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Children Families, Housing Prices and Small Urban Communities: Can High Housing Prices Affect the Number of Children in Certain Localities or Even Displace Families?

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Abstract

The number of children in the Western world has been dropping dramatically so that children are becoming relatively fewer than their elders. Iceland has been sharing the same trend. Several regions in Iceland have been experiencing more rapid reduction than others in the number of children for the past two decades or so. Does fast growing tourism play any role in this matter? According to Lino (2001), housing cost is one of the largest items in the marginal costs of raising children. Therefore, it is reasonable to assume that fast growing tourism leading to increased housing prices or any other factors influencing local housing prices could easily affect the residence of children families in Iceland. The paper will address this problem by creating a general model for the population development of children families, followed by a statistical estimation on a panel data sample against housing prices, covering all municipalities in Iceland during the period of 1990-2006 and another sample for all urban communities in the period 1991-2019. The result suggests that the number of children can decrease following an increase in local housing prices. Moreover, it is not likely to affect the number of inhabitants of the age of 50 - 66 years old but, surprisingly, likely to affect retired inhabitants similarly as children families.

Keywords

Population Development, Migration, Housing Prices, Children Families, Regression Analysis

1. Introduction

The number of foreign tourists has increased significantly during the past few decades, despite a significant setback resulting from Covid 19. This growth had a stimulating effect on entrepreneurs as it provided them with business opportunities in many parts of the country, involving, for example, the renting out of flats and the provision of various other services. Moreover, no unemployment in Iceland foreign labour has been needed to support the growth. Therefore, the number of immigrants has increased dramatically and thus the demand for housing. In the countryside, the slack performance of agriculture has been compensated for by a degree of tourism services. It has also become fairly common for Icelanders to seek ownership of an additional apartment, as a kind of holiday or second home, without necessarily being involved in tourist services (Karlsson, 2017). Besides, foreigners also own properties in Iceland[1]. This is certainly a positive development, but it can also present challenges. Thus, there are examples of municipalities and urban communities with empty housing neither available for sale nor rent to those who might wish to seek work in the area concerned (Karlsson, 2015).

An article on new entries in Icelandic agriculture (Karlsson, 2018) pointed out the importance of conducting research into the growing number of holiday and second homes in Iceland. This has been done abroad (Fountain & Hall, 2002; Fritz, 1982; Gallent, Mace, & Tewdwr-Jones, 2005; Jordan, 1980; Visser, 2004) revealing certain phenomena, for example that distant homeowners can literally prevent newcomers from settling in their area. Furthermore, a highly interesting synopsis of this matter was conducted in a doctoral thesis by Roger Marjavaara (2008). A comparable context, however, has attracted but little attention in Iceland. Families with children have been shown to be sensitive to this development (Brida, Osti, & Santifaller, 2009: p. 144) and it has been demonstrated that this group is most likely to leave under such circumstances. Thus, demand for holiday and second homes can result in demographic change.

This may happen because local apartments are popular as holiday and second homes for those with domicile elsewhere (Karlsson, 2015: pp. 42-43) which can result in positive pressure on the local housing prices. The financial performance of those who base their income on local industries, local services and residential advantages provides insufficient leverage in the housing competition with those who are looking for holiday and second homes. Thus, there are examples of up to half the properties in a particular municipality being owned by non-residents, "outsiders", or non-registered-residents.

To give an example of such a trend, the number of children in Stykkishólmur and Grundarfjörður fell by 40% during the period 1998-2014, as commonly happens in Icelandic country districts or farming communities. According to Statistics Iceland, this trend was later reversed in Stykkishólmur, but not in Grundarfjörður. In Tyrol, Switzerland, the number of children has decreased

[1]Foreigners are those who do not have domicile in Iceland.

sharply and this is considered to be the result of rising housing prices (Brida, Osti, & Santifaller, 2009: p. 144).

Consequently, the research question presented here is as follows: Is the number of children likely to fall in the wake of rising housing prices?

The research is organised as follows: Its theme has been presented in an introductory chapter and a research question framed. Then, theories and previous research in the field will be discussed. Next, the methodology of the research will be outlined. Subsequently, the data will be described and, finally, the conclusions of the research will be analysed, followed by a summing up of the report.

2. Theoretical Background, Model and Previous Research

The theoretical discussion part of this chapter is almost identical to a comparable discussion in Karlsson's (2012) doctoral thesis. Let us imagine a community of two regions, south and north. The theoretical model, first proposed by Baldwin (2001), concerns a typical household facing a choice between migrating from the south to the north or staying where it is. Households in both regions are identical, and they face the following utility maximization problem:

$$\max_{m_i} \int_0^\infty \left[N_i \omega + \left(\frac{1}{F} - N_i \right) \omega^* - \frac{\tilde{\gamma} m_i^2}{2N_i \left[\left(1/F \right) - N_i \right]} \right] \mathrm{e}^{-\rho t} \mathrm{d}t \tag{2.1}$$

where F is the number of households in both regions, ρ is the subjective discount rate, t refers to time, and i refers to the region. Since ω is real wages (or w/P, where P is the price level in the north) at home (north), ω^* is real wages abroad (south), and N_i is the northern labour supply, the first term in the large bracket is the typical household's income from its immobile factor. Real wage indicates utility or the "index for worker's instantaneous utility", as Baldwin (2001: p. 32) put it. The parenthesis of the second term stands for the labour share in the south, where the labour share is equal to $N^w / F - N_i$, where N^w is the world labour supply that has been normalized to unity. The last term is a migration cost, $c(m_i, N_i)$, a combination of congestion cost, a welcoming committee, and an old-folks effect. The congestion cost reflects the additional cost concerning traffic congestion; that is, there is more time spent on transportation when the community becomes more crowded, $\tilde{\gamma} m_i$. The variable $\tilde{\gamma}$ allows the migration cost to vary.

The welcoming committee effect captures the idea that migration is easier when it has been going on for a while since it is easier to migrate to a region of inhabitants with a similar background. Therefore, the migration cost decreases as migration increases. In this case, the cost of south-to-north migration falls as the stock of Southerners in the north rises, or $1/N_i$. The old-folks effect reflects resistance, as people leave something valuable behind when they migrate; the old-folks effect (or cost of resistance) can be high for an individual who has a large family and many friends and higher for individuals who had a pleasant childhood in their original location than who did not. Therefore, the cost that is due to the old-folks effect is lower for the first migrant than the second, if all other costs are equal. Thus, the cost of the old-folks effect increases with fewer Southerners, noted formally by $\left(1/\left[1/F - N_i\right]\right)$.[2]

The third factor of Equation (2.1) consists of the product of all three elements of the migration cost. The migration cost includes effects comparable to both the agglomeration and the dispersion force, the congestion and the old-folks effect captures the dispersion force, and the welcoming committee effect captures the agglomeration force.

