00114	0.00894*
	(0.004)	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)
fifth lag	-0.0142**	-0.00679***	0.000969	0.00121*	-0.000536	-0.0192**
	(0.004)	(0.002)	(0.002)	(0.000)	(0.001)	(0.005)
sixth lag	-0.00921	-0.00687***	0.00284*	0.0000799	0.00196	-0.0109
	(0.006)	(0.001)	(0.001)	(0.000)	(0.001)	(0.007)
Observations	291	291	291	291	291	291
Time period	1993-2014	1993-2014	1993-2014	1993-2014	1993-2014	1993-2014

Stars indicate significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The OLS-estimations are based on the following equation:

$$\left[DY_{it} - \overline{DY}_i\right] = \sum_{j=0}^{6} \beta_{t-j} \left[Y_{it-j} - \overline{Y}_i\right] + \eta_{it}$$

Standard errors in parentheses are robust to temporal and spatial correlations as well as heteroskedasticity (Driscoll-Kraay standard errors).

Table 12: Changes in the institutional setting (β-coefficients and standard errors)

Systems change in fiscal equalization

	(1)	(2)	(3)	(4)
Cantonal disposable income after...	**Redistribution** *(Eq.1)* **old scheme** β	**new scheme** β	**Stabilization** *(Eq.3)* **old scheme** β	**new scheme** β
... fiscal equalization	0.957***	0.947***	0.994***	0.996***
	(0.013)	(0.018)	(0.001)	(0.001)
Observations	358	182	303	156
Time period	1993-2007	2008-2014	1993-2007	2008-2014

Systems change in federal tax scheme

	(1)	(2)	(3)	(4)
Cantonal disposable income after...	**Redistribution** *(Eq.1)* **old scheme** β	**new scheme** β	**Stabilization** *(Eq.3)* **old scheme** β	**new scheme** β
... federal taxes	0.919***	0.926***	1.000***	1.039***
	(0.017)	(0.010)	(0.052)	(0.014)
Observations	200	340	148	314
Time period	1993-2002*	2003*-2014	1993-2002*	2003*-2014

* Not all cantons changed their tax scheme in the same year.

Stars indicate significance levels: * p $<$ 0.05, ** p $<$ 0.01, *** p $<$ 0.001. The OLS-estimations are based on the following equations:

$$(1) \qquad \overline{DY}_i = \alpha_d + \beta_d \overline{Y}_i + \nu_i$$

$$(3) \qquad \Delta DY_{it} = \alpha_s + \beta_s \Delta Y_{it} + u_{it}$$

Standard errors in parentheses are heteroskedasticity-robust (equation 1) and robust to temporal and spatial correlations as well as heteroskedasticity (Driscoll-Kraay standard errors) (equation 3).

Table 13: Baseline results excluding the canton of Zug

	(1)	(2)	(3)	(4)	(5)
	Redistribution	**Stabilization**			
Cantonal disposable income after...		Fixed Effects	First Differences	Distributed Lag Model Immediate Effect	Distributed Lag Model Aggregate Effect
	$(1-\beta)$	$(1-\beta)$	$(1-\beta)$	$(1-\beta)$	$(1-\sum\beta)$
...federal taxes	0.060***	-0.003	-0.042***	-0.046***	-0.007
	(0.000)	(0.796)	(0.000)	(0.000)	(0.535)
...fiscal equalization	0.068***	0.011**	0.003*	0.004	0.043***
	(0.000)	(0.009)	(0.013)	(0.122)	(0.000)
...federal transfers	0.020**	0.022***	0.030***	0.024***	0.015***
	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)
...unempl. insurance	0.007	0.013***	0.012***	0.010***	0.010***
	(0.406)	(0.000)	(0.000)	(0.000)	(0.000)
...old-age insurance	0.063***	0.065***	0.064***	0.059***	0.056***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Overall	0.215***	0.107***	0.069***	0.054***	0.117***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	519	519	466	279	279
Time period	1993-2014	1993-2014	1993-2014	1993-2014	1993-2014
	Eq. 1	*Eq. 2*	*Eq. 3*	*Eq. 4*	*Eq. 4*

