The effects of local government amalgamation on public spending, taxation and service levels. Evidence from 15 years of municipal consolidation

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Appendix: additional results

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Table S1: Logistic regression: determinants of amalgamation

Population in 2000	-0.000096***
	(-5.47)
General grant per capita in 2000	-0.00066
	(-0.42)
Houses per capita in 2000	-0.68
	(-0.27)
Density in 2000	0.97**
	(2.49)
Observations	473

Dependent variable: probability that municipality is amalgamated in 2001-2011.
z-statistics in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.
Province dummies and constant included but not reported

Table S2: Regressions of total per capita spending: alternative control groups

Model	Static	Static	Static	Dynamic	Dynamic	Dynamic
Control group	Amalgamated or almost amalgamated	Amalgamated	All	Amalgamated or almost amalgamated	Amalgamated	All
A_{pre}	-0.04*	-0.05**	-0.03	-0.03*	-0.02	-0.02
	(-1.86)	(-2.19)	(-1.54)	(-1.84)	(-1.43)	(-1.33)
A_{0-3}	-0.03	-0.04	-0.02	0.00	0.01	0.01
	(-0.99)	(-1.36)	(-0.80)	(0.11)	(0.62)	(0.26)
A_{4-10}	-0.02	-0.03	-0.00	0.00	0.02	0.01
	(-0.58)	(-0.82)	(-0.09)	(0.12)	(0.77)	(0.43)
A_{11+}	-0.01	-0.02	0.01	0.00	0.03	0.01
	(-0.29)	(-0.40)	(0.28)	(0.03)	(0.91)	(0.43)
Lagged dependent				0.70***	0.69***	0.75***
				(17.19)	(12.40)	(44.50)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipal fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes
Municipal time trends	Yes	Yes	Yes	No	No	No
Observations	1,541	1,144	4,492	1,339	985	3,983
Municipalities	135	101	387	135	101	387
R^2	0.74	0.73	0.70			
Pseudo-R^2 (within)				0.67	0.68	0.63

T-values between parentheses, based on robust standard errors clustered by municipality.
Variables are expressed in logs.
Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table S3: Various robustness tests

Regressions similar to those in Table 2, but with alternative specifications

	Annexations included		$A_{4\text{-}8}$ and A_{9+} instead of $A_{4\text{-}10}$ and A_{11+}.		Without general grant as a control variable	
Model	Static	Dynamic	Static	Dynamic	Static	Dynamic
A_{pre}	-0.04**	-0.03*	-0.04*	-0.03*	-0.04**	-0.03*
	(-2.09)	(-1.93)	(-1.80)	(-1.86)	(-2.00)	(-1.82)
$A_{0\text{-}3}$	-0.02	-0.00	-0.03	0.00	-0.04	0.01
	(-0.82)	(-0.08)	(-0.89)	(0.08)	(-1.17)	(0.24)
$A_{4\text{-}10}$	-0.01	-0.00	-0.02	0.00	-0.02	0.00
	(-0.43)	(-0.05)	(-0.43)	(0.10)	(-0.59)	(0.16)
A_{11+}	-0.00	-0.00	-0.01	-0.00	-0.01	-0.00
	(-0.12)	(-0.10)	(-0.17)	(-0.03)	(-0.33)	(-0.02)
Lagged dependent		0.70***		0.70***		0.71***
		(20.37)		(17.25)		(17.06)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality time trends	Yes	No	Yes	No	Yes	No
Observations	1,681	1,463	1,541	1,339	1,541	1,339
Municipalities	147	147	135	135	135	135
R^2 (within)	0.73		0.74		0.73	
Pseudo-R^2		0.66		0.67		0.67

Control group: amalgamated or almost amalgamated.

T-values between parentheses, based on robust standard errors clustered by municipality.

Variables are expressed in logs.

Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table S4: Regressions of total per capita spending with spatial lag; dynamic panel data model

Control group	All	All	All
Balanced panel	No	Yes	Yes
A_{pre}	-0.02	-0.01	-0.01
	(-1.33)	(-0.34)	(0.18)
A_{0-3}	0.01	-0.01	-0.02
	(0.26)	(-0.16)	(0.49)
A_{4-10}	0.01	0.00	-0.00
	(0.43)	(0.12)	(0.02)
A_{11+}	0.01	-0.01	-0.01
	(0.43)	(-0.14)	(0.29)
Lagged dependent	0.75***	0.82***	0.75***
	(44.50)	(45.44)	(45.79)
Spatial lag			0.10***
			(4.61)
Spatial lag on lagged dependent			0.01
			(0.31)
Control variables	Yes	Yes	Yes
Year effects	Yes	Yes	Yes
Municipal fixed effects	Yes	Yes	Yes
Observations	3,983	2,704	2,704
Municipalities	387	246	246
Pseudo-R^2 (within)	0.63	0.62	

T-values between parentheses.
Variables are expressed in logs.
Significance: *** p<0.01, ** p<0.05, * p<0.1.

In Table S4 we check whether inclusion of spatial interaction effects affects the outcomes of the dynamic model. Elhorst (2010) compares a number of different dynamic panel models with spatial interaction effects.[1] He finds that the bias-corrected LSDV (BCLSDV) method from Yu, De Jong and Lee (2008) appears to be hardly biased empirically even if T is small.[2] Therefore we will use this model, for which the econometric specification is:

$$y_{it} = \gamma y_{i,t-1} + X_{it}\beta + \lambda W_i y_{it} + \rho W_i y_{it-1} + \alpha_t I_n + \eta_i + \epsilon_{it} \quad (3)$$

W_i is an *n* x *n* spatial weights matrix which is non-stochastic and generates the spatial dependence among cross sectional units y_{it}. As each row sums to one, $W_i y_{it}$ is the average of y_{it} in neighboring municipalities. Spatial interaction is included both for the dependent variable in the present year *t* and in the previous year *t-1*. No indicator for goodness of fit is available for this estimator. As with the dynamic non-spatial model, we extend model (3) to include the amalgamations dummies.

[1] Elhorst, J.Paul. 2010. "Dynamic panels with endogenous interaction effects when T is small". *Regional Science and Urban Economics*, 40, 272-282.
[2] Yu, Jihai, Robert de Jong and Lung-fei Lee. 2008. "Quasi-maximum likelihood estimators for spatial dynamic panel data with fixed effects when both n and T are large". *Journal of Econometrics*, 146, 118-134.

We include control variables, year dummies and municipal fixed effects. We run the spatial dynamic model for the entire sample. Thus, the control group consists of municipalities that were not amalgamated, or that were amalgamated in a different year. Reducing the sample to limit the control group would result in too many geographical gaps to make spatial analysis useful. Many municipalities would have no or few neighbors included in the analysis. Table S4 presents the results. Column 1 matches Column 6 in Table S2. Column 2 shows the results of the same model, but for a balanced panel. These results can be compared with those of the model including a spatial lag in Column 3, which can only be estimated for balanced panels. The coefficient for the spatial lag is significantly positive. Per capita spending increases with 1 percent when the average level of per capita spending in neighboring municipalities increases with 10 percent. However, the introduction of this effect into the model does not affect our results with regard to the amalgamation effects. These remain insignificant. We take this as evidence that the absence of any effect of amalgamation we find does not result from omitting spatial interaction from the model.

