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Local housing market and transportation improvements: The case of cul de sac and extremely remote localities.

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Abstract

In this paper, I examine the relationship between housing prices and transport improvements in case of tunnel in a locality in an extremely remote area of Iceland – a village far north called Siglufjörður. It have been documented that transportation improvements tend to influence housing prices, due to the general consumer preference for access over amenity value. I will examine whether this relationship holds in case of cul de sac in an extremely remote community in Iceland. A macro panel data set from Iceland will be used. It provides several essential variables for 79 municipalities in Iceland from 1981 through 2006. The results suggest that the impact is negligible against housing prices in this case. Further inspection shows that the price is sticky in the most relevant region, but the quantity is flexible. Thus, the estimation of the model will be repeated as an inverse demand function, where the housing price as exogene variable is replaced by sales quantity.

Keywords: Housing prices, Transportation improvements, Distance gradient, Local

JEL Classifications: R40; R21; R41; C23

1 Introduction

Does travel distance have impact on housing market in an extremely isolated location? Iceland is an interesting subject for this question because it is large but sparsely populated, it is geographically isolated, it has many isolated localities, and data sample for the entire country is available for long period of time including many large and small scale transportation improvements. This paper examines this relationship by a fixed effect panel data model in order to capture the pure effect of transportation improvements in a locality in an extremely remote area.

It has been argued that transportation improvements tend to have impact on the housing market by increasing prices (Baldwin et al., 2003; McDonald & Osuji, 1995; McMillen, 2004). According to many economists such as Fujita and Thisse (2002, pp. 78-91), McCann (2001), and Fujita (1989), the price of land and real estate is highest in city centers and decreases with every unit of distance from city center. Thus, when some areas are pulled closer to the city center through an improvement in transportation, the land values in these areas increases. The marginal impact seems however to be spatially limited to the urban areas close to large business centers (Vifill Karlsson, 2008). Does that necessarily mean that the impact is negligible in areas much further away?

There are some evidence for that the housing prices is rather sticky, especially when the pressure is downward (Hort, 2000). The local economic growth of being continuously negative is

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rather common symptom in remote areas. The local housing prices tend to be highly sensitive to household income and economic growth. Thus, it is most likely that the demand for housing has been under downward negative pressure for years in those areas.

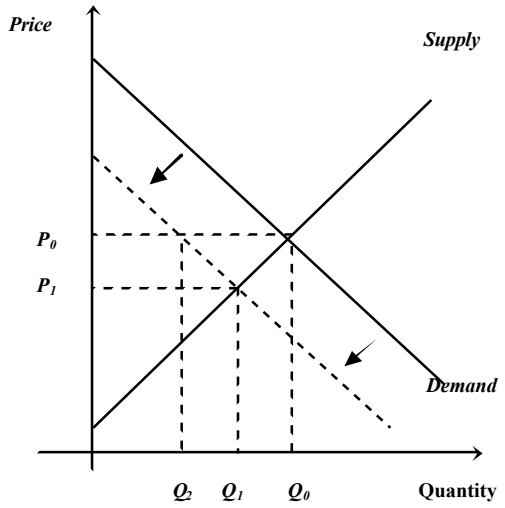

Figure 1: Price rigidity in the housing market.

Therefore, if the price is sticky under a negative pressure of the housing market it will remain equal to P_0 instead of P_1 (Figure 1). The quantity will, however, change from Q_o to Q_2 instead of Q_1 if the price were flexible. When or if a positive pressure will return, as in case of large scale transportation improvement, the quantity sold will increase again while the price remains the same. If the demand curve will return to its original position the annual quantity sold dwellings will move from Q_2 to Q_o and the price remains the same. This is true if the supply of houses and dwellings is close to being perfectly price elastic: meaning that the owners are eager to sell when they receive an offer above minimum price.

If this is the case, traditional estimation of the impact of transportation improvements on housing market via price will not detect any impact. The impact is however detectable since the value of local housing has risen from $P_0 Q_2$ to $P_0 Q_0$. Thus, it is reasonable to believe that a traditional method of estimating any impact on the local housing market in remote areas will not return true estimates: the sales quantity becomes much more relevant observation than price.
The aim of this study is to argue for the relevance of the sold quantity of dwellings as the primary subject in studies of this type – that is where the relevant communities are extremely remote areas. Thus, there will be two research questions to be answered in this paper as follows: *Do transport improvements have significant impact on the local housing price market of extremely remote areas*? *Do transport improvements have significant impact on the local housing sales quantity market of extremely remote areas*?

