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Municipal amalgamations and local housing prices

Vífill Karlsson¹, Grétar Thór Eythórsson²

¹ Bifröst University, Bifröst, Iceland, University of Akureyri, Akureyri, Iceland and West Iceland Regional Office, Borgarnes, Iceland

² University of Akureyri, Akureyri, Iceland

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Abstract. In this paper, we examine the relationship between housing prices and municipal amalgamations. Due to consumer preference for access over amenity value, there is a spatial disparity of housing prices, reflecting the value of land in specific locations. According to [Tiebout \(1956\)](#) local amenity values will increase if the services of a municipality improve without a comparable rise in taxes or service fees, or if taxes or service fees decrease while the service level remains the same. The bid-rent curve is a framework frequently used to capture a presence of goods or bads such as amenities, disamenities, and externalities. Accordingly, the present study will be used to detect a possible social benefit or loss following amalgamations of municipalities. Macro panel data from Iceland will be used, representing several essential variables of the house market for 79 municipalities in Iceland during the period from 1992 through 2006. The research shows a significant positive relationship, *ceteris paribus*, between regional municipal amalgamations and local real prices of apartments.

Key words: Housing prices, amalgamation of municipalities, Hedonic price model, local government reforms, Fixed effect model

1 Introduction

Theoretically, municipal amalgamations should return lower average cost per capita due to economies of scale, but empirically the evidence is somewhat mixed. It is possible, however, that the return of a reform such as municipal amalgamation was either used to reduce local taxes, municipal service fees, or to improve municipal services. In all cases this should benefit the inhabitants and attract new residents from other regions that did not amalgamate simultaneously or carry out any reforms, according to [Tiebout \(1956\)](#). A recent study suggested, however, that this has not been the case in Iceland ([Karlsson, Eythórsson 2019](#)). An older study, based on Icelandic data, detected relatively weak evidence for lower average operational cost of municipalities following amalgamations ([Karlsson 2015](#)). Nevertheless, another study concerning Iceland concluded that the amalgamations have led to an improved service level in the relevant municipalities – at least in the most central urban community of a newly amalgamated municipality ([Eythórsson, Karlsson 2018](#)). But this study had some minor methodological drawbacks. It was based on a survey among the inhabitants of relatively few municipalities while [Karlsson, Eythórsson \(2019\)](#) included close to 40 amalgamations during a period of 20 years. Thus, the results are mixed for Iceland as well. Therefore, an alternative general

approach to investigate the social return of municipalities amalgamations to test the theory was one of the major objectives of the present study.

One way to address this problem is to investigate whether housing prices change following municipal amalgamations. One could use a spatial data sample of housing prices, and the analytical framework and theory of the bid-rent curve based on the theory by Johann Heinrich von Thünen to test the suggested relationship. Then, all relevant explanatory variables must be included in the model along with a variable or variables for amalgamations. This is the intention of the present paper and the objective is to test whether local housing prices correlate with municipal amalgamations.

This approach, which is sometimes called “method of revealed preferences” (Tietenberg, Lewis 2012), is methodologically robust since the model has been used in comparable terms; that is, to estimate potential externalities. If the answer is “yes”, it suggests that municipal amalgamations have been successful and returned a detectable benefit such as better municipal services or lower local taxes or service fees. This method reveals costs as well since it is a hedonic price model. It is not, however, the purpose of the paper to define the benefit any further or divide it between those three possible channels. Here, the investigation will only focus on whether there is significant evidence for any benefits derived from previous municipal amalgamations in Iceland since the results of all earlier research has been mixed.

The paper is constructed in the following sequence: first, the research-question is addressed and the paper’s topic introduced and rationale presented. The following section briefly analyses the background and structural environment of municipalities in Iceland. A literature review is then provided, with the model and data outlined in Section 3. The estimating results are presented in the Section 4 along with the discussion. Finally, the last section comprises the summary and concluding remarks.

2 Governmental structure in Iceland and the development of local government

The governmental structure in Iceland is a two-tier system, divided into a central government (the state) and local governments (the municipalities). Counties exist but not as administrative units; they serve as jurisdictions for Iceland’s courts and police. Municipalities in Iceland have, however, established eight different regional federations, most of which were founded in the late 1960s. Even though almost all municipalities in Iceland participate in such federations, membership is voluntary and they serve as free organisations. The federations have no legal liabilities with regards to either municipalities or inhabitants, apart from their own regulations. This is why they do not have an identical structure, objectives or programmes – even though they have many factors in common such as the operation of regional development centres, running or supporting adult learning, marketing offices, and managing a regional development fund (i. uppbyggingarsjóður).