Table S5: Regression of total per capita spending; static and dynamic panel with interaction terms

Interaction variable	Population before amalg.		Difference in ideology	
Model	Static	Dynamic	Static	Dynamic
A_{pre}	-0.60	-0.15	-0.03	-0.03*
	(-1.34)	(-0.38)	(-1.27)	(-1.82)
A_{0-3}	-0.61	-0.33	0.01	-0.00
	(-0.94)	(-0.55)	(0.18)	(-0.06)
A_{4-10}	-0.68	-0.11	0.02	0.00
	(-0.94)	(-0.16)	(0.47)	(0.01)
A_{11+}	-0.67	-0.03	0.03	0.00
	(-0.91)	(-0.04)	(0.57)	(0.02)
Interaction with A_{pre}	0.05	0.01	-0.09	0.03
	(1.29)	(0.30)	(-1.51)	(0.39)
Interaction with A_{0-3}	0.06	0.03	-0.19	0.02
	(0.91)	(0.57)	(-1.55)	(0.10)
Interaction with A_{4-10}	0.06	0.01	-0.23	0.00
	(0.92)	(0.17)	(-1.46)	(0.02)
Interaction with A_{11+}	0.06	0.00	-0.22	-0.01
	(0.91)	(0.04)	(-1.29)	(-0.04)
Population before amalg.	0.05	0.01		
	(1.29)	(0.30)		
Difference in ideology			-0.09	0.03
			(-1.51)	(0.39)
Lagged dependent		0.70***		0.70***
		(16.78)		(16.68)
Control variables	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Municipal fixed effects	Yes	Yes	Yes	Yes
Municipal time trends	Yes	No	Yes	No
Observations	1,541	1,339	1,541	1,339
Municipalities	135	135	135	135
R^2 (within)	0.74		0.74	
Pseudo-R^2 (within)		0.67		0.52

Control group: amalgamated or almost amalgamated.
T-values between parentheses, based on robust standard errors clustered by municipality.
Variables are expressed in logs, except for the political difference variables.
Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table S6: Amalgamation effect for amalgamations with two and three municipalities

This table presents regression outcomes with two sets of interaction dummies. Variables with names starting with Mun2 (Mun3) have a value of 1 in the corresponding period when two (three) municipalities are involved in the amalgamation and 0 otherwise. Amalgamations of more than three municipalities are omitted. Lower and upper limits are given for the 95% confidence intervals.

Model	Static	Confidence interval		Dynamic	Confidence interval	
		Lower	Upper		Lower	Upper
Mun2 * A_{pre}	-0.07**	-0.14	-0.00	-0.06	-0.14	0.02
	(-2.02)			(-1.46)		
Mun2 * A_{0-3}	-0.08*	-0.17	0.01	-0.03	-0.14	0.09
	(-1.83)			(-0.44)		
Mun2 * A_{4-10}	-0.08	-0.18	0.02	-0.03	-0.14	0.08
	(-1.49)			(-0.54)		
Mun2 * A_{11+}	-0.07	-0.17	0.04	-0.04	-0.16	0.08
	(-1.22)			(-0.63)		
Mun3 * A_{pre}	-0.03	-0.07	0.01	-0.02	-0.07	0.03
	(-1.45)			(-0.76)		
Mun3 * A_{0-3}	-0.00	-0.11	0.11	0.03	-0.04	0.09
	(-0.00)			(0.76)		
Mun3 * A_{4-10}	0.02	-0.10	0.15	0.03	-0.05	0.11
	(0.34)			(0.77)		
Mun3 * A_{11+}	0.04	-0.09	0.18	0.02	-0.06	0.10
	(0.60)			(0.54)		
Lagged dependent				0.69***	0.61	0.77
				(16.95)		
Control variables	Yes			Yes		
Year effects	Yes			Yes		
Municipality fixed effects	Yes			Yes		
Municipality time trends	Yes			No		
Observations/municipalities	1,345/ 118			1,167/ 118		
R^2 (within) resp. Pseudo-R^2	0.75			0.68		

Control group: amalgamated or almost amalgamated.
T-values between parentheses, based on robust standard errors clustered by municipality.
Variables are expressed in logs.
Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table S7: Hedonic regression of house prices (dependent variable: log of house price.)