The organisation of the study is as follows. Section 2 contains a description of the subject: Iceland and the particular village. Section 3 stresses the data sources, definition, construction, and transformation of the data. Section 4 contains the analysis and results, while Section 6 consists of a summary and concluding remark.

1 Iceland

Iceland is an island of 103,000 km^2 in the North Atlantic Ocean. A large part of Iceland (principally the highlands) is not suitable for people to live in due to the harsh climate, especially during the winter. Thus, relatively few of Iceland's inhabitants live more than 200 meters above

sea level. Only 24,700 km^2 of Iceland's land area is below 200 meters above sea level[2] (Figure 1); the higher elevations are mostly in the center of the island. Thus, the highway system is mainly located along the coast.

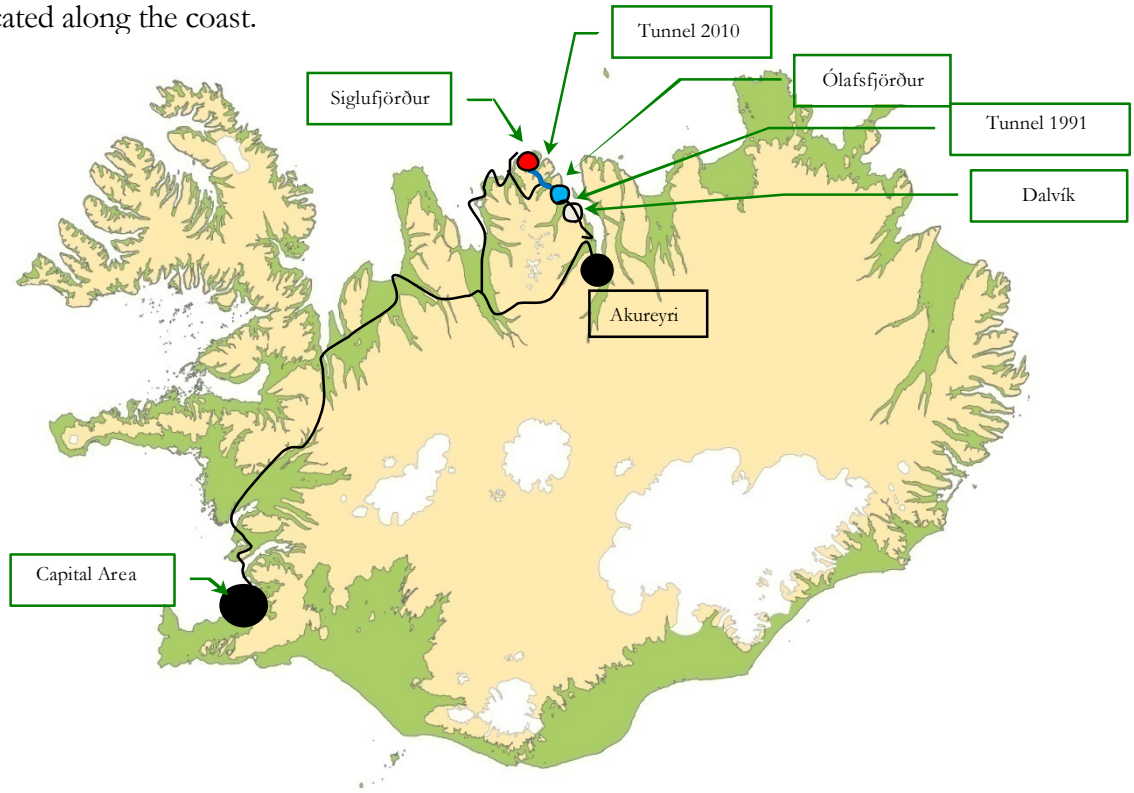

Figure 2: Lowland of Iceland

Lowland is defined as land with an elevation of 0-200 meters above sea level (green shaded area). Source: National Land Survey of Iceland

Approximately 65% of the population lives in the capital area. The rest of the population lives in towns, villages and farms evenly spread around the coastline (Table 1). There are approximately 100 towns and villages in Iceland. Reykjavik, the capital city had with 118,700 inhabitants in January 2009. Akureyri, the largest town outside the capital area, had 17,400 inhabitants. So, even though Akureyri is a significant business center for inhabitants on the north and probably east coast, the role of the capital area should not be neglected where it offers a wider variety of goods and services.

