Can a Transaction Tax or Capital Gains Tax smooth House Prices?

Nicole Aregger*, Martin Brown** and Enzo Rossi***

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Abstract: Motivated by the search for instruments to contain future housing bubbles, we examine the impact of transaction taxes and capital gains taxes on residential house price growth. We exploit the variation in taxation across Swiss cantons, as well as within-canton changes in taxation over time. We relate these taxes to house price growth observed for 92 regions of the country during the period 1985 – 2009. Our results suggest that higher taxes on capital gains exacerbate house price dynamics while transaction taxes have no impact on house price growth. These findings support the existence of a lock-in effect of capital gains taxes on housing supply. They further suggest that taxes on real estate capital gains and transaction values are not suitable measures to prevent excessive house price growth.

Keywords: House prices, Transaction tax, Capital gains tax, Macroprudential policy

JEL Codes: E32, H24, R21

* Aregger: Study Center Gerzensee and University of Berne, nicole.aregger@szgerzensee.ch
** Brown: University of St. Gallen, martin.brown@unisg.ch
*** Rossi: Swiss National Bank and University of Zurich, enzo.rossi@snb.ch
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1 Introduction

As demonstrated powerfully in the recent crisis, developments in the housing market can have a major effect on financial sector stability and real economic activity. The recent turbulences in the financial sector were at least partly caused by the build-up and subsequent collapse of property prices.[1] In the past, housing booms tended to be followed by long lasting recessions and considerable output losses.[2] The recent house price bust in various countries confirmed the potential danger housing price cycles can pose to financial stability.

A main lesson from the recent crisis is that policy-makers should pursue macroprudential policy to strengthen the financial system's resilience to economic downturns and limit the build-up of risks to financial stability.[3] In most economies, macroprudential policy frameworks are at an early stage of development, and the evidence for their effectiveness is tentative. There is also considerable debate about the appropriate instruments to be used in macroprudential policy. One specific macroprudential instrument authorities may use to limit or pre-empt real estate price booms is a (variable) cap on loan-to-value ratios of mortgages.[4] Beyond macroprudential policy, the recent literature suggests that fiscal instruments may also help contain real estate bubbles (Cf. Posen 2009). Jeanne (2008) proposes a counter-cyclical Pigouvian tax on debt, including mortgage debt, to internalize the negative externality which individual borrowers produce on systemic risk. Jeanne and

[1] Cf., e.g., Borio and Disyatat (2009). Reinhart and Rogoff (2008) set out some parallels between America's subprime crisis and 18 previous post-war banking crises in the rich world. They show that banking crises have a common pattern. Each blow-up is preceded, inter alia, by rising home and equity prices. Hilbers et al. (2001) show empirically that unbalanced developments in real estate markets can be an important factor contributing to vulnerabilities and possibly crises in the financial sector.
[2] Cf. IMF (2003), Ahearne et al. (2005), Leamer (2007), Claessens et al. (2008), IMF (2009), Jannsen (2010).
[3] Cf. Milne (2009), CGFS (2010), Jordan (2010), Danthine (2012). Bank of England (2009) discusses possible ways to make a macroprudential policy regime operational.
[4] Cf. Goodhart (2009).

Korinek (2010) discuss a dynamic model in which a Pigouvian tax manages credit booms and busts.

In this study we examine the effectiveness of taxes on real estate transaction values and capital gains as instruments to smooth price growth in the residential housing market. We exploit the variation in taxation across 21 Swiss cantons as well as within-canton changes in taxation over time during the period 1985 – 2009. For instance, in 2005 capital gains taxes in Swiss cantons varied from 17% to 50%. This variation in taxes within Switzerland is similar to the variation in taxes across countries in the European Union (ECB 2003). We relate house price growth in 92 regions to the taxation of transaction values and capital gains in the canton the region is located in.

Switzerland is a particularly interesting country in which to study the effects of real estate taxes for two reasons. First, given the substantial variation in taxation of real-estate transaction values and capital gains across its cantons, Switzerland provides a unique opportunity to study how taxes impact on residential house price growth in a *homogeneous macroeconomic environment* with an *integrated banking sector* and a *common legal system*. By comparison, cross-country studies of regulation, taxation and house prices are marred by (unobservable) macroeconomic and structural characteristics across countries. Second, Switzerland has in the past experienced a banking crisis due to a real estate boom. The sharp rise in real estate prices in the 1980s, followed by a slump in prices in the early 1990s, led to substantial loan losses as well as a restructuring of the Swiss banking sector. The large Swiss banks alone wrote off CHF 30 billion or nearly 13% of their loan volume. Nearly half of the 200 regional banks, a group consisting of small locally-based institutions, did not survive the crisis and lost their independence. From 1990 to 1995 the number of banks operating in Switzerland dropped from 625 to 413.

We find no evidence that capital gains taxes or transaction taxes dampen house price growth. On the contrary, we find that taxes on capital gains, and in particular penalty taxes on short-term gains seem to fuel price growth. Sample splits show that this result is driven by house price dynamics in tourism regions where housing is most likely to be an investment object as opposed to a durable consumption good. Instrumental variable estimates suggest further that this result is not driven by reverse causality.

Our results suggest to policy makers that transaction taxes and capital gains taxes on housing are not suitable as instruments of macroprudential policy. In particular, due to lock-in effects for existing home-owners, taxes on (short-term) capital gains seem even to be counterproductive to the objective of systemic stability.

The rest of the paper is organized as follows. Section 2 offers a review of related literature. Section 3 presents the data and empirical methodology. Section 4 presents the results and section 5 concludes.

2 Related Literature

There is an extensive theoretical and empirical literature examining the impact of housing tax policy on *housing decisions* (cf., for instance, Smith et al. 1988 and Nakagami and Pereira 1995). By contrast, only little research has been devoted specifically to the effects of taxation on *price developments* in real estate markets. In this section we focus on those contributions which study the impact of transaction taxes and capital gains taxes on house price dynamics. This literature provides ambiguous predictions and inconclusive empirical

findings on the relationship between transaction taxes, capital gains taxes and house price developments.

2.1 Theoretical studies

The idea to tax financial transactions in order to reduce asset price volatility was introduced by Keynes (1936) for stock exchanges and Tobin (1978) for currency markets. Stiglitz (1989) argues that a *transaction tax* can reduce speculative trading and price volatility in asset markets. However, the subsequent theoretical literature suggests that *transaction taxes* may amplify rather than smooth price fluctuations, for instance by reducing the liquidity of asset markets (cf., e.g., Hau 2006). The effect of a *capital gains tax* on asset price volatility is also theoretically ambiguous (cf. Fuest et al. 2004 for an overview). The model of Stiglitz (1983), for example, shows that such a tax may increase volatility. In his model, a capital gains tax leads households to postpone the realization of capital gains (lock-in effect[5]) and bring forward capital losses, lifting asset prices when there is upward price pressure and reducing them when the prices of assets are low.

With respect to the housing market, Englund (1986) suggests that *capital gains taxes* on real estate can exacerbate price dynamics by giving rise to lock-in effects which inhibit trade.[6] He considers in a two-period overlapping-generations (OLG) model whether capital gains taxation increases or decreases market demand for owner-occupied housing. In a growing economy an increase in the capital gains tax lowers housing demand for low tax rates, reducing price dynamics. However, as soon as the tax rate reaches a critical value, the

[5] A homeowner postponing the realization of a capital gain is hit by a lower tax rate in present value terms.

[6] Englund (1985) compares taxation of capital gains on realization with taxation on accrual in the context of owner-occupied housing in an infinite-horizon model. Taxing capital gains upon realization rather than as the gains accrue boils down to giving the taxpayer an interest-free loan, effectively taxing capital gains at a lower rate than other income, thereby violating the principles of comprehensive income taxation. Cf. Diamond (1975) and King (1977).

household chooses to stick to the same house for both periods and demand picks up. The general conclusion is that a high capital gains tax may not dampen, but actually accelerate the development of house prices.

Fuest et al. (2004) also use a two-period OLG model to examine whether capital gains taxes increase or decrease fluctuations in house prices. They argue that households who buy their real estate in a boom are likely to suffer a capital loss. By contrast households buying their real estate in a recession are likely to make a capital gain when selling it. A capital gains tax reduces the expected losses of those buying in the boom and reduces the gains of those buying during recession. As a consequence the former will pay more while the latter will pay less so that real estate prices increase even further in booms and fall even more in recessions.

There is to our knowledge no theoretical paper which explicitly models the implications of a transaction tax on house price dynamics. Lundborg and Skedinger (1999) show in a search model with endogenous house prices that a transaction tax unambiguously leads to lock-in effects. Their model does not consider the implications of this effect for house prices in a dynamic setting. However, according to the model of Englund (1986) mentioned above, lock-in effects in the real estate market would amplify house-price volatility.

2.2 Empirical studies

Hoyt and Rosenthal (1992) simulate the effects on housing demand from a simultaneous increase in the capital gains tax rate and a lowering of federal marginal income tax rates, consistent with the US Tax Reform Act in 1986 (TRA86). Rollover provisions in the US tax code enable homeowners to avoid paying tax on the capital gains from the sale of their home if they purchase another home of equal or greater value within a certain period of when they moved. Because of these tax provisions households face a different price of

housing depending on whether they purchased a more (buy up) or less expensive house (buy down). Against this legal background, the TRA86 increased the difference in the price of housing services between buying up versus buying down. On the one hand an increase in the capital gains tax rate raised the penalty for buying down, on the other lower marginal tax rates raised the user cost of owner-occupied housing. As a result housing demand would fall with a decrease in the capital gains tax rate as additional previous homeowners buy down.