The maximization problem is subject to the following constraint:

$$\dot{N}_i = m_i \tag{2.2}$$

Followed by the deduction made by Karlsson (2012: pp 94-96) the household optimal migration behaviour in the dynamic model can be written as:

$$\dot{n}_N = \frac{n_N\left(1-n_N\right)\left(\omega-\omega^*\right)}{\gamma\rho} \tag{2.3}$$

If $\dot{n}_N$ is equal to zero, then the steady state[3] of the equilibrium is obtained, and no one will migrate; if $\dot{n}_N > 0$, then it is favourable to migrate from the south to the north; and if $\dot{n}_N < 0$, then a north-to-south migration is favourable.

Migration is dependent on wages. If wages, ω, increase in the north $\dot{n}_N > 0$ and south-to-north migration becomes attractive, ceteris paribus. If wages, ω^*, increase in the south $\dot{n}_N < 0$ and north-to-south migration becomes attractive, ceteris paribus.

The rate of migration to the north, $\dot{n}_N$ is dependent on the population in the north (or the share of the world population in the north, n_N). However, this process is not infinite because $\partial\dot{n}_N/\partial n_N > 0$ and $\partial^2\dot{n}_N/\partial n_N^2 < 0$.The initial migration will fuel itself until a certain level is reached, at which point the cost from the old-folks effect and the traffic congestion will dominate the benefit of the welcoming committee effect, and the migration will stop, ceteris paribus. Therefore, if transportation improvements are successful and traffic congestion is less frequent, the south-to-north migration becomes more extensive. This result is in line with the previous version of the CPM.

Migration is also dependent on the direct migration cost, γ. When migration costs increase, the household becomes less willing to migrate, ceteris paribus.

According to Equation (2.3), the discount rate, ρ, discourages migration. The exact value of the discount rate is assumed to be equal to or larger than zero and equal to or less than one: $0 \le \rho \le 1$.

Ottaviano et al. (2002) developed an alternative quasi-linear framework that

[2] $\left[1/F - N_i\right]$ stands for the number of northerners who work in the South, since N^w has been normalized to unity.

[3] *Steady state* is a long-run equilibrium that includes accumulation and technical change (dynamics) (Eatwell, Milgate, & Newman, 1987: p. 626). The same understanding is in Dornbusch and Fischer (1990) but is coloured by a macroeconomic point of view. Bannock, Baxter, and Davis (1972) state that steady state growth is "*a feature of an economy in which all variables grow (or contract) at a constant rate.… If these rates are maintained indefinitely, steady state growth exists*".

does not include this imperfection while retaining the major characteristics of the core-periphery model. Ottaviano's framework adds housing prices to the previous version (Baldwin, Forslid, Martin, Ottaviano, & Robert-Nicoud, 2003: p. 129).

Almost all other migration models of economics, such as the disequilibrium (Hunt, 1993; McCann, 2001), the equilibrium (Roback, 1982) and the Harris-Todaro models (Harris & Todaro, 1970) allow for the influence of housing prices implicitly through household income such that higher housing prices reduce real wages and trigger out-migration.

It was decided to conduct a statistical test in this regard, with official statistics from Iceland. The test was to be based on a large numerical data series used by Karlsson (2012) in the compilation of his doctoral thesis, covering all municipalities in Iceland during the period 1990-2006; cf. a description of these in the chapter on data and also in the doctoral thesis referred to above (Karlsson, 2012). A new data series on urban communities, was also implemented, which will be outlined in further detail in the data chapter. Since the number of families with children was not available in this data series, it was decided that the dependent variable of the model should be the number of children, y. The statistical model was in a general format as shown below:

$$y_{it} = \alpha_i + X'_{it}\beta + \varepsilon_{it} \tag{2.4}$$

where β is the vector of all relevant independent variables. This is a fixed effect regression model where the coefficients include variations within municipalities or urban communities, not between variations as well as random effect (Verbeek, 2004). In this model, the independent variables became total family earnings, housing prices, size of population and, finally, it was decided to include the balance between men and women in the community and the average age in the community to address the possible regional disparity in a number of children related to them. This is a fixed-effect model for panel data.

One option, for that kind of model, was to use so-called time dummy variables which are made to absorb impacts that could be regarded as a development in the dependent variable extending across all provinces, municipalities or urban centres or all macroeconomic impacts. As regards number of children has been falling in many parts of the world throughout the 20^{th} century. If a strong impact makes itself felt across all parts of the country such variables should be inserted into the model. This, however, did not yield a significant effect on the dependent variable when tested (not shown here). This is also understandable when long-term development is investigated in terms of urban centres (**Table A1**). Thus, there is no particular reason to include such variables.

When it comes to previous researches on related topics, increased demand for holiday apartments has had the potential of a crowding-out effect, reducing the number of full-time residents has been investigated (Fountain & Hall, 2002; Fritz, 1982; Gallent, Mace, & Tewdwr-Jones, 2005; Jordan, 1980; Visser, 2004) as discussed in Roger Marjavaara's doctoral dissertation (Marjavaara, 2008), but whether housing prices encourage the departure of families with children has been a much less researched topic; that is, whether there are somewhat fewer children in locations of high housing prices. It should be reiterated, however, that this is referred to in research by Brida et al. (2009: pp. 143-144) who go on to cite work by Gallent et al. (2005), but in neither of those papers is the matter properly investigated. Marjavaara (2008) also points out that high housing prices caused by the demand for holiday and second homes in densely populated areas may cause problems for younger and less affluent people. They, furthermore, cite Sharpley and Sharpley (1997) and Glesbygdsverket (2004) without connecting this, in particular, to children and/or people with children. That is also in line with Lino (2001) where the housing cost was suggested to be the highest single expense item in bringing up a child in the U.S.A.

3. Data

The analysis conducted in this research is based on two separate data collections; one covering municipalities and the other on urban centres. The municipal data collection was compiled in relation to a doctoral thesis in 2012 (Karlsson, 2012), but the data collection on urban centres is new. The objective of using data collections for both municipalities and urban centres was to strengthen the analysis by approaching the topic from two sides. Many municipalities consist of both urban and provincial communities. The municipal data collection already existed, but was somewhat dated and not as precise as the collection on urban centres which enabled us to bypass figures relating to provincial communities where price developments on the housing market are subject to different impacts than apply in urban districts, since in the former the selling of farmlands and profits therefrom will skew all pricing trends. Besides, individual income in provincial communities can be more undervalued in public statistics than in urban centres, for example due to tax rules for business owners that apply to farmers, for example, and are thus not reliable in the present study. Finally, the housing market tends to be more efficient in urban than provincial communities, in terms of the number of sold dwellings per capita.