The main historical pattern structure indicates that the number of municipalities at just over 200 at the beginning of the 20th century, gradually increased until the middle of the century, reaching a peak of 229 municipalities, when agriculture began to lose its dominance to fisheries and the main flow of interregional migration was from farming to coastal communities. Accordingly, new hamlets, villages and towns developed, and in some cases the need arose for new municipalities. Their number decreased slowly after this, until after 1990 when the trend changed significantly. The rapid changes since 1990 were directly and indirectly facilitated by two referenda on municipal amalgamations – the first in 1993 and the second in 2005 – and their implications. Since 2018 the number of municipalities has been 69.

The number of municipalities never exceeded the 229 that existed in 1952. One municipality disappeared the following year when all the inhabitants moved away, reducing the number of municipalities from 229 to 228 (Figure 1). In 85 amalgamations, where 243 municipalities joined and some of them repeatedly, the number of municipalities fell to 69 in 2020 (Figure 1). There are 160 fewer in 2020 than in 1952. Amalgamations in Iceland have always been voluntary even though the central governments have sometimes

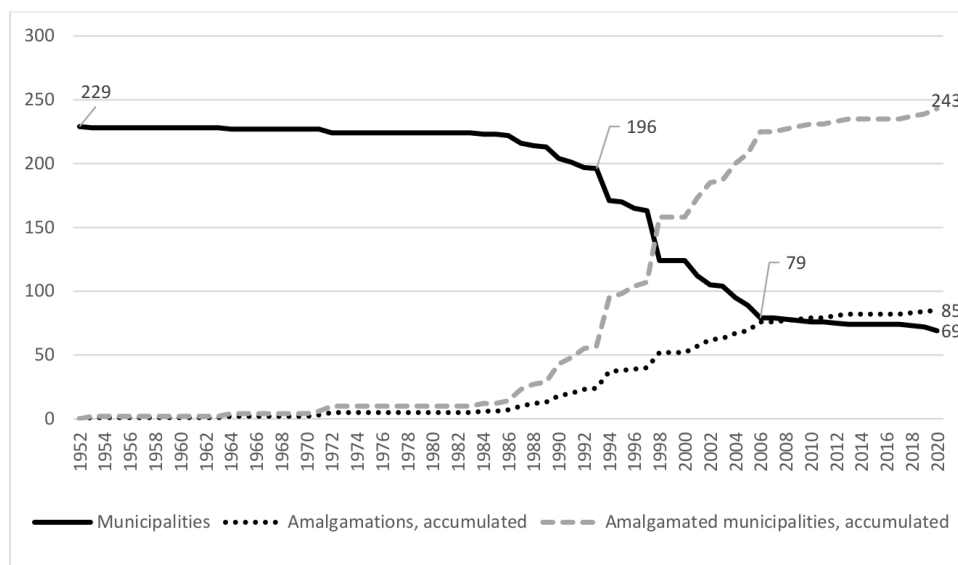


Figure 1: Number of municipalities in Iceland, amalgamations and amalgamated municipalities 1952-2020

offered motivation to amalgamate. Some minor restrictions have been set in law like a minimum of 50 municipal inhabitants in. These restrictions were abolished with the Local Government Act in 2011. According to the Act, no municipality can be amalgamated with another municipality until after a local referendum, whereby a majority of the participating voters vote for amalgamation. The current government policy is, however, to set the minimum number of municipal inhabitants at 250 by the elections in 2022 and at 1,000 by the elections in 2026. This particular issue was not completed due to massive resistance from especially the smaller municipalities.

From Figure 1, it becomes apparent that the most successful years of municipal amalgamations were 1994 and 1998 and the period from 2000-2006 when the number of municipalities dropped from 196 to 76. Fortunately, the present paper includes data from this period.

3 Literature review

3.1 Studies regarding the impact of municipal amalgamations

Earlier research and experience on the impact of municipal amalgamations, has focused on various aspects. When the economic consequences of costs and efficiency are investigated, the results point in different directions. The same applies to the impact on services. [Tavares \(2018\)](#) has collated such studies in a literature review in a recent article.

