Online Appendix B - Calibration

Description: presented here is the calibrated data matrix with the fuzzy-set values, as well as the detailed calibration methods and procedure.

CALIBRATED DATA MATRIX

Table B.1: Fuzzy-set membership values of the Swiss cantons in the sets of the outcome and the six conditions.

	Outcome	**Conditions**					
Cases	**URBSPRA**	**1. MUNAUT**	**2. INSFRA**	**3. OVDBZ**	**4. DEMO**	**5. ECOPOW**	**6. URBPOP**
AG - Aargau	0.69	0.33	0.98	0.56	0.95	0.05	0.90
AR - Appenzell Ausserrhoden	0.55	1	0.45	0.6	0.06	0	0.74
AI - Appenzell Innerrhoden	0.37	1	0.26	0.62	0.61	0.01	0
BL - Basel-Landschaft	0.36	0.67	0.92	0.24	0.75	0.51	0.98
BS - Basel-Stadt	0.01	0	0.01	0.03	0.03	1	0.99
BE - Bern	0.45	0.67	0.95	0.35	0.37	0.72	0.65
FR - Fribourg	0.89	1	0.95	0.84	1	0	0.65
GE - Geneva	0.02	0	0.32	0.07	0.96	0.98	0.99
GL - Glarus	0.82	1	0.62	0.73	0.06	0.26	0.68
GR - Graubünden	0.96	1	0.92	0.79	0.44	0.58	0.02
JU - Jura	0.98	1	0.82	0.99	0.23	0.08	0.07
LU - Lucerne	0.38	0.67	0.82	0.35	0.84	0.13	0.29
NE - Neuchâtel	0.19	0.33	0.46	0.48	0.48	0.84	0.95
NW - Nidwalden	0.23	1	0.46	0.26	0.93	0.52	0.05
OW - Obwalden	0.66	1	0.36	0.58	0.92	0.13	0
SG - Saint Gallen	0.43	1	0.92	0.4	0.7	0.63	0.88
SH - Schaffhausen	0.62	0.67	0.26	0.48	0.28	0.88	0.95
SZ - Schwyz	0.16	0.33	0.73	0.45	0.99	0	0.86
SO - Solothurn	0.88	0.33	0.97	0.55	0.62	0.18	0.92
TG - Thurgau	0.94	0.67	0.95	0.75	0.86	0.02	0.39
TI - Ticino	0.86	0.67	0.88	0.63	0.87	0.8	0.96
UR - Uri	0.72	1	0.45	0.45	0.08	0	0.94
VS - Valais	0.96	1	0.95	0.99	0.94	0	0.68
VD - Vaud	0.43	0.67	0.92	0.53	0.97	0.53	0.95
ZG - Zug	0.03	0.33	0.41	0.12	0.99	1	0.99
ZH - Zurich	0.08	0	0.62	0.14	0.96	0.96	0.99

Calibration method and procedure

OUTCOME: High degrees of urban sprawl – URBSPRA

Direct method of calibration:

- Fully in ≥ 15000 UPU / (inhabitants + jobs)
- Crossover point = 11000 UPU / (inhabitants + jobs)
- Fully out ≤ 7000 UPU / (inhabitants + jobs)

In absence of external references, the set URBSPRA was calibrated by fixing anchors corresponding to natural gaps in the data. The crossover point corresponds not only to a natural gap but also to the median. Given this occurrence, the 11000 value represents the ideal start for testing possible crossover points. A robustness test was performed by raising and lowering the crossover point corresponding to other natural gaps in the data (10000 and 13000). The robustness test is presented and discussed in online appendix C. The "fully in" and "fully out" anchors correspond to the higher and lower gaps observable in the data.

CONDITIONS

1. **High degrees of municipal autonomy – MUNAUT**

Conversion of the 4-class ordinal index into four distinct fuzzy set values:

- 1 = maximal municipal autonomy
- 0.67 = nearly absent cantonal control
- 0.33 = light cantonal control
- 0 = cantonal control

The crossover point is placed between the second and third ordinal categories. In the first two categories, the policy measures for cantonal control on land use that are relevant to our study are absent or truly weak. By contrast, in both the third and fourth categories, these measures are present, although they are used more widely and systematically in the fourth category. Following the example in Rihoux and Ragin (2009), the value of 1 is attributed to the cantons that are "fully in" the set of MUNAUT; 0.67 is attributed to the cantons that are "more in than out" of the set; 0.33 is attributed to the cantons that are "more out than in" the set; 0 means that they are "fully out".

2. **High degrees of institutional fragmentation - INSFRA**

Direct method of calibration:

- Fully in ≤ 0.03 Institutional consolidation index (ICI)
- Crossover point = 0.09
- Fully out ≥ 0.5

Notably, in the raw data (the ICI presented in the main text), 0 represents fragmentation and 1 represents consolidation. The logic had to be reverted in order to create the "High degrees of institutional fragmentation" set.