Table 1: Size and location of towns in Iceland - December 2005.

Source: Statistics Iceland.

Towns population	Total	South coast	West coast	North coast	East coast
Population of 0-500	60	13	19	18	9
Population 500-1,000	17	5	3	4	3
Population 1,000-10,000	25	13	5	4	5
Population >10,000	4	3	0	1	0
Total	105	34	27	27	17

Since public transport in rural Iceland is very limited, inhabitants rely on their own vehicles. Several types of export industries, evenly spread along the coastline, are dependent on speedy and efficient transportation, such as tourism, agriculture, and the fishing industry. Thus, the transportation system appears extremely important to the Icelandic economy, especially in order

[2] 43,100 km^2 of Iceland´s land mass is at an elevation of less than 400 meters

to improve local scale economies. However, travel in Iceland has long been very hazardous. A harsh climate, high mountains, deep fjords, and bad roads have made for poor driving conditions. Icelandic roads have been primitive compared to those in other European countries. But transportation improvements over the past 25 years have been considerable (Table 3).

Table 2: Transportation improvements in districts area of Iceland 1981-2006.

Source: Icelandic road administration.

Project	Year, finish	Type of constructi on	Closest urban 1	Closest urban 2	▲ Road distance	▲ Road distance to the capital	New/renewal
Óshlíðarvegur	1982	Road	Bolungarvík	Ísafjörður	0	0	Renewal
Ólafsvíkurenni	1984	Road	Hellisandur	Ólafsvík	0	0	New
Víkurskarð	1986	Road	Húsavík	Akureyri	0	0	New
Óseyrarbrú	1988	Bridge	Stokkseyri, Eyrarbakki	Þorlákshöfn	25	6	New
Dýrafjörður	1991	Road	Þingeyri	Ísafjörður	7	0	New
Ólafsfjarðargöng	1991	Tunnel	Ólafsfjörður	Dalvík, Akureyri	1	1	New
Ölfusárbrú	1992	Bridge	Selfoss	Hveragerði	0	0	Renewal
Vestfjarðargögn	1995	Tunnel	Flateyri og Suðureyri	Ísafjörður	4	0	New
Gilsfjarðarbrú	1998	Bridge	Ísafjörður, Patreksfjörður Reykhólar	Búðardalur, Borgarnes, Reykjavík	42	42	New
Hvalfjarðargöng	1998	Tunnel	Akranes	Reykjavík	42	60	New
Gemlufallsheiði	2000	Road	Þingeyri	Ísafjörður	0	0	Renewal
Möðrudalsöræfi	2000	Road	Egilsstaðir	Akureyri	0	0	Renewal/ New
Vatnaleið	2002	Road	Grundarfjörður, Ólafsvík, Hellisandur	Borgarnes, Akranes	2	2	New
Brattabrekka	2003	Road	Búðardalur	Akranes	1	1	Renewal
Kolgrafarfjörður	2005	Bridge	Grundarfjörður, Ólafsvík, Hellisandur	Stykkishólmur, Borgarnes	5	5	New

It is very interesting to investigate how valuable improved access to the capital area has been to the residents of rural Iceland. Many wide rivers, along with other characteristics of the landscape and a limited road works budget, have made Iceland's road network unusually circuitous. Furthermore, narrow gravel roads have been the most common type of thoroughfare until recently, especially in the rural areas. As a result, transportation improvements in Iceland have generally aimed at shortening distances (Table 3) by building larger bridges and tunnels, and making roads safer by replacing gravel surfaces with pavement[3], rather than building expressways and increasing the number of lanes, as in other developed parts of the world.