Looking specifically at the impact on economies of scale and costs as well as economic efficiency in this context, Tavares mentions several studies that have failed to find a significant lowering of expenditures as a result of municipal amalgamations in Denmark, Germany, Japan, and Canada ([Blesse, Baskaran 2016](#), [Blom-Hansen et al. 2014](#), [Cobban 2017](#), [Miyazaki 2018](#)). Even [Blesse, Roesel \(2018\)](#) fail to find any evidence of cost saving or staff reductions in their studies of county amalgamations in Austria and Germany. In an Icelandic study, [Karlsson \(2015\)](#) did not find any clear evidence of cost savings connected to amalgamations. The results from [Blom-Hansen et al. \(2016\)](#) doing research on 9 policy areas are more mixed. They found that cost savings in some areas were offset by increases in others. In a study of 11 European countries by [Steiner et al. \(2016\)](#), however, the most important economic effect of amalgamations turned out to be cost savings. [Blesse, Baskaran \(2013\)](#) studied the impact of municipalities' amalgamations on their overhead cost, with the analysis divided between compulsory and voluntary amalga-

mations, and found less of an impact in the cases of voluntary compared to compulsory in the short run. In the long run the overhead costs increased in the cases of voluntary and kept on decreasing in cases of compulsory. This might create in readers an expectation regarding the results in the present study, since there have been only voluntary mergers in Iceland. Finally, a study by [Reingewertz \(2012\)](#) on municipalities in Israel is assessed, where there is evidence that municipal amalgamations have achieved economies of scale.

When the impact of amalgamations on services and service quality is reviewed, the evidence seems to be generally more positive. [Tavares \(2018\)](#) mentions both aspects. A study from the Netherlands by [Allers, Geertsema \(2016\)](#) shows no change in the quality of public services as a result of amalgamations. In a study from Denmark, the results from [Krøtel et al. \(2017\)](#) suggest that public management related to daily operations is not affected by size. Studies from Switzerland by [Steiner \(2003\)](#) and [Steiner, Kaiser \(2017\)](#) both conclude that performance quality of municipalities generally improves with amalgamations. In an Icelandic study by [Eythórsson, Jóhannesson \(2002\)](#), an improvement of municipal services was detected, however, only social services and primary schools were evaluated. In [Eythórsson, Karlsson \(2018\)](#), Icelandic local leaders generally evaluate the impact of amalgamations on services as being rather positive, but it turned out that service quality did not seem to be equal in different parts of the amalgamated municipalities. The centre-periphery divergence was apparent.

3.2 *Studies regarding the bid-rent curve on local amenities*

Local amenities affect the attractiveness of communities and thus generate interregional migration when they change. This was first pointed out by [Tiebout \(1956\)](#) when he focused on the services of local government as an example. Later, the concept of amenities was extended and now covers a wide variety of phenomena such as climate and beautiful nature ([Graves 1979](#), [Roback 1982](#)) or pollution and crimes ([Blomquist et al. 1988](#)). Interregional migration affects housing prices so the value of amenities can be detected through the housing market.

A large number of studies have utilized housing prices to detect some local amenities or dis-amenities, a method called revealed preferences ([Tietenberg, Lewis 2012](#)) as noted earlier. There are examples of estimating the value of a new transportation network, or access to similar additional transportation possibilities ([Bae et al. 2003](#), [Bowes, Ihlanfeldt 2001](#), [Gibbons, Machin 2005](#), [Wen et al. 2018](#)). Another study focused on assessing school quality, recreational opportunities, and crime rate ([Haurin, Brasington 1996](#)) and yet others suggested that geographical disparity in housing prices reflects, inter alia, differences in demographic variables, new constructions, proximity to downtown, manufacturing employment, and aggregate school enrollment ([Case, Mayer 1996](#)).

[Kiel, Zabel \(1996\)](#) used the model to detect any potential racial effects, or, as they say themselves “housing market discrimination and prejudice”. The study included three cities in the USA. Evidence for increasing discrimination in Philadelphia and Denver was among the results, while this appeared to be decreasing in Chicago. The data sample was the American Housing Survey in the period 1978-1991.