Lundborg and Skedinger (1998) provide evidence on the size of the lock-in effect due to capital gains taxation based on survey data of 6,000 Swedish home owners during the 1980s. Their results suggest that capital gains taxation reduces the probability of buying down for households with too high a housing consumption. However, capital gains taxes do not appear to have lock-in effects for households which want to buy up, i.e. those whose income has risen or family size increased and thus for whom consumption is regarded as too small.

Rosen et al. (1984) examine how capital gains taxes affect the risk associated with home ownership. They estimate the impact of capital gains taxation on the tenure choice during the second half of the 1970s, taking into account the uncertainty about the user cost of housing and assuming perfect supply elasticity. Based on US time series and cross sectional data they show that capital gains taxes may, on balance, increase the proportion of owner-occupiers. Two opposing effects are working. On the one hand, the expected cost of owning increases. On the other hand, the forecast error variance of the user cost is sufficiently reduced to dominate.

Closest to our study, Sheffrin and Turner (2001) examine the impact of capital gains taxes across different metropolitan regions with varying patterns of house price dynamics.[7]

[7] From a methodological point of view the panel analysis based on US interstate variation in capital gains taxation during 1979-90 provided by Bogart and Gentry (1995) is the most similar to our approach. In contrast to our paper which looks at the impact on house price dynamics, Bogart and Gentry look at the relation between

Using household data from 1985 to 1995 they find that households would, on the one hand, benefit from a capital gains tax by reducing the volatility of housing prices. On the other hand capital gains taxes increase the user cost. On balance, and contrary to Rosen et al. (1984), the latter effect dominates, leaving households on average worse off. However, the results vary strongly by metropolitan areas and over time. Households in high-volatility areas would benefit from capital taxes whereas homeowners in high-appreciation cities would be hurt.

To our knowledge there is no empirical study which examines the impact of a transaction tax on house price dynamics. As surveyed by Hau (2006), the empirical evidence on the relation between transaction costs and asset price volatility is inconclusive. Based on his panel regressions using data from the French stock exchange between 1995 and 1999 he argues that security transaction taxes in particular are likely to increase volatility.

Our study complements the literature presented above by examining the impact of cross-sectional and time-variation in transaction and capital gains taxes on house price growth. Compared to the above studies on US and Swedish data, our analysis benefits from the fact that we observe varying levels of taxation across regions within a country and over a long period of time. Compared to potential cross-country studies on taxation our analysis has the advantage of studying a sample of regions which have a harmonized macroeconomic policy, an integrated banking system and a common legal environment.

capital gains tax rates and capital gains realizations. They find that capital gains realizations are negatively related to capital gains tax rates, suggesting lock-in effects from capital taxation.

3 Data and methodology

3.1 House prices

Our analysis is based on house prices observed for 92 MS-regions (MS = spatial mobility) in Switzerland over the period 1985 – 2009. Each MS-region is made up of several municipalities which together form a local labor market. A graphical representation as well as a list of all MS-regions and their attribution to the Swiss cantons are provided in Appendix A1. The MS-regions covered in this study account for 87% of the Swiss population and an estimated 87% of Swiss GDP in 2008.[8] For each MS-region we observe an annual index of nominal prices for single-family houses and condominiums separately. Both indices are measured on a hedonic basis to account for quality changes. We calculate average annual nominal price growth for single-family houses (*Price growth SFH*) and condominiums (*Price growth CON*) for each of the following five periods: 1985-1989, 1990-1994, 1995-1999, 2000-2004, 2005-2009. Table 1 provides definitions and sources of all variables employed in our analysis. Table 2 provides summary statistics for all variables.

[Table 1 here]

[Table 2 here]

Figures 1 and 2 display the variation of house price growth across time and MS-regions in our sample. Four important observations can be made from these figures. First, the

[8] We include in our analysis the four MS-regions (Laufental (25), La Broye (93), La Chaux-de Fonds (103) and Murten (42)) for which a share of 21 to 40 percent of the population in these MS-regions is living in municipalities belonging to one or more other cantons than the canton listed in Table A1. All our results are confirmed in robustness tests dropping these four MS-regions.

five periods for which we calculate house-price growth correspond to five distinct phases of house-price movements. Figure 1 shows that between 1985 and 1989 prices for single-family houses rose by 3.5% per year in nominal terms (median). In real terms this corresponds to a cumulative increase of 7% for this period. At the beginning of the 1990s price growth came to a halt. Nominal prices for single-family homes remained stable between 1990 and 1994, implying a cumulative real decline of more than 15%. Between 1995 and 1999 both nominal and real prices for single-family houses remained stable. Between 2000 and 2004 nominal prices for single-family houses rose by 0.8% per year, implying a modest cumulative real growth of 3% for this period. From 2005 onwards price growth accelerated, reaching 3.5% per year in nominal terms and a cumulated real price growth of 13% between 2005 and 2009.

[Figure 1 here]

[Figure 2 here]

The second observation is that the price growth of condominiums displays stronger variation across time than that of single-family homes. Figure 1 shows that in the periods of strongest price increases median price growth for condominiums exceeds that of single-family houses by 1.7% per year (1985-1989) and 0.6% per year (2005-2009), respectively. By contrast in the two periods of real price decline (1990-1994, 1995-1999) the prices of condominiums displayed lower median growth than those of single-family houses.

The third observation from Figure 1 is that in each of the five periods there is substantial regional variation in price growth. Between 1985-1989, for example, nominal price growth for single-family homes grew by less than 0.4% per year in the four slowest growing MS-regions, while price growth exceeded 7% per year in the four fastest growing MS-regions. The most recent period 2005-2009 has seen a similar dispersion in regional

house price developments. Nominal prices for single-family houses rose by less than 1% per year in the two slowest growing MS-regions, while price growth exceeded 8% per year in the three fastest growing MS-regions. The figure shows that the two periods of real price depreciation (1990-1994, 1995-1999) also display substantial regional variation in price developments.

The fourth observation is that the geographical distribution of regions with strong price growth varies substantially between the two boom periods 1985-1989 and 2005-2009. Figure 2 plots house price growth by MS-region for these two periods and shows that the strong price growth at the end of the 1980s (above 5% p.a.) was widespread in urban and semi-urban areas, but not in the main tourist, i.e. mountain areas. By contrast, in the most recent period strong price growth is focused on the financial centers (Zurich and Geneva) and the main tourist areas.

3.2 Taxation of real estate capital gains and transaction values

The taxation of real-estate capital gains and transaction values differs strongly across Swiss cantons.[9] We collected information on the tax regimes and tax rates from the authorities of the 26 cantons over the period 1980-2005. Appendix A2 provides an overview of the current tax regimes of the capital gains tax and transaction tax by canton. Due to missing data only 21 cantons are included in our sample.[10]

[9] Our analysis focuses on the taxation of capital gains and transaction values as we expect these taxes to influence *house price growth*. We do not examine the taxation of property values or (imputed) income, as we expect these taxes to affect the *level of house prices* rather than their growth. In Switzerland the *holding* of real-estate, i.e. the property value and the income derived from it, are taxed. The imputed rent of owner-occupied housing is considered to be part of household income and is therefore subject to the ordinary income tax, while housing value is subject to wealth tax. Housing expenses such as mortgage interest can be deducted from income taxes while the mortgage itself from the wealth tax. In most cantons also maintenance costs or insurance premiums can be deducted from the income tax (SFTA 2010a, 2010b).

[10] There is no tax data available from the canton Zug and St. Gallen, and data for Jura and Solothurn is only available for a limited period. Data on mortgage interest rates for Appenzell A.Rh. are missing.

We employ three indicators of taxation in our empirical analysis. The first two tax indicators measure the taxation of real estate capital gains by canton.[11] For private households, each canton levies a real-estate capital gains tax, which is independent of the income or wealth status of the tax payer.[12] The capital gains tax is levied each time a gain on real estate has been realized and is due by the seller. The gain is computed as the selling price (transaction value) minus the original purchasing price minus the value increasing expenditures by the owner. In most of the cantons the tax rate is progressively related to the level of the capital gain, while in each canton there is an inverse relationship between the tax rate and the duration the real estate was held.[13] This tax pattern aims to penalize short-run price speculation.[14] Our two indicators capture the level and inverse time progression of the capital gains tax. The variable *Capital gains tax* measures the top marginal tax rate applicable to real estate capital gains if the property is sold after holding it 5 years. The variable *Speculation tax* measures by how much the top marginal rate on real-estate capital gains is increased (in percentage points) if the residential property is sold less than one year after it has been purchased. Our third tax indicator measures the transaction tax which is levied every time real estate changes hand.[15] It is applied to the transaction value, i.e. the selling price. In

[11] In Switzerland taxes are levied at the federal, at the cantonal and communal level. Income taxes are levied at all three state levels. Wealth taxes and property taxes are cantonal and communal, but the latter do not exist in all cantons. Capital gains taxes are cantonal and/or communal. The capital gains tax on movable private wealth was abolished in all cantons. The canton Graubünden was the last canton which abolished this tax in 1997 (SFTA 2010d).