Fjallabyggð municipality is the subject of this paper. Siglufjörður and Ólafsfjörður are its villages. Fjallabyggð has almost no rural population. It is among the most remote area of Iceland. There were 1,277 inhabitants in Siglufjörður in January 2009 and 850 in Ólafsfjörður. The population of Siglufjörður has never been higher than 3,103 in the year 1948 and 1,207 in Ólafsfjörður 1983. The local economy depends on fisheries. Herring factories were in both villages when the industry was running. It stopped in the year 1963. The villages have been isolated because of rough landscape. A tunnel in Ólafsfjörður reduced the isolation towards Akureyri in December 1991. A work was simultaneously started in order to improve the road connection between Siglufjörður and Ólafsfjörður by tunnel.

Now, it is interesting to investigate the local housing market in Fjallabyggð. Let us present the housing price and the sales quantity in both villages in scatter grams. A clear distinction will be made between data before and after the installation of the tunnel in the year 1991. A blue diamond represents data before the installation and red triangle after.

[3] According to the Icelandic Road Administration and Statistics Iceland, only about 800 km of state-administered roads were paved in the year 1981, rising to 4,400 km. at the beginning of the year 2007, or approximately 50% of major and collector roads.

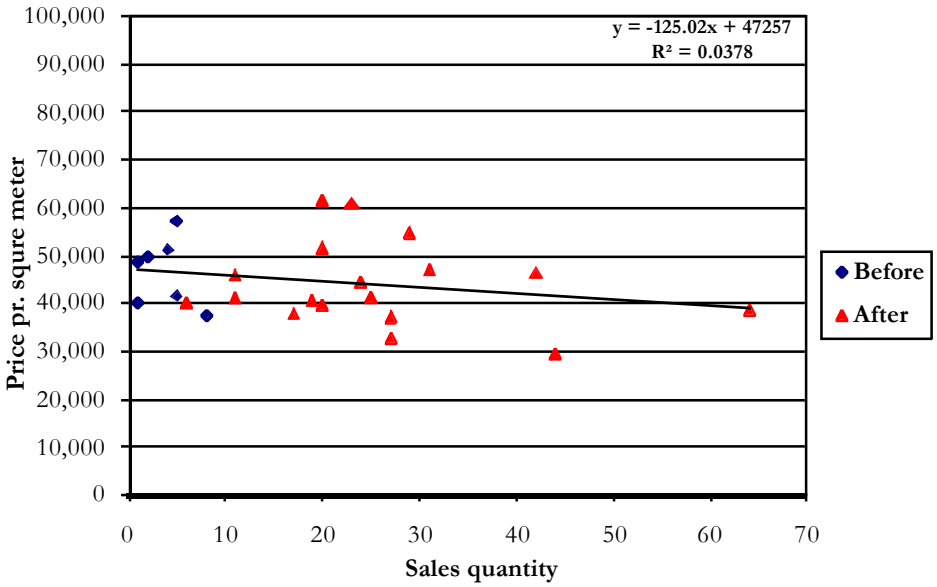

Figure 3: Housing demand in Siglufjörður before and after the high-way tunnel

The tunnel was open for traffic in 1991. The data covers annual averages in the period 1981-2008. Source FMR.

According to the scatter diagram the sales quantity is evidently higher after opening of the tunnel (Figure 3). Furthermore, the price seems to be rigid where the slope of the trend line is negligible and not very reliable according to R^2.