A brief survey of the data (**Table 1**) indicates a certain variability in the figures. This was most pronounced with regard to the number of children, or in the dependent variable, where the standard deviation was almost four times higher than the average. Gender imbalance and average age showed the least variability since those figures tend to remain stable from one period to another.

The data on housing prices was obtained from Registers Iceland. All other data came from Statistics Iceland. The gender imbalance was assessed as any deviation from balance and calculated as follows:

$$G = |1 - g|$$

or the numerical value of 1 minus the gender ratio of people of labour market age, g. The gender ratio is the number of women divided by the number of men.

Table 1. Descriptive statistics of variables classified by municipality during the years 1990-2006.

Variables	Description	Average	Standard deviation
Number of children, *Ch*	Number of children aged 0 - 14 years in each municipality on 1 January each year.	810.91	2599.54
Housing price, *H*	The average cash selling price of sold apartments per square metre at the 2006 pricing level. Based on the annual average in each municipality in ISK.	69,936.2	32,770.91
Total family income, *I*	Average total income of individuals in each municipality at the 2006 pricing level. Based on the total of the year, in thousands of ISK.	2,020.31	658.93
Gender imbalance, *G*	Deviation from the gender balance in each municipality of individuals at working age (aged 16 - 74) on 1 January each year.	0.12	0.09
Average age, *A*	Average age of inhabitants in each municipality on 1 January each year.	34.52	3.20
Inhabitants, *I*	Number of inhabitants in each municipality on 1 January each year.	3360.63	11,779.63

All those variables are classified by municipality each year. All prices in ISK are based on the 2006 pricing level.

Labour market age refers to people aged 16 - 74 in municipal records.

Individual earnings were calculated as the average total earnings of individuals classified by municipalities. This data was specially processed by Statistics Iceland. Apartment prices were the average cash prices of sold apartments per square metre, as specially processed by Registers Iceland. All ISK amounts in data classified by the municipality were at the pricing level of 2006.

It should be noted that the figures for a number of children, inhabitants, average age and gender imbalance are based on the count and status of 1 January each year, while other variables are drawn from the average or total for each year.

The figures representing a number of children applied to residents aged 0 - 14 years. It would have been preferable to use the ages of 0 - 17 since this group is classified as children in Iceland, but the categorisation of the municipal database did not offer this possibility. Thus, this will have to be regarded as a type of proxy variable.

The database for urban centres (Table 2) became significantly more extensive than the one already established for municipalities during the period 1991-2019. On the other hand, only 39 urban centres were included in the final analysis since turnover on the housing market in the smallest units was insufficient for processing price data, although the total number of urban centres, as defined by Statistics Iceland, was 107 in 2019. Thus, only the very largest urban centres were included in the analysis.

Table 2. Descriptive analysis of the variables classified on the basis of urban centres during the period 1991-2019.

Variables	Description	Average	Standard deviation
Number of children, *Ch*	Number of children in each urban community. Number of children aged 0 - 17 years in January each year.	749.9435	2906.907
Number of old workers, *OW*	Number of inhabitants of the age of 50 - 66 years old in each urban community. In January each year.	481.6497	2063.89
Number of retired inhabitants	Number of retired people (of the age of 67 and older) in each urban community. In January each year.	297.5646	1343.203
Housing prices, *H*	Urban communities' average real price of sold apartments per square metre at the 2019 pricing level. Based on the total of the year in ISK.	163,452.8	75,953.27
Total family income, *I*	Urban communities' average total income of individuals at 2006 pricing level. Based on the total of the year in ISK.	3753.219	790,019.3
Gender imbalance, *G*	Urban communities' divergence from gender balance of persons of working age (aged 18 - 49) 1 January each year.	0.1385622	0.1778326
Average age, *A*	Urban communities' residents' average age is 1 January each year.	34.56216	4.233596
Inhabitants, *I*	The average number of inhabitants in each urban community 1 January each year.	2842.839	11,937.65

All those variables are classified according to urban centres each year. All ISK prices are at the 2019 pricing level.

Housing price figures are those which Registers Iceland publish on their website to indicate selling prices according to urban centres in the whole of the country. The figures date from the year 1982. Figures indicating new builds were left out of the database. Housing prices were divided into private housing on the one hand, v_1, and multi-family housing, on the other, v_2. Then the number of sold properties was presented correspondingly, n_1 and n_2. Thus, the average price, $\overline{P}$, was calculated in the following manner:

$$\overline{P} = \sum_{i=1}^{2} v_i \frac{n_i}{n}$$

Total income indicated the average total income of the urban centre in question, separately calculated by Statistics Iceland. All ISK figures were at the 2019 pricing level in the urban centre databases and at the 2006 level in the municipal databases. Some people might consider the income figures abnormally low; this is because the total income in the municipality concerned is divided by the number of all taxable individuals, not only those on the labour market, and also even includes people in part-time work.

Here the gender imbalance was calculated in the same way as in the urban centre databases, although this time it is limited to the age group 18 - 49, because this cohort is most likely to have children at home. The dependent variable, the number of children, referred to inhabitants aged 0 - 17, but not 0 - 14 as in the municipal databases.

Otherwise, the variables of the urban centre databases were processed and defined in the same way as those relating to the municipalities.

4. Analysis

Regression analysis was conducted in accordance with the model above (Eq. 2.5). The authors had access to a large database covering all municipalities during the period 1990-2006 and it was decided to include it in this analysis. The data, however, reflects conditions from that particular period and it was thought to be of interest to repeat the analysis using newer data. Therefore, a data collection was launched, this time focusing on urban communities, instead of municipalities for reasons outlined in the chapter on data.

In the final version of all the models, they appeared to be well defined and all premises were sound (no violation regarding auto-correlation, multicollinearity and heteroskedasticity). Auto-correlation was discovered and this was dealt with by cluster analysis as recommended by Cameron and Miller (2015). The data was tested for endogeneity with respect to apartment prices since there is a certain risk that housing prices may affect the number of children, as posited in the research hypothesis, and, in turn, the number of children may affect housing prices. This factor was tested but was not found to be significant[4].

The results suggest (**Table 3**) that almost all the chosen impact factors had a significant effect on the number of children in municipalities. Increasing housing prices negatively affect the number of children as posited by the theory and the same applies to falling income. There was but little difference between the tested models (1 and 2), perhaps the main divergence being overall slightly less significance in the data relating to municipalities than to urban communities. The least significant variable, however, fulfilled the 10% significance level. The coefficient was −0.0005 which means that if housing prices rise by ISK 10,000 per square metre, the number of children can be expected to fall by 5 in the community concerned, *ceteris paribus*. This corresponds to approximately two families with children.