Examples of other negative amenities (or dis-amenities) such as the impact of the presence of an incinerator, or of natural disasters ([Cobián Álvarez, Resosudarmo 2019](#)), on housing prices was analysed by a hedonic price method ([Kiel, McClain 1995a,b](#)). Another was used for positive amenities such as an urban forest ([Tyrvainen, Miettinen 2000](#)), or the presence of nature in general terms ([Gibbons et al. 2014](#)). This can be linked to the concept of capitalization – a capitalization of public services into apartment prices. One of the essential conditions for full capitalization of this kind is the homogeneous preferences of households regarding amenities ([Hilber 2011](#)). The demand for amenities appears to be heterogeneous across municipalities in Iceland, but there is no evidence across households within municipalities. On the contrary, there is some evidence for Tiebout’s hypothesis ([Tiebout 1956](#)) regarding natural resource amenities, tranquility, and many types of public services ([Karlsson 2021](#)). Accordingly, consumer mobility has generated a heterogeneous external mixture of communities with a relatively homogeneous mixture of consumers within each community. According to [Oates \(1999\)](#) local fiscal differences should therefore be capitalized into apartment prices.

Several examples of the implementation of a hedonic price model in the case of local amenities or dis-amenities have been assessed. If an amalgamation of municipalities is successful it would generate flexibility in their operations; either by lowering taxes or increasing or improving services. Since the latter relates to amenities and the former real household income, both must increase local housing prices. Therefore, a hedonic price model is the appropriate method for the present analysis. It would capture any social benefit following a municipal amalgamation, detected by the local population, regardless of how its returns are spent.

4 The model

The standard model for analysing the spatial disparity of housing prices is based on the theory of Johann Heinrich von Thünen, often called the bid-rent curve, where the housing price, ψ , is a function of household income, Y , travel cost, $T(r)$, distance or travel time, r , to the nearest central business district (CBD), consumption of land, s , and other goods, z (Fujita 1989, pp. 14-16).

$$\psi(r, u) = \max_{z, s} \left\{ \frac{Y - T(r) - z}{s} \mid U(z, s) = u \right\} \quad (1)$$

Many extensions of the model have been developed and the hedonic price model is one of them, being the most frequent approach in analysing the spatial disparity of housing prices within the economic literature (Archer et al. 1996, Cobián Álvarez, Resosudarmo 2019, Cunningham 2006, Gibbons, Machin 2005, Gibbons et al. 2014, Haurin, Brasington 1996, Kiel, Zabel 1996, McMillen 2003, Plaut, Plaut 1998, Tyrvainen, Miettinen 2000, Wen et al. 2018). The standard hedonic price model includes housing and lot characteristics (Cunningham 2006, Tyrvainen, Miettinen 2000). Accordingly, special explanatory variables are added to the standard model which captures the house or apartment characteristics, such as house age, size of garden, number of rooms, building material, and the location's amenity values. Other alternative approaches are the standard repeat sales (McMillen 2003, p. 290) approach and the Fourier repeat sales approach (McMillen 2003, p. 291). The standard repeat sales approach is similar to the hedonic model, but includes only the data of houses which have been sold more than once in the relevant period (Kiel, McClain 1995a, McMillen 2003) and the difference is calculated for each house in order to capture the appreciation in its price. According to McMillen (2003) the repeat sales approach was developed to avoid missing variable biases which tend to fluctuate over time, but it has disadvantages too, since it reduces the available data sample and can create a sample selection bias, as argued by Kiel, McClain (1995a). There are studies of pure hedonic price approaches, such as Cunningham (2006), Eshet et al. (2007), Kong et al. (2007), Haurin, Brasington (1996), Kiel, Zabel (1996), and others of the pure repeat sales model, such as Archer et al. (1996). There are also studies of mixed hedonic and repeat sales model approaches, such as Gibbons, Machin (2005), McMillen (2003), and Kiel, McClain (1995a). The approach of this paper will be that of a pure hedonic model.

The empirical model is based on von Thünen's theory of land rent, extended by Alonso (1964), Mills, Hamilton (1972), Muth (1969), and Evans (1973) to the house market, as noted earlier. Since distance between localities is the essence of this theory, its model becomes an appropriate tool in this paper since one of the explanatory variables of spatial disparity of local real price of apartments is investigated. A theoretical derivation of this model is included in the Appendix of an earlier study (Karlsson 2011). According to Fujita (1989) and Kiel, McClain (1995b), the general context from the basic model can be derived through a log linear utility function into an equation of the following form:

$$h(r) = Ae^{-br} \quad (2)$$

where h is the land value, r is the distance between the land location and the CBD, and A and b are positive constants. Since the present paper follows the work of Karlsson (2011) the empirical model becomes:

$$\ln(h_{it}) = \alpha_i + r_{it}\beta_1 + x'_{it}\beta_2 + d'_{it}\beta_3 + \epsilon_{it} \quad (3)$$

where the natural logarithm of housing price, h , is dependent on the distance, r , to the capital area, or CBD, several other explanatory variables, x' , dummy variables, d' , and relevant residuals, ϵ , of every municipality, i , in every single period, t . Age, size, some other design characteristics of the relevant house buildings, and municipal amalgamations are other explanatory variables. Household income is not needed as suggested by [Yinger \(2015\)](#) where he argued that income-related amenities, amongst others, are not appropriate in an envelope function such as the hedonic price function. The variables for municipal amalgamations are count variables. Unfortunately, limitations of the data prevented any possible estimation of the compensated good, z , lot size, s , and mortgage interest rates.

The current model is based on earlier work by [Karlsson \(2011\)](#) and his data sample, designed for estimating the impact of transportation improvements on housing prices. A polycentric version of the bid-rent model was then constructed, suggesting that there were two levels of CBDs in Iceland. This is why four variables for travel time are included: Two to Reykjavík, one to Akureyri, and one dummy variable (see [Table 2](#)). Akureyri is defined as a second level CBD and therefore the travel times between Akureyri and all municipalities closer to Akureyri than Reykjavík were calculated and constructed as an explanatory variable, s . In order to preserve the observations all municipalities closer to Reykjavík than Akureyri were allocated zero as a value in s . Another explanatory variable, u , was constructed for all other municipalities which captured their travel time to Reykjavík. The third explanatory variable, v , was constructed for all municipalities closer to Akureyri than Reykjavík. This contained the additional travel time for them to Reykjavík because Reykjavík is the top level CBD. Finally, a dummy variable was constructed; that is, 1 for all municipalities closer to Reykjavík than Akureyri. It was only for practical, technical and statistical purposes that zero values were cancelled out as irrelevant in the other three travel time variables. Further discussion regarding the matter is provided by [Karlsson \(2011, p. 231\)](#).

Year dummies, y , were included in the model to capture any macroeconomic impacts on housing prices, such as economic growth, interest rates and other possible macroeconomic variables.

$$\ln(h_{it}) = \alpha_i + s_{it}\beta_1 + s_{it}^2\beta_2 + u_{it}\beta_3 + u_{it}^2\beta_4 + v_{it}\beta_5 + x'_{it}\beta_6 + d_{it}\beta_7 + m_{it}\beta_8 + y_{it}\beta_9 + \epsilon_{it} \quad (4)$$

A vector of hedonic variables is denoted as x'_{it} ; these are housing age, apartment size, number of apartments in each house, the floor number, number of rooms per apartment, building material (out-walls), balconies, and parking spots and garages. The approach of the present paper, as suggested earlier, is to estimate a hedonic price model against housing price, where the most significant explanatory variables are included alongside an explanatory variable for municipality merger, m , and to investigate its impact on housing prices. If it is significant and positive this suggests that a municipal amalgamation is returning a local social benefit. All mergers in the relevant period were included apart from the smallest example because of the inefficiency of its housing market.

5 Data

The main independent variables of the present study reflect the amalgamation of municipalities. These are count variables for the amalgamation of municipalities, based on information gathered from the Icelandic Association of Local Authorities. Count variables were chosen to address amalgamations instead of a dummy variable because some of our present municipalities have experienced several amalgamations.

In one version of the model the amalgamations were classified with respect to the number of amalgamated municipalities in one merger and whether the municipalities in each merger were similar or different in terms of population. If the population of the municipalities that joined a merger counted both hundreds and thousands of inhabitants,

Table 1: Varying number of municipal amalgamations

Year	number of amalgamations								Total
	similar				different				
	2	3	4	> 5	2	3	4	> 5	
1992	2								2
1993	1								1
1994					5	3	2	1	11
1995									0
1996								1	1
1997						1			1
1998					2	2	2	3	9
1999									0
2000									0
2001			1	1	1				3
2002	1	1			2	1			5
2003	1								1
2004			1		1	1			3
2005							1		1
2006	1				3		1		5
Total	6	1	2	1	14	8	6	5	43

this was assumed to be an amalgamation of different municipalities. The most common amalgamations were among two and three different municipalities (Table 1).