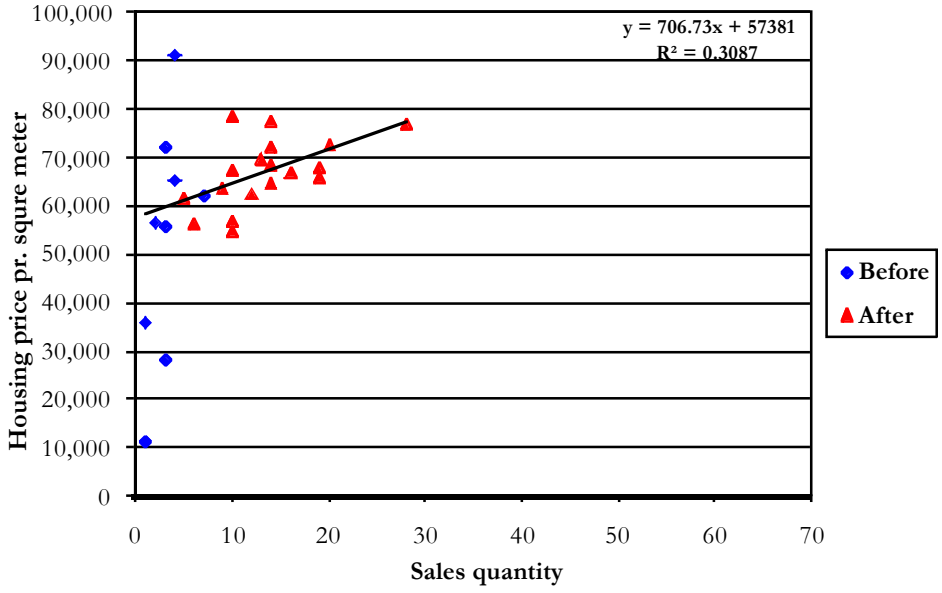

Figure 4: Housing demand in Ólafsfjörður before and after the high-way tunnel

The tunnel was open for traffic in 1991. The data covers annual averages in the period 1981-2008. Source FMR.

In Ólafsfjörður, the quantity becomes evidently higher following the installation of the high-way tunnel in 1981 (Figure 4). The trend line became, however, upward sloping. A three extremely low prices (outliers) in the previous period makes this trend line rather unreliable and the fit is not strong. It is, however, interesting to see that the price is considerably higher in Ólafsfjörður than Siglufjörður and the sales quantity much lower.

2 Data

Iceland is divided into 79 municipalities in the panel data sample of this paper and covers the period 1981-2006. However, in some estimation the data sample will be limited either with respect to time or municipalities. The data comes from various sources. The Land Registry of Iceland contributes data for housing. The Commissioner of Inland Revenue, Statistics Iceland, and the Icelandic Road Administration are other sources as in my former study (Vifill Karlsson, 2008).

Table 3: Variable description and sample statistics.

Variable (acronym)	Description	Mean	Standard deviation
House price (HOPR)	Real price of houses, in Icelandic krónur	9,558,597	4,875,671
Road distance (RDIR)	Average distance in kilometers of each municipality from the capital city, in absolute terms	299.6	228.0
Total Income (TINC)	Total income per capita, in thousands of Icelandic krónur	2,020.3	658.9
House age (HAGE)	Average age of houses sold, in absolute terms	28.9	15.9
House size (HSIZ)	Average size of houses sold, in square meters	143.1	69.2
Number of dwellings (HONR)	Average number of dwellings in each house	1.019	0.103
Dwelling's floor (HOFL)	Average number of floor, reflecting the dwellings position in heights from the ground	1.653	0.653
Rooms pr. dwelling (HORO)	Average number of rooms pr. Dwelling	3.366	1.035
House building material wood (HOM6)	Share of dwellings where wood is outwall's building material	0.205	0.257
Balcony size (HOBA)	Average size of balcony, in square meters	2.361	3.605
Parking/Garage (HOPA)	Share of dwellings where either parking place or any type of garage is included	0.443	0.293
Lot size (HOLO)	Average size lots, in square meters	537.3	410.8
Population (POPU)	Municipality population, in absolute terms	3,360.6	11,779.6
Tunnel (TUNN)	Dummy variable of large transportation improvement. 1 for Hvalfjörður tunnel.	0.210	0.408
Aluminum East Coast (ALEA)	Large scale local investment. New aluminum smelter on the east coast of Iceland	0.004	0.066
Mortgage interest rate (INBA)	INBA is the weight of the government house-bond interest rate (70%) and commercial bank's bond (30%)	0.063	0.008
Supply of houses (HNPP)	The supply side is represented by the local number of houses divided by number of inhabitants.	0.390	0.071

According to the standard deviation (Table 3), the data sample covers considerable variation in all key variables. This is especially prominent in the standard deviation of the housing prices, sales quantity, and road distance. The standard deviation of housing prices is approximately 1/2 of the mean and, of road distance more than 3/4 of the mean. The standard deviation of many other variables, such as total income and house age, are high as well. This contributes to the robustness of the estimators.