[12] For companies, gains on real estate are taxed either according to the corporate income tax rate or the above mentioned gains tax. As 89% of all residential buildings in Switzerland are owned by private persons we focus our analysis on cross-canton differences in the taxation of gains by private persons. Concerning private persons one has to distinguish between private wealth and business assets. On private wealth the capital gains tax is levied and on real estate that belongs to the business assets, the income tax is levied.

[13] Unlike other countries the tax code makes no explicit distinction between buying up and buying down transactions. However, like in other countries, cantonal tax rules provide for postponement of the tax liability if the sales revenue of owner-occupied housing is used to purchase another property within some period of time (roll-over provision). This amounts to an implicit tax-exemption on "buying up".

[14] SFTA (2010c).

[15] Transaction taxes are, similar to capital gains taxes, levied at the canton and/or municipal level.

most cantons the tax is proportional to the real-estate value and due by the buyer.[16] The variable *Transaction tax* captures the top marginal rate of the tax on transaction values by canton.[17]

[Table 3 here]

We collected our three tax indicators at five points in time: 1985, 1990, 1995, 2000 and 2005. Table 3 shows that there is substantial variation across the cantons and over time for each indicator. In 1985, for example, the *Capital gains tax* varied from less than 20% in the cantons of Obwalden and Vaud to 40% and more in Thurgau, Schaffhausen and Valais. Between 1985 and 2005 eight cantons raised this tax (e.g. Basel-Stadt from 32% to 48%), while four cantons reduced it (e.g. Valais from 40% to 26%). The *Speculation tax* on short-term real estate gains varied in 1985 from 0% in Basel-Stadt, Vaud and Valais, to 25% or a doubling of the capital gains tax in Basel-Landschaft. Between 1985 and 2005 this tax was increased in 10 cantons, while it was reduced in four cantons. Finally, the *Transaction tax* rate varied in 1985 from less than 0.5% in Aargau and Uri to 4% in Fribourg and Neuchâtel. Between 1985 and 2005 this tax shows the fewest changes within cantons; it was raised in two cantons and reduced in five others, for example in Zurich, where it was abolished altogether.

[16] SFTA (2010e). Some cantons apply progressive tax rates, in some cantons the transaction tax has the form of a fee and some cantons do not have such a tax anymore. Also, some cantons split the tax between the buyer and seller. Cf. Appendix A2 for details. The majority of cantons levy a lower rate for transactions within families (descendants, spouses, etc.). However, as such intra-family sales are quite rare in Switzerland, we focus on the regular transaction tax rate.

[17] In robustness checks we calculated our three tax indicators based on five standard real estate transactions. The qualitative findings are the same.

3.3 Estimating house price growth

In our empirical analysis we relate price growth, $P_{r,t}$, by MS-region *r* in the period *t* to the taxation of real estate transactions in that period in the canton *c* where an MS-region is located, $T_{c,t}$. As illustrated in model [1] we employ MS-region fixed effects α_r to account for time-invariant, structural differences across MS-regions, which may affect housing demand and supply. For example, regions differ in their attractiveness for tourism, their urban/rural structure,[18] their availability of vacant premises, land for building purposes[19] and home-ownership rates.[20] We further employ period fixed effects α_t to control for the average impact of the business cycle and monetary policy (e.g. nominal interest rates) on housing demand and supply across the country.

$$[1] \qquad P_{r,t} = \alpha_r + \alpha_t + \beta_1 \cdot T_{c,t} + \beta_2 \cdot X_{r,t} + \beta_3 \cdot Z_{c,t} + \varepsilon_{r,t} \ ,$$

whereby $P_{r,t} \in \{$ *Price growth SFH; Price growth CON* $\}$

To control for differences in fundamental dynamics of housing demand and supply across MS-regions and periods of observation we employ three time-varying indicators per MS-region, $X_{r,t}$, and two time-varying indicators per canton, $Z_{c,t}$.[21] The variable *Income growth* measures nominal annual growth of per capita income and *Population growth*

[18] The Swiss Federal statistical office classifies each municipality into one of four types: 1=Central city of an agglomeration, 2=Agglomeration, 3=Isolated city, 4=rural.

[19] Zürich has the lowest housing vacancy rate with 0.03%, while the MS-region "Glarner Hinterland" has the highest rate with 3.82% (in 2008).

[20] The home ownership rate in Switzerland, defined as the ratio of owner-occupied dwellings to total occupied dwellings, is 35%. Owner-occupied dwellings consist of condominium owned dwellings (22.8%), sole owned houses (66.5%) or joint owned houses (10.7%) (SFSO 2004). Bourassa and Hoesli (2006) analyse the reasons for the country's low ownership rate by international standards.

[21] Steiner (2010) considers these indicators to be key determinants of Swiss housing dynamics at the country level.

measures average annual population growth per MS-region and period.[22] The variable *Housing stock growth* is our indicator of growth in housing supply and refers to the net growth of the housing stock and again measures average annual growth per period and MS-region. As housing supply has been found to have a lagged impact on house price dynamics (Steiner 2010), we employ the lagged value of this variable in our analysis.[23] We take account of differences in lending conditions across time and regions. Previous research (Bolliger and Cecchin 2009) shows that there are significant regional differences in mortgage loan pricing within Switzerland. We control for this variation by including the variable *Mortgage rate*, which measures the average interest rate offered on new mortgages at the canton level.[24] Finally, we control for the *Income tax* rate which varies strongly across Swiss cantons, and which has been argued to exert a strong influence on house prices (Bourassa and Hoesli, 2006). Our indicator measures the average tax rate on annual income of CHF100,000.

4 Results

4.1 Univariate results

Table 4 presents a univariate analysis of the relation between the change in housing taxes and the change in house price growth over time at the MS-region level. Our analysis is focused on the two boom periods identified in Figure 1: 1985-1989 and 2005-2009. For each MS-region we calculate the difference in Price growth SFH (Δ *Price growth SFH*) and Price

[22] Population growth includes immigration which has been shown to affect house prices in Switzerland and other developed countries (cf., e.g., Degen and Fischer 2009 and Saiz 2007).
[23] For the period 2005-2009 we use average annual growth in housing for the period 2000-2004, for the period 2000-2004 we use net growth housing stock for the period 1995-1999, etc. For the period 1985-1989 we use net growth in housing stock in 1984 as we have data on the housing stock only from 1984 onwards.
[24] Due to missing data for 2009, our indicators of *Population growth*, *Income growth*, and *Mortgage rate* for the period 2005-2009 are based on 2005-2008 averages.

growth CON (Δ *Price growth CON*) between these two periods. We then compare our three canton-level tax indicators *Capital gains tax*, *Speculation tax* and *Transaction tax* in 1985 and 2005 and identify those cantons in which each tax increased, decreased or stayed the same. Table 4 compares the change in price growth for MS-regions located in cantons where taxes were increased to changes in price growth for MS-regions located in cantons where taxes were decreased or stayed the same.

The difference-in-difference tests reported in Table 4 provide inconclusive evidence for an impact of the *Capital gains tax* or *Transaction tax* on house price growth. MS-regions located in cantons that increased the *Capital gains tax* did not experience significantly lower price growth than MS-regions located in cantons that decreased or did not change that tax. MS-regions located in cantons that increased the *Transaction tax* did experience lower price growth than MS-regions located in cantons that decreased or did not change that tax. However, the difference-in-difference test is only economically and statistically significant for the comparison between those cantons that increased the tax versus those that did not change the tax.

By contrast, the results shown in Table 4 do suggest a strong positive relation between changes in the *Speculation tax* and changes in house price growth. MS-regions located in cantons that increased the *Speculation tax* did experience a *higher* price growth than MS-regions located in cantons that decreased or did not change that tax. The tests reported in the table suggest that these differences are not only statistically significant, but also large in terms of economic magnitude. For example, in cantons which increased their *Speculation tax* the price growth of single-family houses increased by 2.7% p.a. more than in cantons which did not change this tax. Compared with cantons that lowered the *Speculation tax* the prices of single-family houses grew by 1.9% more per annum.

[Table 4 here]

The Table 4 results provide first evidence that taxes on capital gains and transaction values have not dampened house price growth in our sample. By contrast, and in line with a lock-in effect, the results suggest that, penalty taxes on short-term capital gains (speculation tax), may actually spur house price growth. However, it would be premature to draw conclusions on the *causal* impact of taxes on house price growth from the univariate tests above. First, differential changes in housing-taxes across cantons may have coincided with changes in economic conditions (e.g. income growth, immigration or income taxation) which may have affected house price growth. Second, increases in housing taxes, e.g. the *Speculation tax*, may have been driven by expected house-price growth. In our subsequent multivariate analysis we examine whether our univariate findings are robust to accounting for omitted variables and reverse causality.

4.2 Multivariate results

Table 5 presents the results of our estimation of model [1]. Columns (1-3) report results for *Price growth SFH* while columns (4-6) report results for *Price growth CON*. For both dependent variables we present estimates based on all five periods (columns 1,4), the two boom periods only (columns 2,5) as well as the three non-boom periods. As indicated by model [1] all models include (non-reported) MS-region and period fixed effects. Standard errors reported in brackets are clustered by canton.