In order to improve the data sample, all municipalities smaller than 500 inhabitants were discarded. This is because the housing market is least efficient in the smallest communities. Moreover, most of the smallest communities do not include urban centers. This reduced the number of amalgamations from the database. Accordingly, the number of amalgamations was reduced from 39 in the period 1995-2006 and 52 in 1992-2006 (Karlsson, Eythórsson 2019, p. 52) to 29 and 43 respectively (Table 1).

Other data of the present study comes from Iceland, a relatively large European country with a small population. Iceland is divided into 79 municipalities in this paper for the entire period; the number of municipalities in 2006. Accordingly, the data for all years was constructed as annual sums or averages for all the amalgamated municipalities as they were formed after all amalgamations in the year 2006¹. The explanatory variables included in Equation (3) are drawn from various sources, including the Commissioner of Inland Revenue, Statistics Iceland, and the Icelandic Road Administration. Information on housing price, age and other relevant particulars was obtained from the Iceland Property Registry.

Data on travel time is based on road distance and share of paved roads against gravel roads from a particular municipality to Reykjavík and/or Akureyri. Road distances came from Fjölvis Publishing Company, originally collected by the Icelandic Road Administration. Numbers on paved roads came from Eymundur Runólfsson at the Icelandic Road Administration. Maximum speed varied from 70 kilometres per hour to 90 when gravel roads were paved and affected the average speed accordingly. The transportation network has been improved since 1980 when less than 10% of the network was paved (Karlsson 2012, pp. 19-20) and 39% in 2014 (Karlsson 2016, p. 16).

Time dummies were also constructed to the dataset for each year apart from the last one. The dummies take the value of one for every observation of the relevant year and zero otherwise. The mean value of all dummy variables is 0.04.

¹During the period 1992-2006 there have been several amalgamations. Some municipalities disappeared because of the amalgamations. Instead of letting them be present in the dataset when they existed and discarding them when amalgamated, they are always constructed as amalgamated (as according to the year 2006). Amalgamations are then identified by a count variable; zero before and one after the first amalgamation, two if the same municipalities went through another amalgamation in the relevant period, three if third, etc.

Table 2: Variable description and sample statistics

Variable (acronym)	Description	Mean	Std. dev.
House price (hopr)	Real price of apartments, in Icelandic krónur	9,748,400	4,522,221
Travel time to Reykjavík (ttre)	Average travel time between Reykjavík and municipalities closer to Reykjavík than Akureyri.	71.79	103.17
Travel time to Akureyri (ttak)	Average travel time between Akureyri and municipalities closer to Akureyri than Reykjavík.	32.43	64.35
Marginal travel time to Reykjavík (ttrm)	Average travel time between Reykjavík and municipalities closer to Akureyri than Reykjavík.	62.37	111.57
Dummy variable (dmr1)	Dummy variable for splitting municipalities into two groups, 1 for being closer to Reykjavík than Akureyri.	0.69	0.46
House age (hage)	Average age of houses sold, in absolute terms	28.70	15.42
House size (hsiz)	Average size of houses sold, in square meters	137.31	52.60
Number of apartments (horr)	Average number of apartments in each house	1.02	0.09
Apartment's floor (hofl)	Average number of floors, reflecting the apartments position in height from the ground	1.75	0.66
Rooms per apartment (horor)	Average number of rooms per apartment	3.26	0.85
Timber house (hom6)	Share of apartments where wood is outer walls' building material	0.18	0.20
Balcony size (hoba)	Average size of balcony, in square meters	2.64	3.38
Parking/Garage (hopa)	Share of apartments where either parking place or any type of garage is included	0.47	0.25
Amalgamation (amal)	A count variable for the amalgamation of all municipalities. 1 for the first amalgamation of the relevant municipality, 2 for the second and etc.	0.47	0.90
Amalgamation 2S (amlk2b)	A count variable for the amalgamation of two similar municipalities. 1 for the first amalgamation of the relevant municipality, 2 for the second and etc.	0.004	0.063
Amalgamation 2D (amol2b)	A count variable for the amalgamation of two different municipalities. 1 for the first amalgamation of the relevant municipality, 2 for the second and etc.	0.032	0.186
Amalgamation >2S (amlk7b)	A count variable for the amalgamation of more than two similar municipalities. 1 for the first amalgamation of the relevant municipality, 2 for the second and etc.	0.014	0.117
Amalgamation >2D (amol7b)	A count variable for the amalgamation of more than two different municipalities. 1 for the first amalgamation of the relevant municipality, 2 for the second and etc.	0.085	0.327

Note: The data in this table, i.e., mean and standard deviation, is based on annual averages transformed by means of Equation (4).