At a confidence level of 95%, this result means the number of children being reduced by 1 to 8, with regard to the urban community data. Thus, the level of uncertainty is quite high, despite a t-value of 2.72.

Besides, any imbalance between the count of men and women negatively

[4]Size of apartment and unemployment were used as instrument variables, where those are more likely to impact housing prices than the number of children. Size of apartment turned out to be a more useful instrument variable, but in combination they returned a satisfactory Sargan test.

Table 3. Regression analysis regarding the correlation between number of children, apartment prices etc.

Variables	Model 1 Municipalities Years 1990-2006	Model 2 Urban centres Years 1991-2019
Apartment prices	−0.0005 (−1.73)*	−0.0005 (−2.66)**
Total family income	−0.01 (−1.60)	0.000014 (1.24)
Gender imbalance	−225.93 (−2.30)**	−35.14 (−4.87)***
Average age	−15.23 (−5.39)***	−19.28 (−7.39)***
Population	0.23 (27.47)***	0.26 (16.01)***
Population squared	−0.000001 (−22.79)***	−0.000001 (−17.93)***
Constant	798.21 (8.48)***	1190.09 (10.44)***
Number of observations, *n*	1022	1114
R^2 internal	0.8567	0.9387
R^2 between	0.9879	0.9583
R^2 total	0.9886	0.9559

The dependent variable of the regression analysis is a natural logarithm of the number of children aged 0 - 17, divided according to urban centres. The numbers in parentheses are t-values. Three stars after coefficients indicate statistical significance at the value of 1%, two stars indicate significance at 5% and one star shows statistical significance at 10%. Multilinearity did not skew the results since none of them exceeded the numerical value of 0.53. Heteroscedasticity and autocorrelation were dealt with by cluster analysis. In the final analysis data was obtained for 39 urban centres.

affected the number of children. Similarly, a higher average age in a community had a negative effect on the number of children as is to be expected.

It was mainly the correlation of income and number of children that turned out as weak in the first version of the model (models 1 and 2). The correlation was non-significant while a stronger estimate and a coefficient of a positive sign in model 2 and in line with the theory

The number of inhabitants also affected the number of children. This effect varied since the correlation was a non-linear concave function of the second degree. The number of inhabitants works like a proxy variable, *inter alia* regarding all services offered to families with children in larger urban communities, both in schools, sports facilities, leisure activities etc. It is also noted that while there are few inhabitants, a larger population increases the number of children. This effect is strongest initially (marginal effect), but gradually weakens until it is halted at a maximum point when an additional population inhibits an increased number of children. This turning point was at a population of 144,000 in the municipal databases and 109,000 in the urban communities databases.

Consequently, the analysis has provided a positive answer to the research question presented in this paper. If apartment prices rise, the number of children falls in the communities concerned, whether they be municipalities or urban communities.

Other models were tested to support the analysis. They were in the form of natural logarithm as follows:

$$\ln\left(y_{it}\right) = \alpha_i + \ln\left(X'_{it}\right)\beta + \varepsilon_{it} \tag{4.1}$$

This form returns coefficients that can be interpreted proportionally and thus the results are more easily transferred to communities of different population size. The coefficient for apartment prices is, for example, −0.05 in urban communities (Model 4, Table 4). This tells us that if apartment prices rise by 1%, the number of children falls by 0.05% (or if 100% the number of children falls by

Table 4. Regression analysis regarding the correlation between number of children, apartment prices etc.; a natural logarithm model.

Variables	Model 3 Municipalities The period 1990-2006	Model 4 Urban centres The period 1991-2019	Model 5 Urban centres The period 1991-2006
Ln (Apartment prices)	0.002 (0.22)	−0.05 (−3.62)***	−0.02 (−1.56)
Ln (Total family income)	−0.011 (−0.27)	0.09 (3.50)***	0.0003 (−0.01)
Gender imbalance	−0.16 (−1.57)	−0.15 (−23.33)***	−0.17 (−18.87)***
Ln (Average age)	−1.59 (−9.84)***	−1.61 (−24.73)***	−1.22 (−10.72)***
Ln (Population)	1.01 (23.57)***	1.03 (34.77)***	1.06 (30.71)***
Constant	4.21 (7.74)***	3.57 (11.35)***	2.86 (7.85)***
Number of observations, n	1022	1114	613
R^2 internal	0.8837	0.9511	0.9319
R^2 between	0.9986	0.9988	0.9994
R^2 total	0.9979	0.9980	0.9988

The dependent variable of the regression analysis is a natural logarithm of the number of children aged 0 - 17, divided according to urban centres. The numbers in parentheses are t-values. Three stars after coefficients indicate statistical significance at the value of 1%, two stars indicate significance at 5% and one star shows statistical significance at 10%. Multilinearity did not skew the results since none of them exceeded the numerical value of 0.53. Heteroscedasticity and autocorrelation were dealt with by cluster analysis. In the final analysis data was obtained for 39 urban centres.

5%). Generally speaking, the results of this model have been for the most part highly comparable to those of the earlier version. The main divergence was that the results of the coefficient assessment of the municipal data were non-significant as regards apartment prices, total family income and gender imbalance. This was somewhat unexpected since the results for urban communities were significant, in fact considerably more so than in earlier models. When the model was reassessed concerning to data for urban communities for a period comparable to that of the municipal figures, similar weaknesses emerged. The coefficient assessment of apartment prices and total income became non-significant, whereas this did not apply to gender imbalance. This indicates that the experience of the economic downturn after the banking collapse and the subsequent boom has been more of a formative influence in the context examined by this research. Consideration should also be given to the widespread growth of tourism and its potential part in these developments. Furthermore, the newer part of the data may be more reliable than the older section.

The results for income were significantly positive regarding the number of children.

Finally, the correlation of the number of children families against housing prices was compared to the comparable correlation to the number of inhabitants of two older age groups where completely identical models were implemented (**Table 5**). Since the older part of the data sample returned weaker results (**Table 4**), the estimation was only based on the most recent part of the data sample, the period 2007-2019.

The correlation was much lower for the age group of 50 - 66 years old than children families and not significant. That was expected since people of that age are less likely to have children at home than younger people and in much less need for large dwellings. Moreover, their income is generally higher than younger people and their overall depts lower. Accordingly, housing prices do not have a significant impact on the population development of the inhabitants of 50 - 66 years of age.

Interestingly, a similar correlation was detected against retired inhabitants as for children families, marginally higher but of much lower significance. This might be traced to their personal income since it decreases when people retire they become economically more vulnerable than while employed. Lower significance is possible due to varied income among retired people and preferences.