[Table 5 here]

The results presented in Table 5 confirm our main finding of the univariate analysis. We find a significant positive correlation between the *Speculation tax* and house price growth. This correlation is driven entirely by price-growth in the two boom periods 1985-1989 and 2005-2009. The column (2) and column (5) estimates suggest that cantons which increased their speculation tax by 1% experienced an increase in house-price growth between these two periods by 0.3% (single family houses) and 0.24% (condominiums) per annum. Thus the increase in the average *Speculation tax* (across all cantons) between period 1985-1989 and 2005-2009 (3.41%, cf. Table 2) would imply an annual increase in price growth between 0.8% (condominiums) and 1% (single family houses). This is a sizeable effect, given that average annual price growth was 4% - 5% in these periods. Finally, the estimates reported in column (3,6) show that the level of the *Speculation tax* has no impact on house price growth during periods where prices are falling or growing slowly.

According to the estimates reported in Table 5, ordinary *Capital gains taxes* also vary positively with house price growth. However, the economic magnitude of the coefficients for the *Capital gains tax* are much smaller than those of the *Speculation tax*. Moreover, from a statistical viewpoint these estimates are only significant at the 10% level and only for prices of condominiums (cf. column 5). These results suggest that penalty taxes have a stronger lock-in effect than ordinary capital gains taxes.

The estimates of Table 5 also confirm our results of the univariate analysis that the *Transaction tax* is negatively correlated with house price growth. The estimated coefficients suggest that this correlation is sizeable from an economic viewpoint. For example, the estimate provided in column (1) implies that a 1% increase in the *Transaction tax* (which corresponds to the standard deviation of this tax across regions) would reduce house price growth by 0.8% per annum. However, the estimates for *Transaction tax* are only weakly

significant for single family houses and only in the full sample, suggesting that this result is hardly robust.

The estimated coefficients for our control variables suggest that house price growth is lower in cantons with higher *Income tax*. By contrast, our other time-varying indicators of housing demand (Income growth, Population growth, Mortgage rate) and housing supply (Housing stock growth) are not correlated with house price growth. The latter results suggest that differences in the development of housing demand and supply *across MS-regions* do not contribute to explaining differential changes in house-price growth across these regions. That said, aggregate changes in housing demand and supply over the business cycle do impact strongly on house price growth. In robustness checks (not reported) we replicate the specifications (1) and (4) from Table 5, excluding period fixed effects. In these robustness tests we find significant positive coefficients of *Income growth, Population growth and Mortgage rate* and a significant negative coefficient of *Housing stock growth*.

The results presented in Table 5 suggest that the lock-in effect of capital gains taxes on the supply of housing is stronger than the effect of such taxes in reducing speculative demand for housing. The finding that capital gains taxes exacerbates price dynamics due to a reduction in market liquidity is in line with previous empirical findings for financial asset markets (e.g. Hau 2006). However, it is surprising that we find such an effect in an asset market, i.e. the Swiss housing market, which, due to a low home-ownership rate and long tenure is arguably dominated by households with a durable consumption motive rather than an investment motive.

In order to check the reliability of our results and to rule out that these are driven by spurious correlation, we resort to subsample analyses. If capital gains taxes exacerbate price dynamics in the Swiss housing market, this effect should be concentrated in those segments of the market which are most populated by households with an investment motive rather than a

durable consumption motive. Recent market developments and policy initiatives suggest that "pure" investment activity in the Swiss real estate market is concentrated in tourist resorts.[25] We therefore split our sample of MS-regions into three categories according to their importance as a tourism destination. The variable *Tourism* measures the number of overnight stays per annum divided by the resident population. We distinguish regions with high, medium and low tourism intensity according to whether their average *Tourism* value over our whole observation period is in the first, second or third tercile. We expect that the impact of housing taxes on price growth is strongest in the subsample of MS-regions with high tourism.

[Table 6 here]

Table 6 presents our sub-sample analysis by tourism intensity. We limit our analysis to the two boom periods 1985-1989 and 2005-2009. Results for single-family houses are presented in columns (1-4) while results for condominiums are presented in columns (5-8). The results displayed in Table 6 are in line with our predictions: The *Speculation tax* has a significant positive impact on house price growth only in the high-tourism areas. In these areas we also find that the ordinary *Capital gains tax* has a positive impact on house price growth, while neither tax has an effect in MS-regions with medium or low tourism. The results shown in Table 6 confirm that there is no robust effect of the *Transaction tax* on house-price growth in our sample.

Confirming our results in Table 5, we find that in high tourism areas the impact of the *Speculation tax* on house price growth is more than three times as much as that of the *Capital*

[25] In the classic tourist destinations strong building activity in the past has led to an average proportion of second homes in excess of 50%. As a result a referendum initiative entitled "Stop the Endless Construction of Second Homes" was launched. On March 11 2012 Swiss voters accepted the initiative which imposes severe restrictions on the construction of second homes in Switzerland, calling for the proportion of second homes in a municipality to be kept at 20% or lower.

gains tax. The coefficients estimated for single family houses in column (1) and condominiums in column (5) suggests that a 1% increase in the *Capital gains tax* in an MS-region with high tourism is associated with an increase in annual price growth of 0.12% and 0.11% respectively. By comparison a 1% increase in the *Speculation tax* in a region with high tourism is associated with an increase in annual price growth of 0.43% and 0.36% respectively.

Thus the increase in the *Capital gains tax* in the canton of Graubünden (home to the tourist resorts of St. Moritz or Davos) from 30% in 1985 to 50% in 2005 would be associated with an annual increase in price growth of 2.4 percentage points for single-family houses and 2.2 percentage points for condominiums.[26] By comparison the increase in the *Speculation tax* in the canton of Valais, (home to the tourist resorts of Verbier or Zermatt) from 0% in 1985 to 12% in 2005 would be associated with an annual increase in price growth of 5.2 percentage points for single-family houses and 4.3 percentage points for condominiums. These effects compare well to the increase in price growth in these major tourist cantons. In Graubünden prices of single family houses (condominiums) increased annually by 2.3 (1.1) percentage points between 1985-1989 and 2005-2009. In Valais the annual price growth of single family houses (condominiums) increased by 4.6 (2.9) percentage points between 1985-1989 and 2005-2009.

4.3 Accounting for the endogeneity of taxes

Do higher taxes on capital gains lead to an increase in price growth or does higher expected price growth lead to higher taxation of capital gains? Tax rates set by the cantonal authorities could well be endogenous to expected price growth. Cantons which expect a

[26] The Speculation tax rose from 8% to 13%. Cf. Table 3.

strong growth in real-estate prices may hike their rates in advance in order to increase their tax revenue or to smooth future house price growth.[27] In order to mitigate as much as possible potential biases arising from forward-looking tax authorities, we have throughout our analysis measured the tax conditions at the *start of each period* (1985, 1990, 1995, 2000, 2005).

Employing the tax rates at the beginning of a period may not be enough to overcome the potential endogeneity of tax policy. In this section we therefore employ an instrumental variables (IV) approach. We conduct a two-stage least-squares (2SLS) estimation in which our tax indicators *Capital gains tax*, *Speculation tax* and *Transaction tax* are instrumented with indicators of the political, fiscal and economic conditions in each canton. The instrumental variables capture the share of left wing parties in the canton's executive (*Left-wing executive*), the existence of a mandatory referendum on key budget positions at the cantonal level (*Budget referendum*), the scarcity of land for construction purposes in the canton (*Land used*), and the relative importance of the tourism sector in each canton (mean of *Tourism* over all MS-regions in the canton). Funk and Gathmann (2011) show that left-wing governance and the existence of a budget referendum have a significant impact on cantonal fiscal policy in Switzerland. It is unlikely, however, that either of these variables has a direct impact on house price growth within a canton. We further expect the availability of land and the average tourism intensity in a canton have an impact on cantonal taxation of housing transactions. At the same time these canton-level indicators of housing demand and supply should not have a direct impact on house price growth at the MS-region level.

Results of our IV estimations are presented in Table 7. Our analysis is focused on the two boom periods 1985-1989 and 2005-2009. In the first-stage estimates we therefore relate our indicators of taxation in 1985 and 2005 to measures of our instrumental variables in the

[27] On the other hand, due to the strong tax competition in Switzerland (cf., e.g., Brülhart and Jametti 2008) those cantons which expect higher future real estate gains and transaction values may actually reduce their tax rates.

previous period (1980-1984 and 2000-2004).[28] The first-stage estimates (columns 3-5) suggest that the strength of our instruments is acceptable, but varies across the three endogenous variables *Capital gains tax* (F-Test value = 3.10), *Speculation tax* (F-Test value = 6.83), and *Transaction tax* (F-Test value = 10.51). The Hansen tests reported with our second-stage estimates (columns 1-2) suggest the instruments are valid.

[Table 7 here]

The second-stage results for *Price growth SFH* (column 1) and *Price growth CON* (column 2) suggest that our previous results are not driven by reverse causality. On the contrary, our IV estimates yield a significant and positive impact of the (instrumented) *Capital gains tax* and *Speculation tax* on the price growth of single family houses and condominiums. Moreover, the economic magnitude of the IV estimates for *Speculation tax* are similar compared to our OLS estimates in Table 5 (columns 2,5) , while the economic magnitude and statistical significance of the estimates for *Capital gains tax* are greater in the IV approach. In line with our previous results we find no significant impact of the Transaction tax on house price growth.

5 Conclusions

Excessive growth of house prices is seen as one of the major determinants of the recent financial and economic crisis, in the US and in the euro area (e.g. Ireland). Motivated by the search for macroprudential instruments it has been argued that a transaction tax and a

[28] For the variable *Tourism* we employ values for 1985-1989 instead of 1980-1984 due to lack of data for the latter period.

capital gains tax on real-estate sales may dampen the swings in prices in the housing market by "throwing sand in the wheels" of short-term speculation.[29] We investigate the effect of capital gains taxes and transaction taxes on house price dynamics, exploiting the variation in tax rates across Swiss cantons, as well as changes in these tax rates with cantons over the last three decades.