3 Estimating the result

This chapter will be divided into two questions. First we will try to answer the first research question: *Do transport improvements have significant impact on the local housing price market of extremely remote areas*? Then the other question will be on the agenda: *Do transport improvements have significant impact on the local housing sales quantity market of extremely remote areas*?

3.1 Housing price

The empirical model was set forth in (Eq. 4) of my earlier paper (Vifill Karlsson, 2008). Two versions of a fixed effect model will be tested, the semi-logarithm type (SLM) and the quadratic distance type (QDM) – that is, Eq. (4) and (5). The analysis is divided into those two separate models in order to demonstrate the different effect of road distance on the nearest municipalities and the rest of the country. No significant impact was detected when the model was tested for the entire country in one of my previous studies (Vífill Karlsson, Forthcoming). That is obvious when the estimator for Akureyri as CBD is investigated. Thus, the estimation was repeated for data sample of only Akureyri and its closest municipalities. The other part of the entire data sample, municipalities closer to Reykjavík than Akureyri, was discarded. The results are presented in Table 4, including parameter coefficients, t-value, number of observations, n, R square, adjusted R square, F-value, and special t-statistic for testing serial correlation in panel data, as recommended by several authors, such as Wooldridge (2002, pp. 176-177) and Verbeek (2004, pp. 108-110). Initially, the estimate suffered from serial correlation, which was sufficiently eliminated by a lagged variable of the residual, which is a method recommended by Wooldridge (2002, pp. 176-177) and Verbeek (2004, pp. 108-110). Multicollinearity was not observable in the final results. A presence of endogeneity and heteroscedasticity led the analysis to a 2SLS version for fixed effect panel data model where both problems were sufficiently solved. However, in the final version (Model 2), no problems were detected except for the normal distribution of the residuals, as confirmed by the Jarque-Bera test. The test statistic is equal to 715. The reason for that is mainly high kurtosis. This means that an unusually high share of residuals was close to its mean but the skewness close to 1 seems to be in line with normal distribution. In some respects this threatens the efficiency of the estimators less than if the skewness were to blame (**Error! Reference source not found.**).

Table 4: Relationship between housing prices and transportation improvements. A fixed and a random effect panel data model. 1990-2006 for Akureyri as CBD

Variable (acronym)	Model 1 Random effect SLM. Narrow sample	Model 2 Fixed effect 2SLS QDM
Total Income (TINC)	.0001655	.0000966
	(3.78)	(1.07)
House supply (HNPP)	-1.179945	-3.176624
	(-1.69)	(-1.94)
Mortgage interest rate (INBA)	-4.747658	-24.7473
	(-0.83)	(-4.90)
Road distance Akureyri (RDIA)	-.0018947	.0677526
	(-3.40)	(0.70)
Marginal road distance Reykjavík	-.0000111	-.000839
(RDRM)	(-0.04)	(-0.48)
House age (HAGE)	-.0100351	-.0079777
	(-3.40)	(-3.64)
House size (HSIZ)	.0026304	.0026753
	(5.30)	(5.75)

Number of dwellings (HONR)	-.1415695	-.1016403
	(-0.88)	(-0.54)
Dwelling's floor (HOFL)	.0223687	-.1506274
	(0.22)	(-1.69)
Rooms pr. dwelling (HORO)	.090093	.1112621
	(3.53)	(4.42)
House building material wood	.273163	.2290362
(HOM6)	(1.43)	(2.04)
Balcony size (HOBA)	.0187201	.0122659
	(3.80)	(2.57)
Parking/Garage (HOPA)	.3504664	.1966745
	(2.94)	(2.05)
Lot size (HOLO)	-.0001204	-.0001155
	(-1.51)	(-1.77)
Local population (POPU)	.0000309	.0001201
	(3.35)	(0.90)
Constant term (α)	15.66897	
	(39.34)	
n	200	200
F-value	44.10	11.85
R-sq. within	0.4367	
R-sq. between	0.8066	
R-sq. overall	0.5411	
R-sq. centered		0.3225
R-sq. uncentered		0.3225
Serial correlation	No	No
Multicollinearity	No	No
Heteroscedastisty	Robust	No
Residuals distribution	Not normal (JB=475)	Not normal (JB=715)
Panel data sample	unbalanced	unbalanced
Instrumented		INBA: GGNP, CURR

The data sample covers only municipalities of Iceland closer to Akureyri than Reykjavík. Dependent Variable: LOG (HPRI). Methods: Fixed effect panel data model with instrument variables. Statistical program: STATA. The 2SLS model passed the Sargan test (0.1596), Cragg-Donald Wald F statistic (all >7.25) and Anderson canon. corr. LM statistic (92.268). Values in parentheses are t-statistics in the fixed effect models and z-statistics in the fixed effect 2SLS models.