5. Discussion

The conclusions support the hypothesis that housing prices affect the number of families with children. In light of this, it was decided to investigate developments in number of children during the period covered by the analysis, or as close to it as possible (**Figure 1**, **Table A1** and **Table A2**). Firstly, the number of children decreased during the period in 82 of 108 urban communities; that is, those where data existed for the entire and the complete period 1991-2019, or 76%

Table 5. Regression analysis regarding the correlation between number of children, apartment prices etc. compared to older people; a natural logarithm model.

Variables	Model 6 Urban centres The period 2007-2019 Age 0-17	Model 7 Urban centres The period 2007-2019 Age 50-66	Model 8 Urban centres The period 2007-2019 Age 67 and older
Ln (Apartment prices)	−0.06 (−4.31)***	−0.02 (−0.84)	−0.07 (−2.12)**
Ln (Total family income)	0.03 (1.36)	−0.06 (−1.33)	0.14 (2.03)**
Gender imbalance	−0.13 (−4.37)***	0.002 (0.04)	−0.40 (−2.93)**
Ln (Average age)	−1.68 (−15.55)***	2.58 (14.08)***	3.20 (12.47)***
Ln (Population)	0.97 (15.47)***	0.79 (7.15)***	1.35 (9.90)***
Constant	5.154272 (8.37)***	−8.08 (−9.07)***	−17.67 (−12.19)***
Number of observations, *n*	501	501	501
R^2 internal	0.8387	0.8108	0.8363
R^2 between	0.9982	0.9872	0.9892
R^2 total	0.9978	0.9863	0.9873

The dependent variable of the regression analysis is a natural logarithm of the number of children aged 0 - 17, divided according to urban centres. The numbers in parentheses are t-values. Three stars after coefficients indicate statistical significance at the value of 1%, two stars indicate significance at 5% and one star shows statistical significance at 10%. Multilinearity did not skew the results since none of them exceeded the numerical value of 0.53. Heteroscedasticity and autocorrelation were dealt with by cluster analysis. In the final analysis data was obtained for 39 urban centres.

(**Table A1**). It transpired that the largest increases proportionally in the number of children were at Hrafnagil, Hvanneyri, Mosfellsbær, sparsely populated parts of the capital region, Kópavogur and thinly inhabited areas in the Southern region (for details cf. **Table A1**). These developments have been graphically expressed (**Figure 1**) showing the highest increase where the bubbles are green and largest. Red and yellow bubbles indicate a negative development, with red communicating more negativity than yellow.

The figure shows that the green bubbles are most common in the capital area and its neighbourhood, although Reykjavík itself only increased by 1% during the period (**Table A1**). Here, size appears to work against the capital for the increase is much larger elsewhere in its vicinity, or 44% in Hafnarfjörður, 78% in Kópavogur, 99% in Mosfellsbær, 62% in Álftanes and 56% in Garðabær. Seltjarnarnes is the exception here, showing a decrease of 9%. But increases are manifest

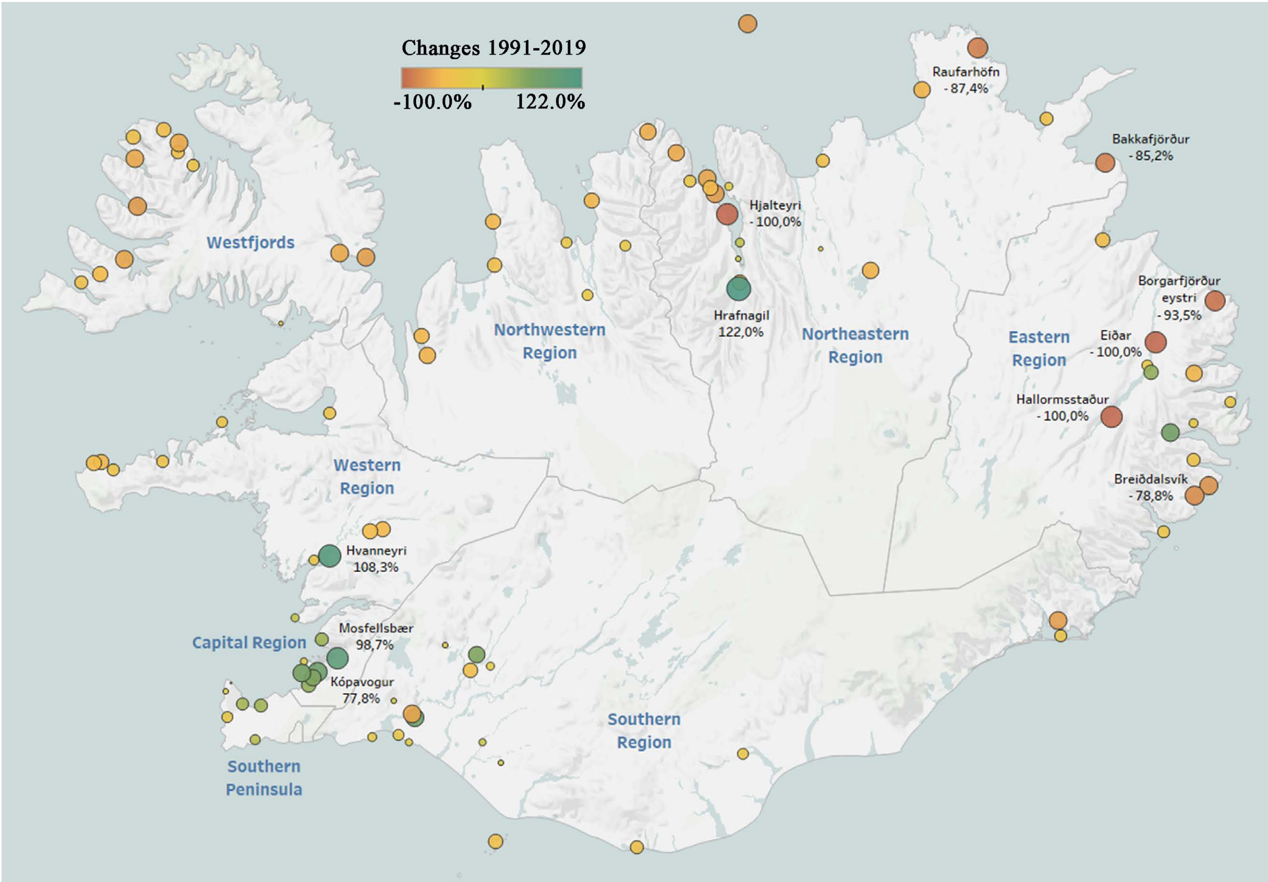

Figure 1. Number of children (aged 0 - 17), relative changes in urban centres during the period 1991-2019. Based on data from Statistics Iceland. Figure by Þorkell Stefánsson specialist at the Icelandic Regional Institute.

in the nearest urban centres in neighbouring districts of the Southern peninsula, Southern region (South Iceland) and Western region (West Iceland).