Similar to previous evidence for Tobin taxes in financial asset markets (e.g. Hau 2006) we find no evidence that transaction taxes affect house price growth. Our findings also support theoretical models (Englund, 1986) which suggest a lock-in effect of capital gains taxes. Taxes on capital gains, and in particular penalty taxes on short-term gains, seem to fuel price growth by making house owners more reluctant to sell their property. The lock-in effect is strongest in tourist destinations where we expect to find more real estate transactions motivated by pure investment considerations.

Overall, our findings suggest that taxes on transaction values and capital gains in the real-estate market may not be suitable as instruments of macroprudential policy. Indeed, due to lock-in effects for existing home-owners, taxes on (short-term) capital gains may be counterproductive to the objective of more stable housing prices

[29] The OECD has, for instance, expressed a view along these lines. Cf. Fuest et al. (2004).

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Table 1. Variable definitions and sources

Sources: BAK (Basel Economics): www.bakbasel.ch. W&P (Wuest & Partner): http://www.wuestundpartner.com. SFSO (Swiss Federal Statistical Office): www.bfs.admin.ch. SFTA (Swiss Federal Tax Administration): www.estv.admin.ch. SNB (Swiss National Bank): www.snb.ch

Variable name	Definition	Source	Level of observation	Periodicity
	House prices			
Price growth SFH	Average annual growth rate of the hedonic transaction price index of single-family houses.	W&P	MS-region	1985-1989 / 1990-1994 / 1995-1999 / 2000-2004 / 2005-2009
Price growth CON	Average annual growth rate of the hedonic transaction price index of condominiums.	W&P	MS-region	1985-1989 / 1990-1994 / 1995-1999 / 2000-2004 / 2005-2009
	Taxation of real estate transactions			
Capital gains tax	Top marginal gains tax rate (%) if real estate has been held for five years.	Cantonal tax authorities, SFTA	Canton	1985 / 1990 / 1995 / 2000 / 2005
Speculation tax	Additional tax (in %) on capital gains if real estate is sold after less than one year instead of after 5 years.	Cantonal tax authorities, SFTA	Canton	1985 / 1990 / 1995 / 2000 / 2005
Transaction tax	Top marginal transaction tax rate (%).	Cantonal tax authorities, SFTA	Canton	1985 / 1990 / 1995 / 2000 / 2005
	Control variables			
Income tax	Average tax rate on annual income of 100'000 CHF	SFTA	Canton	1985-2008
Income growth	Average annual growth rate of per capita income (nominal).	BAK	MS-region	1985-1989 / 1990-1994 / 1995-1999 / 2000-2004 / 2005-2008
Population growth	Average annual growth rate of population.	SFSO	MS-region	1985-1989 / 1990-1994 / 1995-1999 / 2000-2004 / 2005-2008
Housing stock growth	Average annual net growth rate of the stock of dwellings (lagged by one observation period).	SFSO	MS-region	1985-1989 / 1990-1994 / 1995-1999 / 2000-2004 / 2005-2008
Mortgage rate	Mortgage interest rate offered by cantonal banks on new mortgages.	SNB	Canton	1985-1989 / 1990-1994 / 1995-1999 / 2000-2004 / 2005-2008
Tourism	Number of overnight stays per annum divided by the resident population	SFSO	MS-region	1985-1989 / 1990-1994 / 1995-1999 / 2000-2004
	Instrumental variables			
Left-wing executive	Share of left-wing members of canton-level executive.	SFSO	Canton	1980-1984 / 2000-2004
Budget referendum	Canton has a mandatory referendum on key budget positions (1=yes)	Funk & Gathmann	Canton	1980 / 2000
Land used	Ratio of residential area to total area of a canton.	SFSO	Canton	1980-1984/ 2000-2004
Tourism_canton	Number of overnight stays per annum divided by the resident population	SFSO	Canton	1985-1989 / 2000-2004

Table 2. Summary statistics

This panel reports the mean and standard deviation (in brackets) across the 92 MS-regions in our sample for the periods 1985-1989, 1990-1994, 1995-1999, 2000-2004, 2005-2009 separately and all 5 periods together. Definitions and sources of the variables are provided in Table 1.

Period	1985-1989	1990-1994	1995-1999	2000-2004	2005-2009	all 5 periods
House prices						
Price growth SFH	3.69 (1.99)	-0.11 (1.44)	-0.22 (1.03)	0.93 (1.79)	3.94 (2.01)	1.65 (2.48)
Price growth CON	4.97 (1.22)	0.08 (1.33)	-1.99 (1.24)	1.98 (1.58)	4.54 (2.44)	1.91 (3.10)
Taxation of real estate transactions						
Capital gains tax	31.17 (7.52)	33.21 (9.36)	33.87 (8.95)	33.97 (9.02)	32.45 (9.13)	32.94 (8.84)
Speculation tax	12.91 (8.42)	12.65 (7.77)	14.60 (9.68)	14.60 (9.67)	16.32 (7.44)	14.21 (8.71)
Transaction tax	1.86 (1.05)	1.84 (1.03)	1.84 (0.97)	1.76 (0.87)	1.60 (1.03)	1.78 (0.99)
Control variables						
Income tax	11.80 (1.68)	10.24 (1.62)	10.95 (1.65)	10.55 (1.67)	10.22 (1.78)	10.75 (1.77)
Income growth	5.29 (0.89)	3.00 (1.08)	1.09 (1.09)	-0.19 (1.45)	3.07 (1.48)	2.45 (2.24)
Population growth	0.88 (0.71)	1.10 (0.69)	0.26 (0.72)	0.76 (0.61)	0.78 (0.73)	0.76 (0.74)
Housing stock growth	1.67 (0.79)	1.70 (0.62)	2.05 (1.15)	1.23 (0.53)	0.70 (1.04)	1.47 (0.97)
Mortgage rate	5.50 (0.06)	6.91 (0.14)	4.57 (0.07)	3.82 (0.07)	3.17 (0.04)	4.79 (1.31)
Tourism	3.19 (6.21)	3.19 (6.21)	2.79 (5.42)	2.78 (5.43)	2.79 (5.37)	2.95 (5.72)
Instrumental variables (canton averages)						
Left-wing executive	0.18 (0.14)				0.19 (0.12)	
Budget referendum	0.57 (0.51)				0.38 (0.50)	
Land used	6.05 (8.05)				6.71 (8.21)	
Toursim_canton	2.29 (3.17)				2.09 (2.68)	

Table 3. Taxes on real estate gains and transaction values by canton

The table displays the value of the variables *Capital gains tax* (in %), *Speculation tax* (in %) and *Transaction tax* (in %) in 1985 and 2005 for the 21 cantons in the sample. Definitions and sources of the variables are provided in Table 1.

		Capital gains tax		Speculation tax		Transaction tax	
Canton	Abbr.	1985	2005	1985	2005	1985	2005
Aargau	AG	30	32	19	8	0.4	0.5
Appenzell I.Rh.	AI	38	38	12	12	1.0	1.0
Bern	BE	39	34	22	30	1.5	1.8
Basel-Landschaft	BL	25	25	25	20	3.0	2.5
Basel-Stadt	BS	32	48	0	12	3.0	3.0
Fribourg	FR	29	29	20	20	4.0	3.0
Genève	GE	20	30	12	20	3.0	3.0
Glarus	GL	29	29	9	11	0.5	0.5
Graubünden	GR	30	50	8	13	1.5	1.5
Luzern	LU	27	27	14	14	1.5	1.5
Neuchâtel	NE	24	40	16	24	4.0	3.3
Nidwalden	NW	25	29	11	11	1.0	1.0
Obwalden	OW	16	17	7	8	1.5	1.5
Schaffhausen	SH	48	44	21	20	0.7	0.7
Schwyz	SZ	27	27	15	15	1.0	1.0
Thurgau	TG	40	40	10	10	1.0	1.0
Ticino	TI	26	26	10	4	1.1	1.1
Uri	UR	33	44	10	11	0.3	0.2
Vaud	VD	18	18	0	12	3.3	3.3
Valais	VS	40	26	0	12	1.4	1.4
Zürich	ZH	38	38	22	22	2.0	0.0

Table 4. Full-sample difference-in-difference tests

This table relates the difference in price growth 2005-2009 minus 1985-1989 for single family houses (Δ Price growth SFH) and condominiums (Δ Price growth CON) to changes (2005 minus 1985) in *Capital gains tax*, *Speculation tax* and *Transaction tax.* The table reports the outcome of t-tests comparing those MS-regions which are located in cantons that increased taxes to those MS-regions located in cantons which did not change taxes and to those which reduced taxes.