An unexpected insignificant relationship between housing prices and road distance from Akureyri triggered aggressive doubt regarding the model relevance regarding extremely remote areas. The research question was: Is the impact of a large scale transportation improvement on the local housing market captured by the housing prices in case of cul de sac? The result does not suggest a positive answer.

Is there any logical explanation for the result? It can be related to sticky prices, especially when the pressure is negative. Almost all extremely remote areas of Iceland have been suffering from local depression and net out-migration for many decades. Thus, the housing prices could probably been close to its lower limit. It has been quite popular in Iceland to own a second home, in connection to leisure time and/or vacation. Furthermore, it has been increasingly popular for former citizens, to keep contact to their roots. When people have to migrate against their will it can be better for them to keep their houses as second home instead of selling them for low price, buy a new one in the capital area and a summer house elsewhere: generating a certain lower limit of the local housing prices. Thus, it is interesting to test whether any

transportation improvement have significant impact on sales quantity instead. That leads us to the second research question.

3.2 Sales quantity

The second research question is: *Do transport improvements have significant impact on the local housing sales quantity market of extremely remote areas*?

The model was generally comparable to the previous model except for the dependent variable. Instead of housing prices, sales quantity will be used. However, since many of the large transportation improvements in the relevant period do not include any decrease of distances between the municipalities and nearest CBD, dummy variables were constructed to capture their possible impact. Furthermore, since the value of the dependent variable becomes zero in many cases a tobit model was implemented.

The analysis suffered from heteroskedasticity and absence of normality. Then the dependent variable was transformed by an inverse hyperbolic sine (ihs). A presence of endogeneity was tested against total income and the hypothesis not rejected. Total income and house supply were the instrumented variables. Theoretically, house supply has impact on housing prices and housing prices tend to decrease supply of dwellings. Instrument variables were: lagged version of labor income, local population, housing prices, number of dwellings, share of elderly in local population and number of dwellings divided by local population. The results is presented as parameter coefficients along with t-value, number of observations, n, R square, adjusted R square and F-value (Table 5).

Table 5: Relationship between housing sales quantity and transportation improvements. A fixed effect panel data model along with 2SLS version.

Variable (acronym)	Model 3 Fixed effect	Model 4 Fixed effect 2SLS
Total Income (TINC)	4.03e-06	8.01e-06
	(4.65)	(17.29)
Unemployment (UNEM)	.0797065	.3089269
	(6.58)	(5.50)
Population (POPU)	1.04e-06	4.82e-07
	(6.77)	(3.26)
Labor gender (LGEN)	.0099677	.0120881
	(4.72)	(4.58)
Road distance from Reykjavík (RDIR)	-.0001035	-.0000384
	(-6.60)	(-3.32)
House age (ALEA)	.0036126	.00254
	(1.36)	(0.94)
House size (TUN3)	.0034518	.0042603
	(2.61)	(2.98)
Number of dwellings (OLAF)	.0090456	.0076358
	(4.91)	(2.78)
Dwelling's floor (VEST)	.0040276	.004239
	(2.50)	(1.57)
Rooms pr. dwelling (VIKU)	.0031379	.0010557
	(3.07)	(0.26)
House building material wood (MODR)	.0040297	.0065348
	(1.53)	(2.09)
Balcony size (GILS)	-.0009796	-.000055
	(-0.43)	(-0.03)