Stars indicate significance levels: * p < 0.05, ** p < 0.01, *** p < 0.001. The OLS-estimations are based on the following equations:

$$(1) \quad \overline{DY}_i = \alpha_d + \beta_d \overline{Y}_i + \nu_i$$

$$(2) \quad \left[DY_{it} - \overline{DY}_i\right] = \beta_s \left[Y_{it} - \overline{Y}_i\right] + \mu_{it}$$

$$(3) \quad \Delta DY_{it} = \alpha_s + \beta_s \Delta Y_{it} + u_{it}$$

$$(4) \quad \left[DY_{it} - \overline{DY}_i\right] = \sum_{j=0}^{6} \beta_{s,t-j} \left[Y_{it-j} - \overline{Y}_i\right] + \eta_{it}$$

The coefficients $(1-\beta)$ measure the separate redistributive / stabilizing effects of the respective mechanisms. The p-values in parentheses relate to the null hypothesis $H_0 : \beta = 1$. It indicates whether the regression coefficients are statistically significantly different from 1. If the coefficient is equal to 1 this would imply no redistribution / stabilization. The p-values for equation 1 are based on heteroskedasticity-robust standard errors. The p-values for equations 2 to 4 are based on standard errors that are robust to temporal and spatial correlations as well as heteroskedasticity (Driscoll-Kraay standard errors). The choice of six lags in the distributed lag model is motivated by the time lag of six years inherent in the fiscal equalization scheme.

Table 14: Robustness: All variables measured in logs

	(1)	(2)	(3)	(4)	(5)
	Redistribution	**Stabilization**			
Cantonal disposable income after...		Fixed Effects	First Differences	Distributed Lag Model Immediate Effect	Distributed Lag Model Aggregate Effect
	$(1-\beta)$	$(1-\beta)$	$(1-\beta)$	$(1-\beta)$	$(1-\sum\beta)$
...federal taxes	0.063***	-0.012	-0.051***	-0.056***	-0.009
	(0.000)	(0.186)	(0.000)	(0.000)	(0.516)
...fiscal equalization	0.054**	0.008	-0.001	-0.003	0.038***
	(0.001)	(0.104)	(0.385)	(0.275)	(0.000)
...federal transfers	0.016*	0.023***	0.026***	0.020***	0.016***
	(0.036)	(0.000)	(0.000)	(0.000)	(0.000)
...unempl. insurance	0.006	0.008***	0.009***	0.006***	0.007**
	(0.220)	(0.000)	(0.000)	(0.000)	(0.004)
...old-age insurance	0.061***	0.055***	0.056***	0.048***	0.043***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Overall	0.198***	0.082***	0.042**	0.016	0.098***
	(0.000)	(0.000)	(0.002)	(0.247)	(0.000)
Observations	540	540	485	291	291
Time period	1993-2014	1993-2014	1993-2014	1993-2014	1993-2014
	Eq. 1	*Eq. 2*	*Eq. 3*	*Eq. 4*	*Eq. 4*

Stars indicate significance levels: * p < 0.05, ** p < 0.01, *** p < 0.001. The OLS-estimations are based on the following equations:

$$(1) \quad \overline{logDY}_i = \alpha_d + \beta_d \overline{logY}_i + \nu_i$$

$$(2) \quad \left[logDY_{it} - \overline{logDY}_i\right] = \beta_s \left[logY_{it} - \overline{logY}_i\right] + \mu_{it}$$

$$(3) \quad \Delta logDY_{it} = \alpha_s + \beta_s \Delta logY_{it} + u_{it}$$

$$(4) \quad \left[logDY_{it} - \overline{logDY}_i\right] = \sum_{j=0}^{6} \beta_{s,t-j} \left[logY_{it-j} - \overline{logY}_i\right] + \eta_{it}$$

The coefficients $(1-\beta)$ measure the separate redistributive / stabilizing effects of the respective mechanisms. The p-values in parentheses relate to the null hypothesis $H_0 : \beta = 1$. It indicates whether the regression coefficients are statistically significantly different from 1. If the coefficient is equal to 1 this would imply no redistribution / stabilization. The p-values for equation 1 are based on heteroskedasticity-robust standard errors. The p-values for equations 2 to 4 are based on standard errors that are robust to temporal and spatial correlations as well as heteroskedasticity (Driscoll-Kraay standard errors). The choice of six lags in the distributed lag model is motivated by the time lag of six years inherent in the fiscal equalization scheme.

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