In this case, the qualitative comparison with Sweden, which is the example cited in the main text, is useful as an external reference. The mean of the ICI index for the Swedish counties is 0.21, and the mean for the Swiss cantons is 0.11. To understand the qualitative difference between an ICI value of 0.11 and an ICI value of 0.21, consider two hypothetical cantons: Canton A has 100'000 inhabitants distributed in 10 municipalities of 10'000 inhabitants each. Canton B has 50'000 inhabitants distributed in 5 municipalities of once again 10'000 inhabitants each. The ICI value is 0.10 for Canton A and 0.20 for Canton B. The latter is indeed much less fragmented since his territory is only divided in 5 municipalities, and not 10, meaning that Canton B is in a condition where there is a considerably lower number of municipal actors involved in the implementation of the land-use planning policy.
The initial idea was to use the mean ICI for Swedish counties as a crossover point for Switzerland. This approach would have been useful to distinguish the consolidated cantons (those with an ICI higher than the Swedish mean) from the more fragmented ones (those with an ICI lower than the Swedish mean). However, since the Swedish mean was 0.21 and the Swiss cantons had low ICI values, only 3 cases would have been more out than in the set "high degrees of institutional fragmentation" (remember the logic is reverted). Only two other cases are relatively close to

the 0.21 value (Geneva with 0.19 and Obwalden with 0.17). Hence, the crossover point had to be lowered to the minimum Swedish ICI value (0.09), which also corresponds to a gap in the data. Hence, the cases "more out than in" the set "high degrees of institutional fragmentation" in Switzerland are those that display at least a degree of consolidation similar to the less consolidated Swedish county (which still represents a good instance of a consolidated local territorial institution in a European comparison).
The "fully out" threshold separates the highly consolidated canton of Basel-Stadt (ICI = 0.79) from the group of "more out than in" cantons clustered between ICI = 0.09 and ICI = 0.23. The 0.5 ICI value represents, for example, an ideal canton of 200,000 inhabitants divided in two municipalities of 100,000 inhabitants each or any other situation where the cantonal population is divided in two municipalities of the same size. Hence, any situation presenting an ICI > 0.5 can be qualitatively defined as fully out of the INSFRA set. The "fully in" threshold is based on the data distribution since external references were not available.

3. **Oversized designated building zones – OVDBZ**

Direct method of calibration:

- Fully in ≥ 500 m2/inhabitant
- Crossover point = 335 m2/inhabitant
- Fully out ≤ 150 m2/inhabitant

Since external references were not available, natural gaps in the data were used in order to establish the three anchors.

4. **Strong demographic growth – DEMO**

Direct method of calibration:

- Fully in ≥ 15%
- Crossover point = 4.8%
- Fully out ≤ -3%

The original idea was to create a set labelled "Demographic growth" by fixing the crossover point at 0% in the raw data to distinguish cases with positive and negative demographic evolutions. However, the result would have been a set with highly skewed membership degrees (only 4 cantons had a negative evolution during the 1995-2010 period). Thus, the set was renamed "Strong demographic growth," and the crossover point was increased to reflect this qualitative state. The new threshold (4.8%) is based on an external reference and corresponds to the mean demographic growth rate for the EU countries during the 1995-2010 period (data retrieved on http://databank.worldbank.org, accessed 24 September 2018). The fully in and fully out anchors were based on the highest and lowest natural gaps in the data respectively.

5. **Economic power - ECOPOW**

Direct method of calibration:

- Fully in ≥ 96,000 CHF (cantonal GDP per inhabitant in CHF)
- Crossover point = 67,000 CHF (cantonal GDP per inhabitant in CHF)
- Fully out ≤ 62,000 CHF (cantonal GDP per inhabitant in CHF)

In the case of the ECOPOW set, it was particularly hard to find a relevant external reference. For example, which cantons can be defined as "poor" in an international comparison in terms of GDP per capita? How should the lower threshold for this set be fixed? The retained strategy was to analyse the data distribution. Two main groups of cantons divided by the 66,000 CHF threshold were identified. The lower tier is represented by Glarus with 65,297 CHF/inhabitant and by less rich cantons with less than 65,000 CHF / inhabitant. The upper tier is represented by cantons starting with approximately 70,000 CHF / inhabitant or more, including cantons like Vaud or Basel-Landschaft, which are just below the bar of 70,000 CHF/inhabitant. For the fully in anchor, the threshold of 96,000 CHF / inhabitant was used to distinguish the four "very rich cantons" of Zurich, Zoug, Geneva and Basel-Stadt from the others. For the lower threshold, a small gap in the data distinguish the cantons around and below 60,000 CHF / inhabitant (Thurgau has 60,247 CHF / inhabitant) from those with 62,000 CHF / inhabitant or more.

6. **Urban population – URBPOP**

Direct method of calibration:

- Fully in ≥ 90%
- Crossover point = 70%
- Fully out ≤ 50%

External references were useful for establishing the crossover point. The 2030 projection for the European countries is that 77% of their population will live in urban areas (United Nations, 2015). The threshold was fixed to 70% in order to qualify the cluster of cantons around 75% of urban population as “more in than out of the set” of URBPOP and distinguish them from the cantons with less than 70% of urban population (a gap is present between 67% and 74%). The fully out and fully in thresholds are based on the data distribution.

References

- United Nations (2015) *World Urbanization Prospects. The 2014 Revision.* New York: Department of Economic and Social Affairs, Population Division