The data series were annual averages for each municipality. This means that the list of hedonic variables is made up of: average age and size of apartments, numbers of apartments in each house, rooms per apartment, number of apartments made of wood, including balcony, a garage or a parking spot. Housing prices were annual averages as well, while the variables for population and road distance were static. Data on population is based on the figure on 1 December every year and the data on road distance is based on data from 1 January every year. The data series were originally classified spatially by municipalities, except for the data on road distance, which was classified by towns or localities. They were transformed from localities into municipalities. All variables that include values in Krónur are in real terms and thus corrected for possible skewness that could be traced to inflation of the Króna.

The averages and the standard deviation of the explanatory variables as well as of the dependent variable show considerable variation (Table 2). The standard deviation of housing prices is approximately 1/2 of the mean and, of road distance, more than 3/4 of the mean. This is evidence of large differences which demonstrates the potential for robust explanations. However, this panel data sample is an unbalanced one since observations for several variables are missing.

6 Estimating the result

6.1 The model results, interpretation, and discussion

The empirical model was set forth in Section 3 (Equation 4). All insignificant explanatory variables, apart from time dummies, closer to Reykjavík than Akureyri, and amalgamations, were discarded from the models to make the analysis more focused. This included number of apartments (honr), apartment's floor (hoff), timber house (hom6), and travel time to Akureyri square (ttak2) (Table 2).

A significant positive change in housing prices was detected following an amalgamation in the case of one variable for all amalgamations (Model 1 in Table 3). When the amalgamations were classified into four different types all of them returned positive coefficients. Two of them were also significant. This was in the case in more than two municipalities, especially similar ones (Model 2 in Table 3). Note that there were only four cases of the amalgamation of more than two similar municipalities, whereas there were 19 cases of more than two different ones (Table 1).

6.2 The reliability of the results

The overall results are in line with the previous analysis (Karlsson 2011) of this data sample, only more significant and robust. Those results were compared with many other related studies and found to be in line with the vast majority of them.

The analysis output contains the coefficients' t -values, number of observations, n , and R squares. For addressing a potential multicollinearity problem, the correlation coefficients were calculated as well. If no absolute values were higher than 0.6 this was marked as a "no" in the table as an indication of absence of multicollinearity.

Serial correlation and heteroscedasticity were also present in the models. The presence of serial correlation was tested by running a simple regression analysis between the residuals and lagged residuals as suggested by Wooldridge (2002, pp. 176-177), and it returned a significant coefficient in the model or a t -value of 10.36. A modified Wald test for testing groupwise heteroskedasticity in fixed-effect regression models was also used, and it returned a probability of Chi2 lower than 0.01 (or close to zero). The proper response was to implement a cluster-robust inference as suggested by Cameron, Miller (2015). Endogeneity was not seen as a threat in the current model.

Confidence intervals were calculated for logarithm of housing prices to detect any possible stability of the implicit prices over time. The results suggest a negligible instability of the price variable when the data sample was divided into three even five year periods (Table 4). This became notable when the standard error was shown to be somewhere between 0.1-0.2% of the mean.

Table 3: Relationship between housing prices and amalgamation – A polycentric model in semi logarithm of a quadratic distance version; data sample 1992-2006