A significant increase is worth noting in locations with a tiny population, often with countryside connections, but fairly close to a larger service centre. This, for example, applies to Hrafnagil, approximately 10 km from Akureyri (see the population in Table A2), Hvanneyri at a similar distance from Borgarnes, Reykholt in the Biskupstungur district, about 42 km from Selfoss and 11 km from Flúðir. A considerable increase was also observed in sparsely populated parts of both the capital region and the Southern peninsula. Is this the dream of a more child-friendly environment, combined with easy access to services? Do low, or lower, housing prices also have an important role here? Those two factors came in strong in a survey on women's reasons for moving from the capital region to Selfoss, Reykjanesbær and Akranes (Bragadóttir, Karlsdóttir, Magnúsdóttir, & Sigurgeirsson, 2007).

It is also noteworthy that the decrease appears to be most prominent in the Eastern region where the red bubbles congregated (Figure 1 and Table A1). An aluminum plant was built in Reyðarfjörður (Eastern region) in 2005 which gave rise to the hypothesis of a correlation between the arrival of the aluminum plant and decreasing numbers of children in some areas of East Iceland, although the number of children in Reyðarfjörður grew considerably, or by 69% during the period, ranking Reyðarfjörður in the eighth place regarding favourable development (**Table A2**). The trend could have been for families from other locations in the Eastern region to move in large numbers to Reyðarfjörður to find work at the new aluminum plant. Such considerations, however, do not appear to be supported by trends in the numbers of children during shorter periods, since the population drains away from most places in the Eastern region began long before the building of the aluminum plant and has remained fairly even and consistent during the entire period, according to Statistics Iceland. It is hard, therefore, to understand this significant decrease in East Iceland.

In the Westfjords and North-West Iceland, no locations show a positive trend in the number of children during the period 1991-2019. Nevertheless, in some of those areas, the situation appears to be improving towards the latter half of the period (**Table A2**). In this context, a positive turnaround is particularly evident in Patreksfjörður and even in Bolungarvík, Laugarbakki and possibly in Sauðárkrókur. The turnaround in Bolungarvík and Laugarbakki to some extent reminds us of the earlier mentioned trend in Hvanneyri, Hrafnagil and Reykholt in Biskupstungur, especially if the progress in Bolungarvík is combined with other locations in the neighbourhood of the largest town in the area Ísafjörður, and far away in another area, Laugarbakki is also in the vicinity of a larger town, Hvammstangi. Similarly, we see a somewhat more positive trend in the village of Nesjakauptún in Hornafjörður during the last two periods, 7 km away from a much larger urban community, Höfn, to mention another similar example in South East Iceland. Other places showing a more positive and favourable tendency during the latter part of the period are Djúpivogur and Kirkjubæjarklaustur although this is harder to explain in the terms referred to above. This could simply be a case of ongoing positive projects that have lasted long enough to attract young people of childbearing age.

It has been maintained that demand for holiday and second homes in urban communities can push up housing prices and have a negative impact on families with children, especially in distant and isolated small urban communities where market value is significantly below building cost[5]. Therefore, a sketch was drawn up showing the proportion of holiday homes in Icelandic municipalities and the number of children as the ratio of the total population (**Figure 2**). Data was available for the year 2017. A negative trend was revealed, indicating that the more holiday and second homes were found in a municipality, the lower the ratio of children in the community in question. This lends support to the hypothesis that rising housing prices, for some reason, tend to reduce the number of children in the location concerned.

It has been argued here that the property prices, of apartments or farms, may

[5]It may of highest significance here that the Housing Financing Fund has for a long time based its maximum housing loans (generally about 80%) on the market value of properties which acts as a brake on housing supply. Some changes have been made to this policy or are at discussion level.

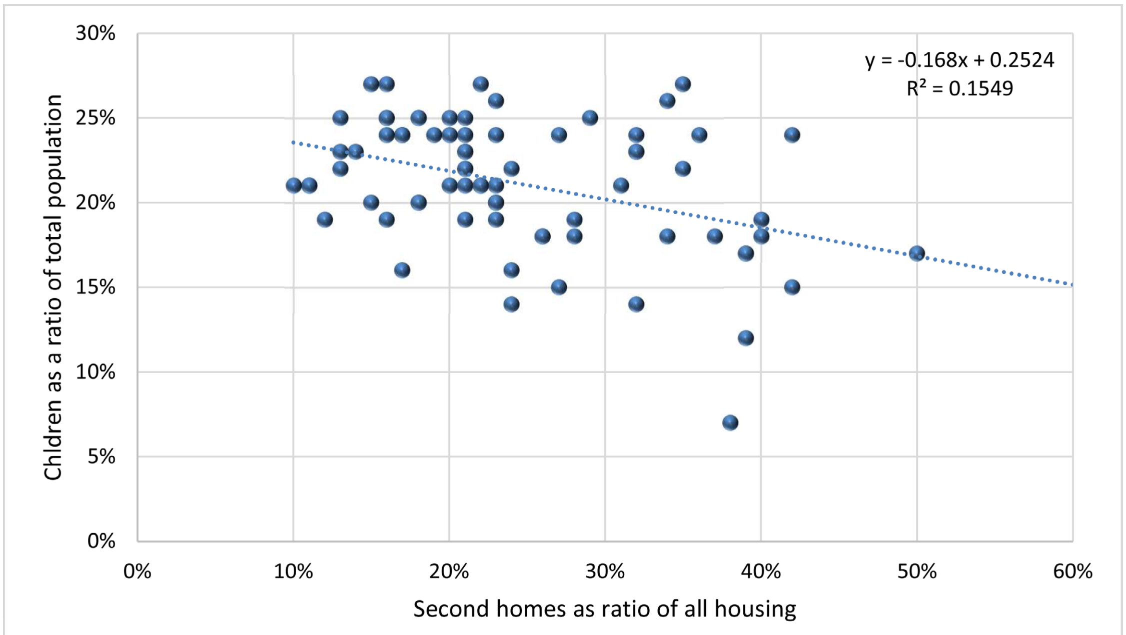

Figure 2. Second homes and children in 2017. Data from Registers Iceland and Statistics Iceland are divided according to municipalities.

discourage families with children from popular communities offering good services as well as other sought-after benefits. In this respect, some locations appear to have become, so to speak, the victims of their success, based on the assumption that children and adults of a fertile age are among the most desirable groups in any community with a view to its future. This may be gleaned from the interaction between Reykjavík and its adjacent districts and is no less in evidence when we look at Akureyri and neighbourhood. A similar relationship even appears to emerge in the Southern region, with its most favourable development in sparsely populated areas, in the South with respect to Reykholt, in Biskupstungur and the village of Nesjakauptún in Hornafjörður, in West Iceland, for example, Hvanneyri, the Westfjords in areas close to Ísafjörður and possibly at Laugabakki in the Northwestern region.