Parking/Garage (BRAT)	.0005996	.0004275
	(0.24)	(0.12)
Lot size (VATN)	.0038592	.0024162
	(1.61)	(1.26)
Local population (ENNI)	.0053424	.0018274
	(4.24)	(0.28)
Residual t-1	.9374904	.8039255
	(10.84)	(9.21)
Residual t-2	-.5869214	
	(-5.98)	
Constant term (α)	.017415	
	(2.94)	
n	1881	1881
F-value	69.06	71.49
R-sq. within	0.4991	
R-sq. between	0.3084	
R-sq. overall	0.2183	
R-sq. centered		0.12
R-sq. uncentered		0.12
Serial correlation	No	No
Multicollinearity	No	No
Heteroscedastisty	Robust	No
Residuals distribution	Not normal	Not normal
	(JB=16369)	(JB=14125)
Panel data sample	unbalanced	unbalanced
Hausman test	-81.22	

Dependent Variable: LOG (HPRI). Methods: Fixed effect panel data model with instrument variables. Statistical program: STATA. The 2SLS model passed the Sargan test (0.80), Cragg-Donald Wald F statistic (25.89) and Anderson canon. corr. LM statistic (98.88). Values in parentheses are t-statistics in the fixed effect models and z-statistics in the fixed effect 2SLS models.

As, stated earlier, the second research question of present paper was: *Do transport improvements have significant impact on the local housing sales quantity market of extremely remote areas?* Now, the answer is positive. This result suggests that transportation improvements, including those that shorten distances, have an impact on the local sales quantity of houses.

4 Conclusion

The aim of this study was to measure the influence of transportation improvements on the local real price of houses of extremely remote areas: furthermore a locality of being extremely distant and a cul de sac The analysis was based on annual average housing prices, sales quantity, a distance from the nearest CBD (the capital area of north Iceland), total household income, and several other relevant explanatory variables for all relevant municipalities in Iceland from 1981 through 2006. The data were analyzed with a fixed effect model in several different versions in order to detect pure impacts of improvements in transportation. A quadratic distance model was most appropriate for the present data sample.

It has been documented that the relationship between local housing prices in Iceland and transportation improvements in form of shortening the distance from the CBD, i.e. the capital city, is statistically significant and negative However, when the analysis is repeated for extremely remote locations the significance of the relationship disappears. The relationship is, however, significantly strong when the relationship of sales quantity and transportation improvements is tested in case of localities in extremely remote areas and a cul de sac.

The general conclusion from this analysis is that in sparsely populated countries, such as Iceland, transportation improvements which reduce the distance from a municipality to the CBD

tend to increase local housing prices of localities close to the CBD. Even though the price remains unaffected in others, the sales quantity captures the real impact on the local housing market, which reflects increased value for local houses.

5 Reference

Baldwin, R. E., Forslid, R., Martin, P., Ottaviano, G., & Robert-Nicoud, F. (2003). *Economic Geography and Public Policy*. Princeton: Princeton University Press.

Fujita, M. (1989). *Urban Economic Theory: Land Use and City Size*. Cambridge: Cambridge University Press.

Fujita, M., & Thisse, J.-F. (2002). *Economics of Agglomoration: Cities, Industrial location, and Regional Growth*. Cambridge: Cambridge University Press.

Hort, K. (2000). Prices and turnover in the market for owner-occupied homes. *Regional Science and Urban Economics, 30*(1), 99-119.

Karlsson, V. (2008). The relationship between housing prices and transport improvements: a comparison of metropolitan and rural areas in a large but thinly populated European country. *Bifrost Journal of Social Science, 2*, 26.

Karlsson, V. (Forthcoming). The relationship of housing prices and transportation improvements: Location and marginal impact.

McCann, P. (2001). *Urban and Regional Economics*. Oxford: Oxford University Press.

McDonald, J. F., & Osuji, C. I. (1995). The effect of anticipated transportation improvement on residential land values. *Regional Science and Urban Economics, 25*(3), 261-278.

McMillen, D. P. (2004). Airport expansions and property values: the case of Chicago O'Hare Airport. *Journal of Urban Economics, 55*(3), 627-640.

Paelinck, J. (1978). Spatial econometrics. *Economics Letters, 1*(1), 59-63.

Verbeek, M. (2004). *A Guide to Modern Econometrics* (Second ed.). West Sussex: John Wiley & Sons, Ltd.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge: The MIT Press.