Variable	Model 1 One variable for amalgamation	Model 2 Eight variables for amalgamation
Travel time to Reykjavík (ttre)	-0.00934 (-3.97)***	-0.0101 (-4.73)***
Travel time to Reykjavík sq. (ttre2)	0.00002 (5.37)***	0.00002 (6.28)***
Travel time to Akureyri (ttak)	-0.0077 (-4.11)***	-0.0080 (-4.61)***
Marginal travel time to Reykjavík (ttrm)	0.0031 (1.96)*	0.0032 (2.23)**
Closer to Reykjavík than Akureyri (dmr1)	-0.0631 (-0.58)	-0.0606 (-0.57)
House age (hage)	-0.0098 (-4.45)***	-0.0094 (-4.45)***
House size (hsiz)	0.0014 (2.15)**	0.0014 (2.20)**
Rooms per apartment (horo)	0.0783 (2.43)**	0.0723 (2.29)**
Balcony size (hoba)	0.0107 (2.15)**	0.0102 (2.15)**
Parking/Garage (hopa)	0.1726 (3.43)***	0.1787 (3.52)***
Amalgamation (amal)	0.0816 (2.50)**	
Amalgamation 2S (amlk2b)		0.0221 (0.19)
Amalgamation 2D (amol2b)		0.0096 (0.11)
Amalgamation >2S (amlk7b)		0.3344 (6.05)***
Amalgamation >2D (amol7b)		0.1380 (3.54)***
Time dummy 1992 (tdum12)	-0.1352 (-4.03)***	-0.1293 (-3.78)***
Time dummy 1993 (tdum13)	-0.1253 (-4.32)***	-0.1215 (-4.09)***
Time dummy 1994 (tdum14)	-0.0259 (-0.79)	-0.0035 (-0.10)
Time dummy 1995 (tdum15)	-0.0700 (-2.12)**	-0.0480 (-1.36)
Time dummy 1996 (tdum16)	-0.0849 (-2.33)**	-0.0642 (-1.64)
Time dummy 1997 (tdum17)	-0.0634 (-1.75)*	-0.0431 (-1.23)
Time dummy 1998 (tdum18)	-0.0544 (-1.43)	-0.0471 (-1.31)
Time dummy 1999 (tdum19)	0.0106 (0.37)	0.0182 (0.63)
Time dummy 2000 (tdum20)	0.0120 (0.46)	0.0187 (0.71)
Time dummy 2001 (tdum21)	-0.0314 (-1.04)	-0.0311 (-1.08)
Time dummy 2002 (tdum22)	0.0041 (0.14)	-0.0026 (-0.09)
Time dummy 2003 (tdum23)	0.0997 (2.89)**	0.0948 (2.77)**
Time dummy 2004 (tdum24)	0.1661 (4.24)***	0.1613 (4.05)***
Time dummy 2005 (tdum25)	0.3065 (7.92)***	0.3000 (7.59)***
Constant	16.1964 (63.85)***	16.2748 (71.69)***
Number of observations, n	772	772
R-sq within	0.405	0.4256
R-sq between	0.2141	0.2417
R-sq overall	0.2396	0.2568

Notes: Dependent Variable: LOG (hopr). * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. Methods: Fixed effect panel data model. Statistical program: STATA. Values in parentheses are t -statistics.

Table 4: Confidence interval of the dependent variable LOG (House price), mean, and standard error

Period	Obs	Mean	Std. Err	Confidence interval (95%)	
				lower limit	upper limit
1992-1996	223	15.969	0.021	15.927	16.011
1997-2001	234	16.032	0.026	15.982	16.083
2002-2006	233	16.229	0.032	16.165	16.292

According to the discussion above, the results appear robust and reliable. The final results were not disturbed by any potential heteroscedasticity, multicollinearity, serial correlation, or endogeneity.

7 Conclusion

The purpose of this study was to detect any possible impact municipal amalgamations could have had on local housing prices. The idea here was to reveal the expected impact of the amalgamations because many previous studies concerning Iceland on the success of amalgamations have not detected any, or only negligible, impact. Previous studies have mainly focused on investigating the relationship between amalgamations and the operating cost of municipalities, with the most recent one examining the relationship between amalgamations and interregional migration (Karlsson, Eythórsson 2019). The study that came closest to the expected outcome was one on the impact of amalgamation on the municipalities' service level (Eythórsson, Karlsson 2018). Thus, the present study should be a valuable contribution as to whether the amalgamations have been successful in Iceland or not.

Two models were used for the estimation. The first included one variable for all amalgamations and the second used four variables for amalgamations.

The present results suggest that municipal amalgamations have been partly successful. Model 1 suggests that amalgamations of municipalities in Iceland have been successful when correlations between the variables for all amalgamations in the period 1992-2006 and housing prices turned out to be positive and significant. Model 2 revealed amalgamation as having a significant impact on local housing prices when there were amalgamations of more than two municipalities. No significant positive correlation was detected in the case of an amalgamation of two municipalities.

The main research objective was to investigate a potential correlation between local housing prices and municipal amalgamation. The result was partly positive and it suggested that municipal amalgamations in Iceland have been successful with regards to increasing social benefit when more than two municipalities were involved. Such amalgamations have led to an improved service level, lowered local taxes and the service fees of local government. Those developments are reflected in housing prices.

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