The average house price per municipality per year is obtained by regressing the log of the transaction price in 2013 euros on dwelling characteristics and municipality/year-specific fixed effects. Dwelling characteristics are differentiated for single family units and apartments whenever relevant. For robustness, we exclude municipalities where less than 20 houses were sold in any single year. Using 50 as a cut-off point does not change the results much. The price index is constructed from the fixed effects.

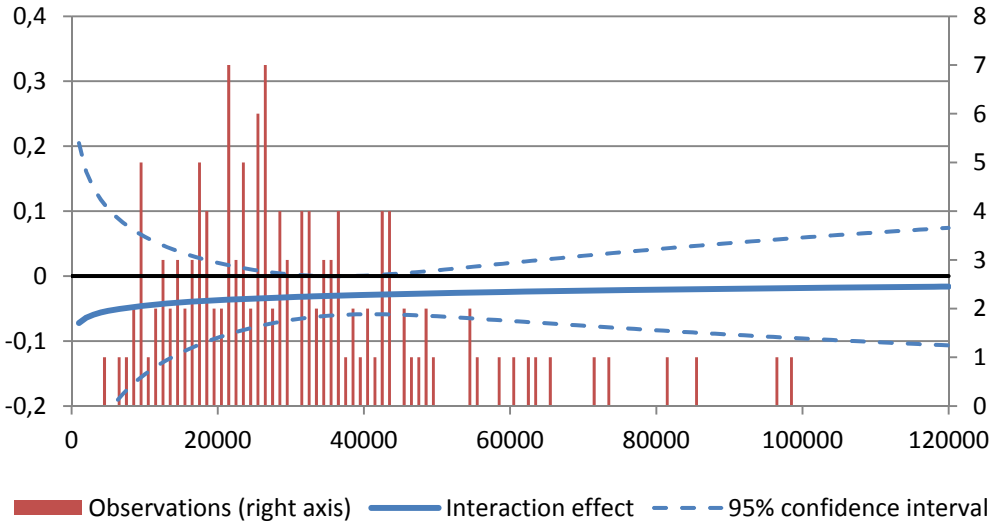
Lot area (log)	0.153***	2 bathrooms (house)	0.0184***
	(109.6)		(13.57)
Living area (log)	0.156***	3 bathrooms (house)	0.0769***
	(49.32)		(36.59)
Living area (log))	0.714***	4 bathrooms (house)	0.139***
	(59.44)		(21.09)
Log volume (house)	0.346***	2 bathrooms (apartment)	0.0463***
	(103.1)		(11.83)
Log volume (apartment)	0.0381***	3 bathrooms (apartment)	0.181***
	(6.685)		(27.30)
2 rooms (house)	-0.0294***	Open porch	-0.0706***
	(-4.469)		(-6.226)
3 rooms (house)	-0.0204***	Elevator	0.0341***
	(-3.726)		(14.38)
4 rooms (house)	-0.00365	Basement	0.0198***
	(-0.674)		(9.300)
5 rooms (house)	0.00806	Semi-detached house	0.0280***
	(1.488)		(17.80)
6 rooms (house)	0.0271***	Townhouse (end of block)	0.00846***
	(5.003)		(12.41)
7 rooms (house)	0.0629***	Duplex house	0.0669***
	(10.73)		(45.74)
2 rooms (apartment)	0.0281***	Detached house	0.124***
	(5.168)		(61.17)
3 rooms (apartment)	0.0299***	Simple house	-0.0551***
	(4.447)		(-31.44)
4 rooms (apartment)	-0.0209***	Canal house	0.241***
	(-2.578)		(25.62)
5 rooms (apartment)	-0.000931	Manor house	0.111***
	(-0.143)		(55.50)
6 rooms (apartment)	0.0354***	Farm house	-0.0304***
	(4.496)		(-9.636)
7 rooms (apartment)	0.0555***	Bungalow	0.137***
	(5.338)		(77.21)
2 balconies (house)	0.0596***	Villa	0.199***
	(46.87)		(94.80)
3 balconies (house)	0.0970***	Country house	0.160***
	(10.23)		(58.93)
2 dormers (house)	0.0237***	Downstairs apartment	-0.0964**
	(34.06)		(-2.571)
3 dormers (house)	0.0349***	Upstairs apartment	-0.179***
	(14.65)		(-4.631)
Roof terrace (house)	0.0264***	Maisonnette	-0.208***
	(24.59)		(-5.432)
Roof terrace (apartment)	0.0443***	Porch flat	-0.165***
	(20.41)		(-4.245)
Scullery (apartment)	0.0926***	Flat with walkway access	-0.173***
	(36.18)		(-4.624)