6. Synopsis

After having seen research from abroad indicating that more holiday homes in urban areas can, via higher housing prices, affect the demographic composition of communities in such a way that the number of families with children falls in comparison to other groups, it was decided to investigate whether similar trends could be identified in Iceland. In the absence of satisfactory data on the trend described above, the chosen approach was to examine whether a general increase in housing prices had an impact on families with children and the number of children was used as a proxy variable in this context.

Use was made of earlier data recorded by Statistics Iceland and Registers Iceland during the period 1990-2019, showing the number of children, housing prices and various other items that might be expected to affect the number of children in accordance with economic interregional migration theory. Data was gathered covering all urban centres. In addition, the research was supported by comparable data covering Icelandic municipalities, gathered during the years 2005-2010 as part of doctoral research by Vífill Karlsson (2012) and covered the period 1990-2006.

A panel data analysis using a fixed effect model revealed that increased housing prices tend to reduce the number of children. The research question of the article; *Is the number of children likely to fall in the wake of rising housing prices? is,* therefore, answered in the affirmative. There was no marked difference between the conclusions of all the models used (models 1 and 2), although there was somewhat less significance attached to municipal data which, nevertheless, passed the test of a 10% significance level. This is worthy of note since the data is of such diverse origin. In addition, it was decided, based on the conclusion regarding total income, to test a model in the form of a non-linear function. However, testing a model in a log-normal form (models 3, 4 and 5) brought to light the weakness of the municipal data, which appears to be rooted in the period covered by that particular research. The results, therefore, can be considered statistically sound, providing reliable indications of the causal connections tested here.

Finally, a comparison was made to other age groups and the results suggest the number of local old workers (age 50 - 66) to be insensitive to housing prices while retired inhabitants tend to be sensitive in a similar manner as children families.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Addendum

Table A1. Number of children (aged 0 - 17), trend 1991-2019 by urban centres and divided by shorter periods. Based on data from Statistics Iceland. Ranked by the long term trend 1991-2019 (91-19)

Urban centre	91-95	95-99	99-03	03-07	07-11	11-15	15-19	91-19
Hrafnagil	−10%	5%	44%	46%	26%	5%	−16%	122%
Hvanneyri	−13%	26%	26%	69%	−19%	−12%	25%	108%
Mosfellsbær	8%	20%	8%	13%	7%	3%	13%	99%
Sparsely populated districts in the capital region	−8%	−2%	−13%	−2%	6%	47%	55%	84%
Kópavogur	6%	22%	9%	7%	10%	5%	2%	78%
Sparsely populated areas of Southern region	20%	6%	5%	−25%	20%	−6%	53%	73%
Selfoss	3%	3%	14%	19%	5%	−2%	17%	72%
Reyðarfjörður	−9%	−5%	−1%	45%	5%	5%	24%	69%
Álftanes	4%	6%	29%	22%	9%	−11%	−3%	62%
Garðabær	6%	−1%	12%	3%	10%	9%	8%	56%
Reykholt in Biskupstungur	44%	−6%	22%	13%	−13%	2%	−5%	56%
Egilsstaðir	6%	−8%	9%	29%	−1%	4%	2%	45%
Hafnarfjörður	11%	4%	7%	9%	4%	3%	−1%	44%
Grundarhverfi	15%	18%	59%	−6%	−4%	−13%	−18%	38%
Vogar	6%	3%	40%	20%	−8%	−16%	−5%	34%
Keflavík and Njarðvík	−1%	−4%	0%	7%	13%	4%	10%	32%
Grindavík	−5%	2%	9%	11%	−3%	0%	8%	22%
Svalbarðseyri	19%	−3%	−3%	11%	−15%	−7%	19%	17%
Akranes	−6%	1%	2%	11%	5%	0%	2%	15%
Hella	8%	−8%	9%	8%	1%	−6%	1%	11%
Hveragerði	3%	−4%	3%	8%	1%	−8%	5%	8%
Hvolsvöllur	5%	−16%	23%	−1%	3%	4%	−6%	8%
Akureyri	3%	−2%	6%	2%	1%	−2%	−1%	7%
Reykjavík	4%	0%	0%	−3%	0%	1%	−2%	1%
Garður	8%	−9%	1%	7%	−2%	−6%	2%	1%
Rauðalækur	−22%	71%	−50%	17%	−100%		−18%	0%
Reykhólar	9%	−21%	5%	0%	−8%	19%	−5%	−5%
Laugar	−9%	−31%	27%	43%	−28%	41%	−20%	−6%
Sandgerði	−2%	−5%	−5%	13%	−2%	−16%	12%	−7%
Laugarvatn	−27%	16%	30%	−14%	−14%	7%	7%	−8%

Continued

Seltjarnarnes	9%	−5%	0%	−12%	−11%	−2%	13%	−9%
Stokkseyri	−4%	7%	−3%	9%	−15%	−23%	25%	−11%
Flúðir	12%	24%	−10%	9%	13%	−25%	−26%	−14%
Grenivík	−14%	−24%	40%	−4%	−8%	1%	4%	−14%
Eskifjörður	−3%	−4%	−15%	8%	−4%	1%	2%	−16%
Þorlákshöfn	−3%	−1%	−9%	1%	1%	−10%	4%	−17%
Borgarnes	−9%	−6%	−1%	0%	−12%	4%	−1%	−23%
Hafnir	11%	−27%	0%	50%	−29%	−3%	−10%	−24%
Eyrarbakki	−6%	0%	2%	4%	2%	−25%	−1%	−25%
Hólar in Hjaltadalur	0%	10%	18%	15%	−13%	−19%	−29%	−25%
Varmahlíð	3%	−8%	3%	26%	−5%	−27%	−13%	−26%
Sauðárkrókur	6%	−13%	−3%	−9%	2%	−10%	0%	−26%
Kirkjubæjarklaustur	−3%	6%	−21%	−37%	47%	−4%	0%	−27%
Neskaupstaður	−8%	−18%	−5%	−2%	6%	4%	−6%	−28%
Fellabær	0%	−2%	−3%	13%	−18%	−15%	−3%	−28%
Stykkishólmur	8%	−18%	1%	−22%	−6%	3%	6%	−29%
Höfn in Hornafjörður	7%	−2%	−3%	−15%	−7%	−6%	−7%	−30%
Dalvík	0%	−2%	−2%	−15%	4%	−13%	−6%	−30%
Djúpivogur	−4%	−19%	−11%	−27%	25%	12%	−2%	−31%
Súðavík	0%	−11%	−3%	−5%	−22%	−5%	13%	−32%
Sparsely populated areas in the Southern region	−2%	−6%	−6%	−3%	−11%	−16%	7%	−32%
Búðardalur	−13%	−19%	−7%	5%	3%	30%	−28%	−33%
Ólafsvík	−9%	−19%	19%	−13%	3%	−9%	−6%	−33%
Grundarfjörður	22%	−3%	−10%	−18%	−16%	−7%	−3%	−34%
Fáskrúðsfjörður	−10%	−25%	−10%	13%	−1%	−2%	−2%	−35%
Þórshöfn	3%	−15%	−6%	−9%	27%	−30%	−6%	−37%
Vík in Mýrdalur	−14%	−10%	−5%	−22%	9%	−3%	3%	−38%
Patreksfjörður	3%	−24%	−15%	−20%	0%	10%	6%	−38%
Húsavík	−1%	−6%	−8%	−16%	−4%	−8%	−4%	−39%
Ísafjörður	−4%	−9%	−10%	−10%	−6%	−12%	4%	−39%
Vestmannaeyjar	−3%	−7%	−11%	−14%	−6%	−4%	−5%	−41%
Laugarás	15%	−5%	−14%	−25%	−46%	−46%	186%	−41%
Suðureyri	−5%	−8%	10%	−22%	18%	−31%	−5%	−42%
Blönduós	−14%	−21%	−13%	−10%	2%	−5%	11%	−43%