		Δ Price growth SFH		Δ Price growth CON	
	Observations	Mean	Std. Err.	Mean	Std. Err.
Full sample	*92*	*0.257*	*0.307*	*-.428*	*0.282*
Δ Capital gains tax					
increase	24	0.324	0.653	-0.173	0.541
same	41	-0.325	0.409	-0.969	0.378
decrease	27	1.186	0.582	0.169	0.592
ΔΔ increase - same	65	0.717	0.731	0.796	0.644
ΔΔ increase - decrease	68	-0.861	0.872	-0.343	0.809
Δ Speculation tax					
increase	50	1.369	0.457	0.299	0.420
same	25	-1.395	0.337	-1.650	0.383
decrease	17	-0.582	0.493	-0.765	0.541
ΔΔ increase - same	75	2.764***	0.691	1.95***	0.654
ΔΔ increase - decrease	67	1.951**	0.837	1.065	0.787
Δ Transaction tax					
increase	19	-1.335	0.419	-2.107	0.439
same	51	1.291	0.458	0.481	0.410
decrease	22	-0.764	0.384	-1.085	0.378
ΔΔ increase - same	70	-2.626***	0.795	-2.588***	0.724
ΔΔ increase - decrease	41	-0.570	0.567	-1.021	0.576

Table 5. Full-sample multivariate results

The dependent variables are *Price growth SFH* and *Price growth CON*. The time dimension of the panel covers the five periods 1985-1989, 1990-1994, 1995-1999, 2000-2004, 2005-2009. Standard errors, clustered by canton are reported in brackets. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. Definitions and sources of all variables are provided in Table 1.

Dependent variable:	*Price growth SFH*			*Price growth CON*		
MS-regions						
Periods	*All*	*1985-1989, 2005-2009*	*1990-1994, 1995-1999, 2000-2004*	*All*	*1985-1989, 2005-2009*	*1990-1994, 1995-1999, 2000-2004*
Model	(1)	(2)	(3)	(4)	(5)	(6)
Capital gains tax	0.067	0.09	0.035	0.042	0.097	0.001
	[0.057]	[0.068]	[0.122]	[0.041]	[0.049]*	[0.101]
Speculation tax	0.18	0.303	-0.047	0.163	0.242	0.014
	[0.058]***	[0.088]***	[0.088]	[0.058]**	[0.079]***	[0.086]
Transaction tax	-0.827	-0.73	-1.867	-0.583	-0.854	-1.602
	[0.356]**	[0.885]	[2.113]	[0.421]	[0.889]	[1.214]
Income tax	-0.709	-1.558	-0.399	-0.715	-1.477	-0.729
	[0.477]	[0.642]**	[0.692]	[0.320]**	[0.625]**	[0.470]
Income growth	-0.091	0.027	-0.028	0.039	0.228	0.001
	[0.089]	[0.264]	[0.156]	[0.051]	[0.241]	[0.087]
Population growth	0.111	-0.327	0.437	0.477	0.581	0.414
	[0.293]	[0.601]	[0.424]	[0.312]	[0.704]	[0.414]
Housing stock growth	0.16	0.161	0.185	0.091	-0.301	0.194
	[0.183]	[0.537]	[0.378]	[0.160]	[0.520]	[0.278]
Mortgage rate	0.25	-2.271	-1.06	-1.509	-1.214	-2.026
	[2.354]	[5.875]	[2.997]	[1.676]	[6.632]	[2.493]
MS-region FE	yes	yes	yes	yes	yes	yes
Period FE	yes	yes	yes	yes	yes	yes
Observations	460	184	276	460	184	276
R-squared	0.68	0.69	0.40	0.83	0.698	0.746
Number of MS-regions	92	92	92	92	92	92
Number of Cantons	21	21	21	21	21	21
Number of periods	5	2	3	5	2	3

Table 6. Multivariate Analysis by Tourism Intensity

The dependent variables are *Price growth SFH* and *Price growth CON*. The time dimension of the panel covers the 2 periods 1985-1989 and 2005-2009. High tourism, Medium tourism and Low tourism regions are defined based on terciles of the ratio of tourist overnight stays in comparison to local population measured over the entire observation period. Heteroskedasticity-robust standard errors, clustered by canton are reported in brackets. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. Definitions and sources of all variables are provided in Table 1.

Dependent variable:	*Price growth SFH*				*Price growth CON*			
Periods	*1985-1989, 2005-2009*				*1985-1989, 2005-2009*			
MS-regions	*Tourism = high*	*Tourism = medium*	*Tourism = low*	*All*	*Tourism = high*	*Tourism = medium*	*Tourism = low*	*All*
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Capital gains tax	0.124	-0.011	0.17	0.032	0.114	0.052	0.144	0.066
	[0.040]***	[0.068]	[0.107]	[0.087]	[0.039]**	[0.066]	[0.117]	[0.095]
Speculation tax	0.433	0.137	0.122	0.197	0.36	0.135	0.046	0.148
	[0.141]***	[0.090]	[0.087]	[0.110]*	[0.132]**	[0.070]*	[0.089]	[0.100]
Transaction tax	-0.14	0.179	0.049	-0.624	0.116	-0.915	0.507	-0.708
	[0.928]	[1.202]	[1.285]	[0.666]	[0.695]	[1.286]	[1.392]	[0.721]
*Tourism = high **								
Capital gains tax				0.073				0.033
				[0.091]				[0.107]
Speculation tax				0.33				0.288
				[0.172]*				[0.158]*
Transaction tax				-1.031				-1.022
				[0.825]				[0.899]
MS-region FE	yes	yes	yes	yes	yes	yes	yes	yes
MS-region controls	yes	yes	yes	yes	yes	yes	yes	yes
Period FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	60	62	62	184	60	62	62	184
R-squared	0.85	0.82	0.85	0.75	0.849	0.811	0.845	0.747
Number of MS-regions	30	31	31	92	30	31	31	92
Number of Cantons	13	14	10	21	13	14	10	21
Number of periods	2	2	2	2	2	2	2	2

Table 7. Controlling for endogeneity of tax changes

The dependent variables are *Price growth SFH* and *Price growth CON*. The time dimension of the panel covers the two high price-growth periods 1985-1989 and 2005-2009. In columns (1-2) we instrument the variables *Capital gains tax*, *Speculation tax* and *Transaction tax* with the variables *Left-wing executive, Budget referendum, Land used* and *Tourism_canton*. First stage regressions for this IV analysis are presented in columns (3-5). Heteroskedasticity-robust standard errors, clustered at the canton-level are reported in brackets. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. Definitions and sources of all variables are provided in Table 1.

MS-regions	All regions				
Periods	*1985-1989, 2005-2009*				
Dependent variable:	*Price growth SFH*	*Price growth CON*	*Capital gains tax*	*Speculation tax*	*Transaction tax*
Model	(1)	(2)	(3)	(4)	(5)
Capital gains tax	0.219	0.21			
	[0.066]***	[0.078]***			
Speculation tax	0.299	0.214			
	[0.090]***	[0.084]**			
Transaction tax	-0.85	-0.683			
	[0.881]	[0.840]			
Left-wing executive			-8.933	25.102	-1.551
			[8.065]	[6.851]***	[0.418]***
Budget referendum			-2.072	4.382	0.528
			[2.754]	[2.960]	[0.105]***
Land used			4.435	-9.019	-1.138
			[6.066]	[4.795]*	[0.346]***
Tourism_canton			-8.68	3.275	0.016
			[2.960]***	[1.930]	[0.082]
MS-region controls	yes	yes	yes	yes	yes
Canton FE	yes	yes	yes	yes	yes
Period FE	yes	yes	yes	yes	yes
IV	2nd stage	2nd stage	1st stage	1st stage	1st stage
Observations	184	184	184	184	184
R-squared	0.490	0.432	0.885	0.919	0.976
F-Test of instruments			3.10	6.83	10.51
Hansen J-Test (p-value)	0.30	0.13			
Number of MS-regions	92	92	92	92	92
Number of Cantons	21	21	21	21	21
Number of periods	2	2	2	2	2

Figure 1. House price growth by period

This figure displays box plots for the variables *Price growth SFH* and *Price growth CON* for the five periods 1985-1989, 1990-1994, 1995-1999, 2000-2004 and 2005-2009. For each period the figure shows the distribution across MS-regions. Each box starts at the lower quartil (25th percentile) and ends at the upper quartil (75th percentile). The line inside the box indicates the median. The upper and lower adjacent values are defined as the 75th (25th) percentiles plus (minus) 1.5 times the size of the box (75th percentile - 25th percentiles). Outside values are represented by dots.