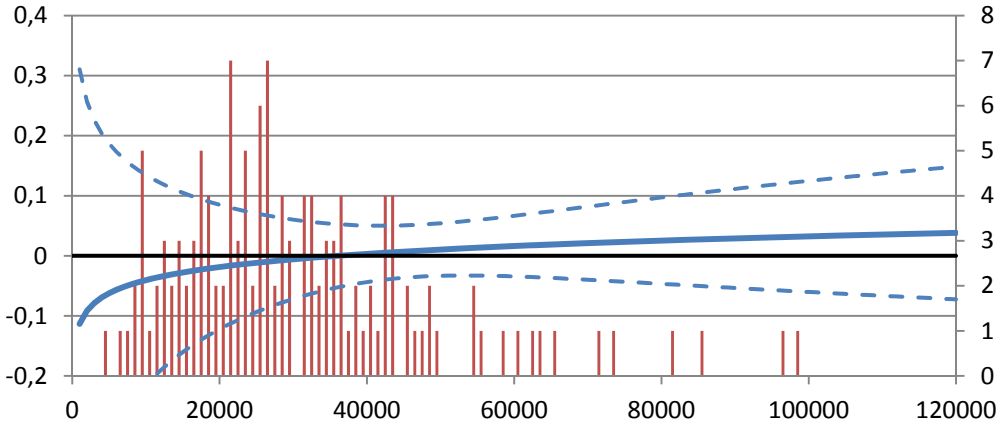
Care flat	-0.0969***	Garden to be laid out	0.00118
	(-2.623)		(0.424)
Built between 1906-1930	-0.0609***	Garden in neglected state	0.0456***
	(-20.60)		(26.70)
Built between 1931-1944	-0.0578***	Garden in normal state	0.0815***
	(-11.07)		(45.99)
Built between 1945-1959	-0.0831***	Garden in fine state	0.0690***
	(-20.90)		(38.79)
Built between 1960-1970	-0.119***	Parking space present	0.0266***
	(-24.99)		(25.09)
Built between 1971-1980	-0.0895***	Carport (no garage)	0.0522***
	(-19.09)	present	(46.70)
Built between 1981-1990	-0.0398***	Garage (no carport)	0.0693***
	(-8.767)	present	(95.00)
Built between 1991-2000	0.0171***	Carport and garage	0.0746***
	(3.601)	present	(57.02)
Built after 2001	0.0431***	Garage for multiple cars	0.0671***
	(7.009)	present	(52.33)
Low quality apartment	-0.0514***	Indoor parking space	-0.0181***
	(-15.08)		(-15.96)
High quality apartment	0.107***	Situated downtown	0.0588***
	(34.87)		(43.03)
Interior maintenance state	0.0674***	Situated near busy road	-0.0287***
good	(66.37)		(-20.46)
Interior maintenance state	0.114***	Situated near forest	0.0578***
excellent	(66.64)		(22.17)
Interior maintenance state	-0.0369***	Situated near water	0.0544***
bad	(-17.36)		(34.29)
Exterior maintenance state	0.0480***	Situated near park	0.0165***
good	(40.53)		(12.36)
Exterior maintenance state	0.0580***	Situated with free view	0.00612***
excellent	(33.85)		(8.352)
Exterior maintenance state	-0.0530***	Sold in February	0.00526***
bad	(-20.88)		(7.725)
2 types of isolation	0.0174***	Sold in March	0.0111***
	(26.30)		(15.39)
3 types of isolation	0.0152***	Sold in April	0.0168***
	(16.89)		(21.67)
4 types of isolation	0.0112***	Sold in May	0.0222***
	(9.292)		(26.99)
5 or more types of	0.0153***	Sold in June	0.0248***
isolation	(12.93)		(26.81)
Monument	0.105***	Sold in July	-0.0137***
	(24.19)		(-14.36)
Garden at North	-0.0150***	Sold in August	-0.0112***
	(-15.51)		(-12.21)
Garden at Northeast	-0.0121***	Sold in September	-0.00658***
	(-9.997)		(-7.690)
Garden at East	-0.0149***	Sold in October	-0.00526***
	(-15.91)		(-6.850)
Garden at Southeast	-0.00535***	Sold in November	-0.00272***
	(-4.510)		(-3.973)
Garden at South	-0.00367***	Sold in December	-0.00220***
	(-4.062)		(-3.162)
Garden at Southwest	-0.000430	Constant	8.521***
	(-0.399)		(498.6)
Garden at West	-0.00783***	N	1,779,126
	(-8.325)	R-squared	0.876
Garden at Northwest	-0.00857***		
	(-7.109)		