Continued

Bolungarvík	−11%	−19%	−13%	−8%	−11%	11%	0%	−43%
Sparsely populated areas in the Northwestern region	−11%	−11%	0%	−15%	−8%	5%	−14%	−45%
Vopnafjörður	−11%	−15%	−11%	−4%	−10%	−10%	5%	−45%
Sparsely populated areas in the Northeastern region	−9%	−9%	−5%	−15%	−9%	−10%	−4%	−47%
Kleppjárnsreykir	−6%	−27%	36%	40%	−52%	60%	−50%	−50%
Kristnes	6%	−6%	13%	−11%	6%	6%	−56%	−50%
Tálknafjörður	2%	10%	−13%	−26%	10%	−1%	−35%	−50%
Sparsely populated areas in the Western region	−8%	−8%	−14%	−8%	−19%	−8%	0%	−50%
Hellissandur	−5%	−15%	−9%	−14%	1%	2%	−23%	−50%
Litli-Árskógssandur	−5%	10%	4%	−21%	−3%	−25%	−22%	−51%
Rif	−6%	−9%	−12%	−18%	10%	9%	−35%	−52%
Reykholt in Borgarfjörður	−16%	−63%	33%	63%	−15%	−36%	29%	−53%
Skagaströnd	0%	−6%	−11%	−15%	−2%	−17%	−19%	−53%
Hvammstangi	−13%	−33%	−4%	−3%	−2%	−17%	5%	−53%
Hofsós	−8%	−12%	−22%	−9%	21%	−20%	−17%	−53%
Seyðisfjörður	−22%	5%	−21%	−20%	−16%	−3%	6%	−55%
Kópasker	40%	0%	−21%	−11%	−26%	−24%	−18%	−55%
Sparsely populated areas in the Eastern region	−6%	−13%	−12%	−26%	−15%	4%	−6%	−55%
Reykjahlíð	−20%	−14%	−11%	−7%	−24%	−23%	33%	−56%
Laugarbakki	9%	−8%	−4%	−55%	−40%	0%	67%	−57%
Siglufjörður	0%	−15%	−21%	−24%	−6%	−13%	−2%	−59%
Ólafsfjörður	2%	−15%	−16%	−25%	−12%	−16%	−2%	−61%
Hnífsdalur	−12%	−17%	−13%	−8%	−16%	−32%	15%	−61%
Flateyri	−10%	−33%	−4%	−12%	−22%	−13%	13%	−61%
Hólmavík	6%	−33%	10%	−16%	−3%	−30%	−14%	−62%
Hrísey	14%	−24%	−27%	−20%	11%	−13%	−26%	−64%
Bíldudalur	−16%	−14%	−30%	−37%	−19%	76%	−22%	−65%
Árbæjarhverfi in Ölfus	−18%	0%	57%	0%	−55%	20%	−50%	−65%
Drangsnes	−14%	7%	−22%	−40%	0%	80%	−59%	−69%
Nesjakauptún village in Hornafjörður	−13%	−19%	−38%	−24%	−38%	50%	0%	−69%
Sparsely populated areas in the Western region	−22%	−30%	−13%	−21%	8%	−19%	−7%	−69%

Continued

Hauganes	4%	7%	−10%	−6%	−20%	−22%	−50%	−70%
Þingeyri	−6%	−33%	−18%	4%	−20%	−7%	−27%	−71%
Grímsey	5%	−32%	−7%	8%	−21%	−14%	−42%	−72%
Stöðvarfjörður	−21%	10%	−12%	−18%	−30%	−26%	−21%	−74%
Breiðdalsvík	−6%	−39%	−3%	−16%	−32%	−48%	27%	−79%
Bakkafjörður	0%	−7%	−28%	−17%	0%	27%	−79%	−85%
Raufarhöfn	−1%	11%	−43%	−20%	−31%	−40%	−38%	−87%
Borgarfjörður eystri	−33%	−45%	−12%	7%	0%	−13%	−79%	−93%
Borðeyri	−20%	100%	−50%	100%	−100%			−100%
Eiðar	40%	−38%	−31%	−56%	−100%			−100%
Hallormsstaður	31%	−10%	−26%	−21%	−18%	−100%		−100%
Hjalteyri	75%	−38%	−23%	−20%	−13%	−100%		−100%
Skógar	−33%	−42%	−71%	−100%				−100%
Árnes							45%	
Bifröst				15%	−18%	−9%	−42%	
Borg in Grímsnes						33%	4%	
Brautarholt in Skeiðar						−17%	73%	
Brúnahlíð in Eyjafjörður							7%	
Innnes							−45%	
Lónsbakki						−21%	27%	
Sólheimar in Grímsnes			−24%	−15%	−55%	140%	−67%	
Tjarnabyggð							−6%	
Vallarheiði					−100%			
Krossholt			−29%	60%	−100%			
Írafoss and Ljósafoss								
Melahverfi						−20%	−41%	

Table A2. Total population 1991-2019 by selected urban centres.

Urban community	Region	1991	2019
Akureyri	North-east	14,437	18,606
Borgarnes	West	1778	2012
Flúðir	South	204	432
Hrafnagil	North-east	86	270
Hvanneyri	West	134	307
Reykholt í Biskupstungum	South	94	260
Selfoss	South	3959	8039

Data from Statistics Iceland.