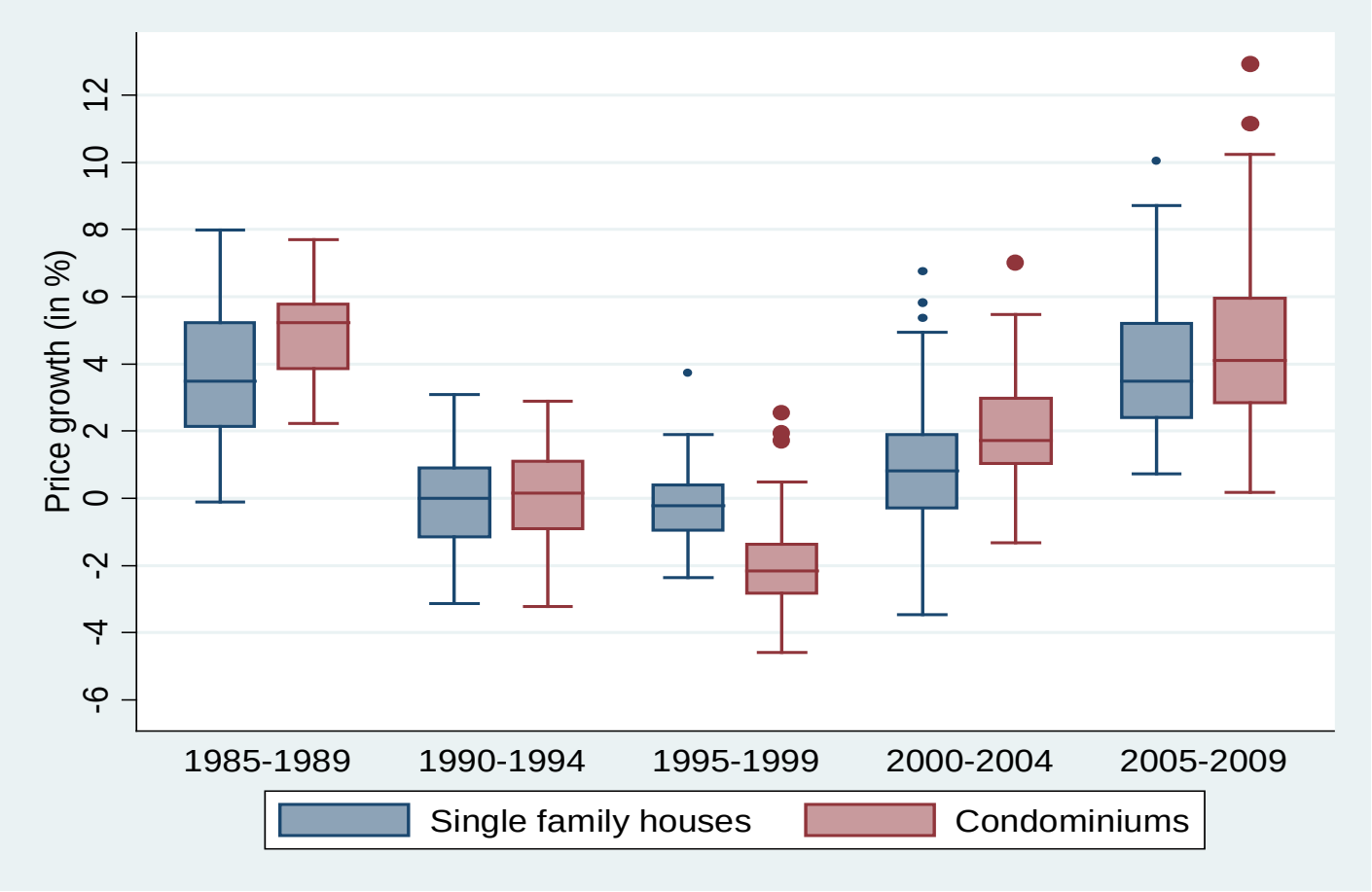
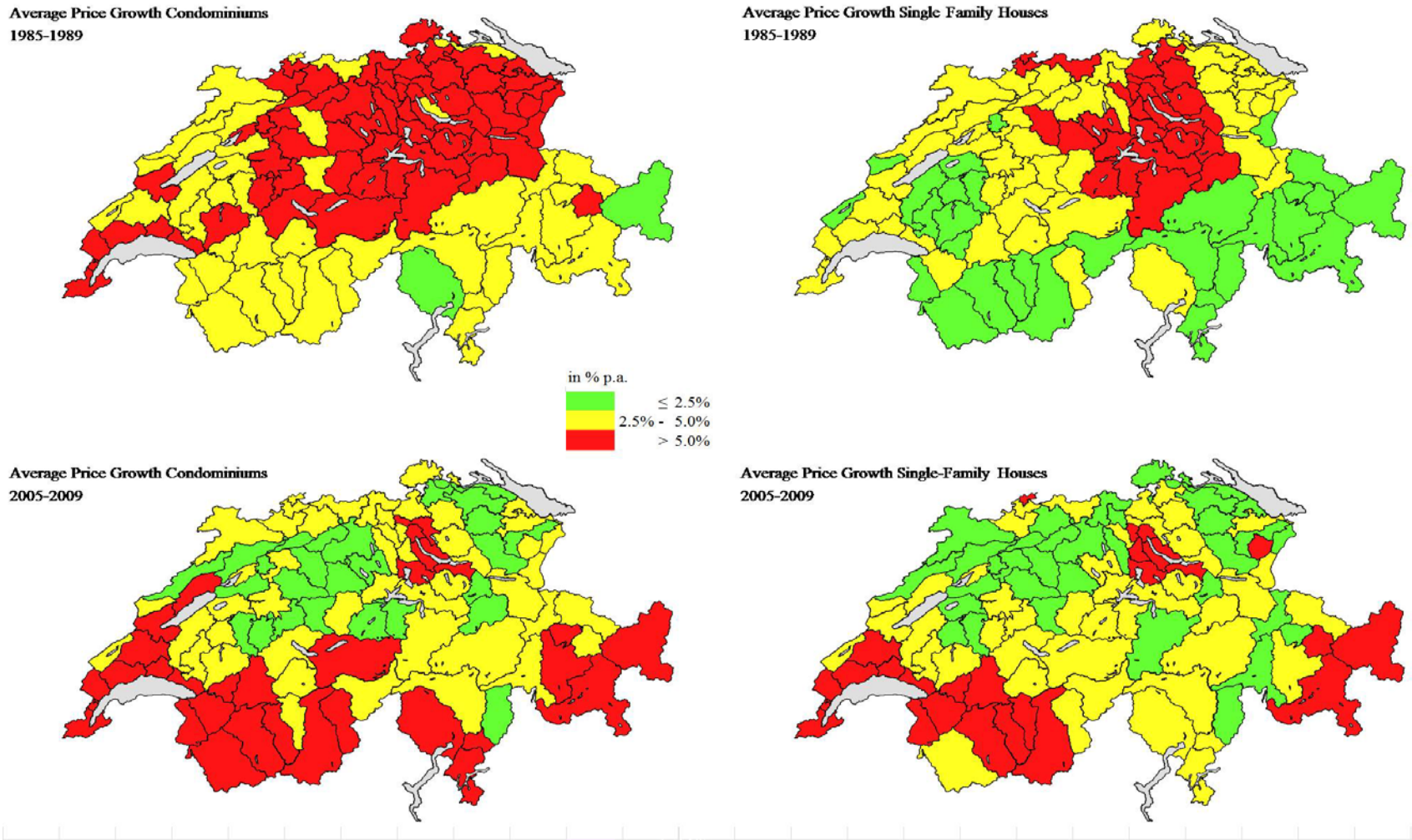


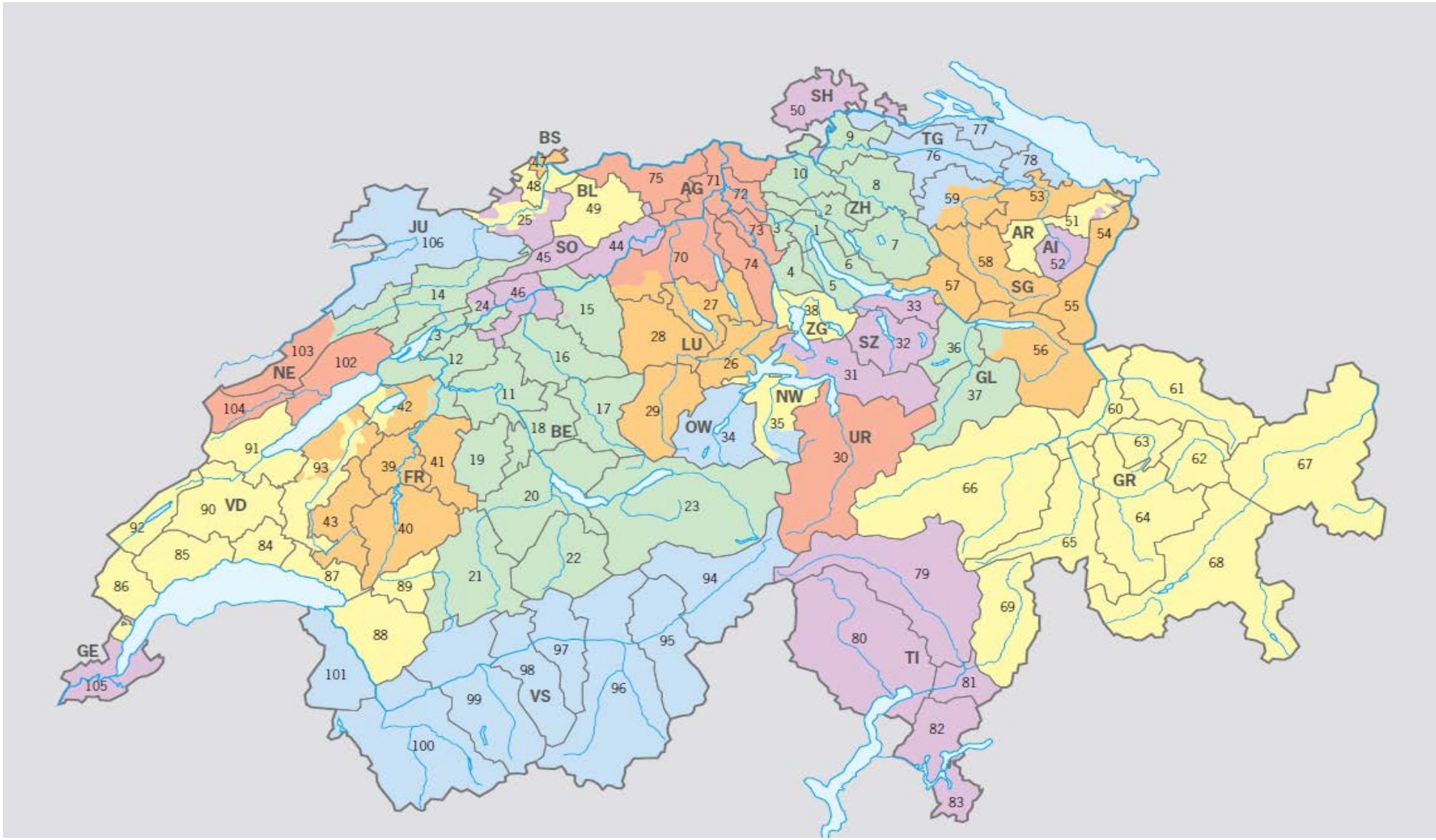
Figure 2. House price growth by MS-region: 1985-1989 & 2005-2009

This figure displays the realization of the variables *Price growth SFH* and *Price growth CON* for each MS-region for the two periods 1985-1989 and 2005-2009. MS-regions with annual price growth below 2.5% are shaded green. MS-regions with annual price growth between 2.5% and 5% are shaded yellow. MS-regions with annual price growth above 5% are shaded red.