Robust t-statistics in parentheses
*** p < 0.01, ** p < 0.05, * p < 0.1

Figure S1. Marginal effect of amalgamation on total municipal spending, conditional on population

Figure 3 in the paper presents results for the long term effect. Here we present graphs for the interaction with the other three amalgamation dummies. Population is on the horizontal axis, marginal effect on the left hand axis, number of observations on the right hand axis. From top to bottom: A_{pre}, $A_{0\text{-}3}$ and $A_{4\text{-}10}$.





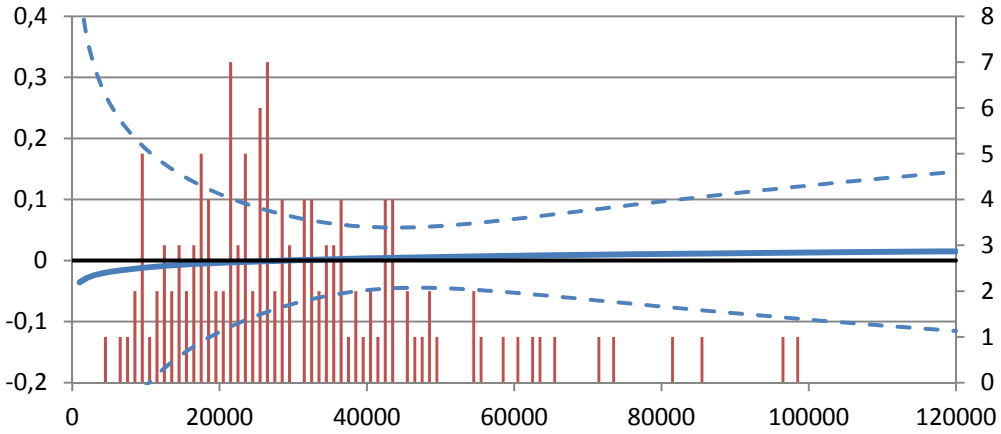


Figure S2. Marginal effect of amalgamation on total municipal spending, conditional on preference heterogeneity

Based on Column 4 of Table S5. Preference heterogeneity (for ideology of the coalition) on the horizontal axis, marginal effect on the left hand axis, number of observations on the right hand axis. From top to bottom: A_{pre}, A_{0123}, $A_{4\text{-}10}$ and A_{11+}.