Appendix A1. Cantons and MS-regions

This figure displays the 26 cantons and the 106 MS-regions in Switzerland. Source: SFSO.



Appendix A1. Cantons and MS-regions

The table lists the 106 MS-regions and their attribution to a canton. Note that information on the attribution of municipalities to MS-regions and cantons is available. In 14 MS-regions the municipalities belong to two or more cantons. These MS-regions have been assigned to the canton that covers the majority of municipalities. *Source:* SFSO.

Canton	Abbr.	MS-region	MS-region nb.
Zürich	ZH	Zürich	1
		Glattal-Furttal	2
		Limmattal	3
		Knonaueramt	4
		Zimmerberg	5
		Pfannenstiel	6
		Zürcher Oberland	7
		Winterthur	8
		Weinland	9
		Zürcher Unterland	10
Bern	BE	Bern	11
		Erlach-Seeland	12
		Biel/Bienne	13
		Jura bernois	14
		Oberaargau	15
		Burgdorf	16
		Oberes Emmental	17
		Aaretal	18
		Schwarzwasser	19
		Thun	20
		Saanen-Obersimmental	21
		Kandertal	22
		Oberland-Ost	23
Luzern	LU	Luzern	26
		Sursee-Seetal	27
		Willisau	28
		Entlebuch	29
Uri	UR	Uri	30
Schwyz	SZ	Innerschwyz	31
		Einsiedeln	32
		March	33
Obwalden	OW	Sarneraatal	34
Nidwalden	NW	Nidwalden	35
Glarus	GL	Glarner Unterland	36
		Glarner Hinterland	37
Zug	ZG	Zug	38
Fribourg	FR	La Sarine	39
		La Gruyère	40
		Sense	41
		Murten/Morat	42
		Glâne-Veveyse	43
Solothurn	SO	Grenchen	24
		Olten	44
		Thal	45
		Solothurn	46
Basel-Stadt	BS	Basel-Stadt	47
Basel-Landschaft	BL	Laufental	25
		Unteres Baselbiet	48
		Oberes Baselbiet	49
Schaffhausen	SH	Schaffhausen	50
Appenzell Ausserrhoden	AR	Appenzell A.Rh.	51
Appenzell Innerrhoden	AI	Appenzell I.Rh.	52
St.Gallen	SG	St.Gallen	53
		Rheintal	54
		Werdenberg	55
		Sarganserland	56
		Linthgebiet	57
		Toggenburg	58
		Wil	59
Graubünden	GR	Chur	60
		Prättigau	61
		Davos	62
		Schanfigg	63
		Mittelbünden	64
		Viamala	65
		Surselva	66
		Engiadina Bassa	67
		Oberengadin	68
		Mesolcina	69
Aargau	AG	Aarau	70
		Brugg-Zurzach	71
		Baden	72
		Mutschellen	73
		Freiamt	74
		Fricktal	75
Thurgau	TG	Thurtal	76
		Untersee	77
		Oberthurgau	78
Ticino	TI	Tre Valli	79
		Locarno	80
		Bellinzona	81
		Lugano	82
		Mendrisio	83
Vaud	VD	Lausanne	84
		Morges	85
		Nyon	86
		Vevey	87
		Aigle	88
		Pays d'Enhaut	89
		Gros-de-Vaud	90
		Yverdon	91
		La Vallée	92
		La Broye	93
Valais	VS	Goms	94
		Brig	95
		Visp	96
		Leuk	97
		Sierre	98
		Sion	99
		Martigny	100
		Monthey	101
Neuchâtel	NE	Neuchâtel	102
		La Chaux-de-Fonds	103
		Val-de-Travers	104
Genève	GE	Genève	105
Jura	JU	Jura	106

Appendix A2. Tax regimes by canton

This table provides an overview of the current (2010) tax regimes of the real-estate capital gains tax and transaction tax by canton. For the capital gains tax *Taxing authority* indicates by who the tax is levied. *Taxation of accumulated gains* indicates whether all realized gains within a year are accumulated or taxed separately. If real estate was owner-occupied and the proceeds of selling it are reinvested within a certain time period in owner-occupied housing then taxation is postponed (*Postponement upon reinvestment*). In GE the tax is reimbursed instead of postponed. The tax is also postponed in the case of inheritance (except in NE and GE) and donation. In some cantons the capital gains tax rate increases with the size of the gain (*Progression gain*) and in all cantons the rate depends on the holding duration (*Degression holding duration*). Some cantons have a base tax rate which is multiplied every year by a cantonal only or a cantonal, municipal and a parish-factor (*Annual multiplier*). The tax rate may vary across municipalities (*Variation across municipalities*).
The transaction tax rate is *Proportional in transaction value*, *Progressive in transaction value* or is a *Fixed fee*. The transaction tax rate does not vary with the holding duration. The last column indicates whether there is a reduced transaction tax rate or no tax for certain types of transactions (for example transfers within family) (*Exemptions*). In cantons where taxes vary across municipalities the tax rate of the major city has been used. The sources are the cantonal tax authorities and the SFTA. * In Zurich the transfer tax has been abolished per January 2005 and in Schwyz per January 2009. ** For gains from owner-occupied housing the tax is 30%, independent of the holding duration.

		Capital gains tax	Taxing authority					Rate				**Transaction tax**	Taxing authority			Rate				
Canton	Abbr.		Canton	Municipality	Canton and municipality	Taxation of accumulated gains	Postponement upon reinvestment	Progression in gain	Degression in holding duration	Annual multiplier	Variation across municipalities		Canton	Municipality	Canton and municipality	Proportional in transaction value	Progression in transaction value	Fixed fee	Variation across municipalities	Exemptions
Aargau	AG		x	o	o	o	x	o	x	o	o		x	o	o	x	o	o	o	x
Appenzell I.Rh.	AI		x	o	o	o	x	x	x	o	o		x	o	o	x	o	o	o	x
Appenzell A.Rh.	AR		x	o	o	o	x	o	x	o	o		o	x	o	x	o	o	x	x
Bern	BE		o	o	x	x	x	x	x	x	x		x	o	o	x	o	o	o	x
Basel-Landschaft	BL		x	o	o	x	x	x	x	o	o		x	o	o	x	o	o	o	x
Basel-Stadt	BS		o	o	x	o	x	o	x**	o	x		x	o	o	x	o	o	o	x
Fribourg	FR		o	o	x	o	x	o	x	o	o		o	o	x	x	o	o	x	x
Genève	GE		x	o	o	o	o	o	x	o	o		x	o	o	x	o	o	o	x
Glarus	GL		x	o	o	o	x	x	x	o	o		x	o	o	x	o	o	o	x
Graubünden	GR		o	o	x	x	x	x	x	o	x		o	x	o	x	o	o	x	x
Jura	JU		o	o	x	x	x	x	x	x	x		x	o	o	x	o	o	o	x
Luzern	LU		x	o	o	o	x	x	x	x	o		x	o	o	x	o	o	o	x
Neuchâtel	NE		x	o	o	o	x	x	x	o	o		x	o	o	x	o	o	o	x
Nidwalden	NW		x	o	o	o	x	o	x	o	o		x	o	o	x	o	o	o	x
Obwalden	OW		x	o	o	x	x	o	x	x	x		x	o	o	x	o	o	o	x
St.Gallen	SG		x	o	o	o	x	x	x	x	o		o	x	o	x	o	o	o	x
Schaffhausen	SH		o	o	x	o	x	x	x	x	x		x	o	o	x	o	o	o	x
Solothurn	SO		x	o	o	o	x	x	x	x	x		x	o	o	x	o	o	o	x
Schwyz*	SZ		x	o	o	x	x	x	x	o	o		-	-	-	-	-	-	-	-
Thurgau	TG		x	o	o	o	x	o	x	o	o		x	o	o	x	o	o	o	x
Ticino	TI		x	o	o	o	x	o	x	o	o		x	o	o	o	x	o	o	x
Uri	UR		x	o	o	o	x	x	x	o	o		x	o	o	o	x	o	o	o
Vaud	VD		x	o	o	o	x	o	x	o	o		o	o	x	x	o	o	x	x
Valais	VS		x	o	o	o	x	x	x	o	o		x	o	o	o	x	o	o	o
Zug	ZG		o	x	o	o	x	x	x	o	o		x	o	o	x	o	x	o	o
Zürich*	ZH		o	x	o	o	x	x	x	o	o		-	-	-	-	-	-	-	-