Online Appendix:

The Gift of Moving: Intergenerational Consequences of a Mobility Shock

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A Constructing Years of Schooling

Our education variable is reported on a five-point scale using the International Standard Classification of Education (ISCED). The first level is compulsory schooling, which is 10 years in Iceland and is completed by most students when they are 16 years old. The second level is a degree from a junior college. In junior college, students can choose between traditional tracks that prepare students for university studies and vocational tracks such as carpentry, hair-dressing, plumbing, etc. Junior college degrees take four years to complete and are completed by most students when they are 20 years old. We therefore convert the second level to 14 years of schooling. The third level is post-secondary, non-tertiary degrees. These include various technical degree programs that in most cases take 6 months to 2 years to complete. We convert this level to 15 years of schooling. The fourth level is university education, both bachelor's and master's degrees. Most bachelor's degrees take three years to complete in Iceland and most masters degree take one to two years to complete. We convert this level to 18 years of schooling, i.e., four additional years over and above junior college. Finally, the fifth level is doctoral degrees. We assume that these take four years to complete after a completion of a bachelor's degree and a one year master's degree. We therefore convert these degrees to 22 years of schooling.

B Earnings Effect over Subsamples

One might worry that the large causal effect of moving we estimate is concentrated in the period of the financial boom Iceland experienced over the period 2002 to 2008. This is not the case. To illustrate this we estimate the following regression

$$Y_{it} = \alpha + \sum_{t=1981}^{2014} \beta_t Moved_i \times period_t + \mathbf{X}_i'\gamma + \delta_t + \varepsilon_{it}, \tag{1}$$

where the variable $period_t$ represents an indicator variable for each non-consecutive 5-year period in sample period of 1981-2014 (i.e., 1981-1985, 1986-1990, ... 2011-2014). The endogenous regressors $Moved_i \times period_t$ are instrumented using interactions of the 5-year period dummies with the instrument $Destroyed_i$. The β_t estimates from this regression are plotted in Figure A.4. The figure shows that the effect of moving is positive throughout the sample period and does not appear to have a systematic relationship with the business cycle. In particular, it is high both before and after the financial crisis.

C Earnings Effects over the Life-Cycle

We can estimate the life-cycle profile of the effect of living in a house that was destroyed on earnings by estimating the following regression

$$Y_{it} = \alpha + \sum_{\tau=18}^{62} \beta_\tau Destroyed_i \times age_\tau + \mathbf{X}_i'\gamma + \delta_t + \varepsilon_{it} \tag{2}$$

where the variable age_τ represents an indicator variable for each 2-year age group from age 18 to 63 (i.e., 18-19, 20-21, ..., 62-63). We include a full set of 2-year age fixed effects, time fixed effects and the same demographic controls as in our main specifications. Panel A of Figure A.3 plots the β_τ coefficients from this specification. These results are slightly different from what one might expect from Figure 3. The difference arises because of the inclusion of the controls.

We can also estimate the life-cycle profile of the causal effect of moving by age by using an instrumental variables procedure where we estimate

$$Y_{it} = \alpha + \sum_{\tau=18}^{62} \beta_\tau Moved_i \times age_\tau + \mathbf{X}_i'\gamma + \delta_t + \varepsilon_{it} \tag{3}$$

and instrument for the endogenous regressors $Moved_i \times age_\tau$ with $Destroyed_i \times age_\tau$. Panel B of Figure A.3 plots the β_τ coefficients from this specification.

D Spatial Correlation

The standard errors in our main analysis are clustered at the address level. This allows for correlation across individuals that lived at the same address at the time of the eruption (in most cases members of the same family). A reasonable concern with our results is that there might be more widespread spatial correlation. For confidentiality reasons, we do not have information about the exact address of the individuals in our sample. Since the Westman Islands is a small place, it is coded as a single geographic unit in our tax data (which identifies location by postal code). Unfortunately, this precludes us from studying spatial correlation in our main outcome variables.

However, since we constructed the house price data we use ourselves by digitizing administrative records, we have the exact address of each house in our sample. We can, therefore, study spatial correlations in house prices prior to the eruption. To do this, we have manually geocoded the location of every house in our dataset. This process was somewhat involved because many of the residential streets in question were subsequently covered with lava and no longer exist. We used a combination of web-based map viewers from the National Land Survey of Iceland and street maps of the Westman Islands pre-eruption to locate houses and to construct a geocoded location for each house.

Using these data we have calculated two measures of spatial correlation of house prices. First, we have calculated Geary's C:

$$C = \frac{N-1}{2W} \frac{\sum_i \sum_j w_{ij}(x_i - x_j)^2}{\sum_i (x_i - \bar{x})^2},$$

where x_i denotes the price of house i, the weight w_{ij} is the inverse distance between house i and j, and W is the sum of all weights w_{ij}. If the price of neighboring houses tends to be positively correlated, this will lead to values of Geary's C that are significantly lower than 1 (negative spatial correlation will lead to values significantly higher than one). A value of one indicates no spatial correlation. For our sample, the value of Geary's C is estimated to be 0.974, which is very close to 1. We cannot reject the null hypothesis of no spatial correlation (the P-value is 0.128).

The second measure of spatial correlation that we have calculated is Moran's I:

$$I = \frac{N}{W} \frac{\sum_i \sum_j w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_i (x_i - \bar{x})^2}.$$

Moran's I is analogous to an autocorrelation coefficient, but measures correlations over space (in two dimensions) rather than over time. If adjacent houses tend systematically to have more similar house prices than houses that are further away from each other, this will tend to raise the value of Moran's I. Values of Moran's I close to 1 suggest strong positive spatial correlation, while values close to -1 suggest strong negative spatial correlation. Moran's I is more sensitive to "global" spatial correlation than Geary's C, since the building blocks involve differences versus the overall mean, as opposed to immediately surrounding houses.

Our estimate of Moran's I is 0.02. This value indicates statistically significantly spatial correlation. However, the economic magnitude of this spatial correlation is extremely small. The test statistic implies that a 1% increase in a given house price is associated with a 0.02% increase in the house prices of its neighbors.

To aid interpretation of Moran's I, Figure D.1 plots a "Moran's I scatter plot." This figure plots the price of each house (on the x-axis) against its "spatial lag." The spatial lag is a "synthetic neighbor," defined as the weighted average of the value of all other houses in the town, weighted by the inverse of their geographic proximity. Hence, closer houses are given higher weights than those that are further away. A positive relationship in Figure D.1 indicates positive spatial correlation. It is clear from the figure that any positive spatial correlation in our house price data is very modest. Moreover, the figure above distinguishes between houses in the destroyed (orange)

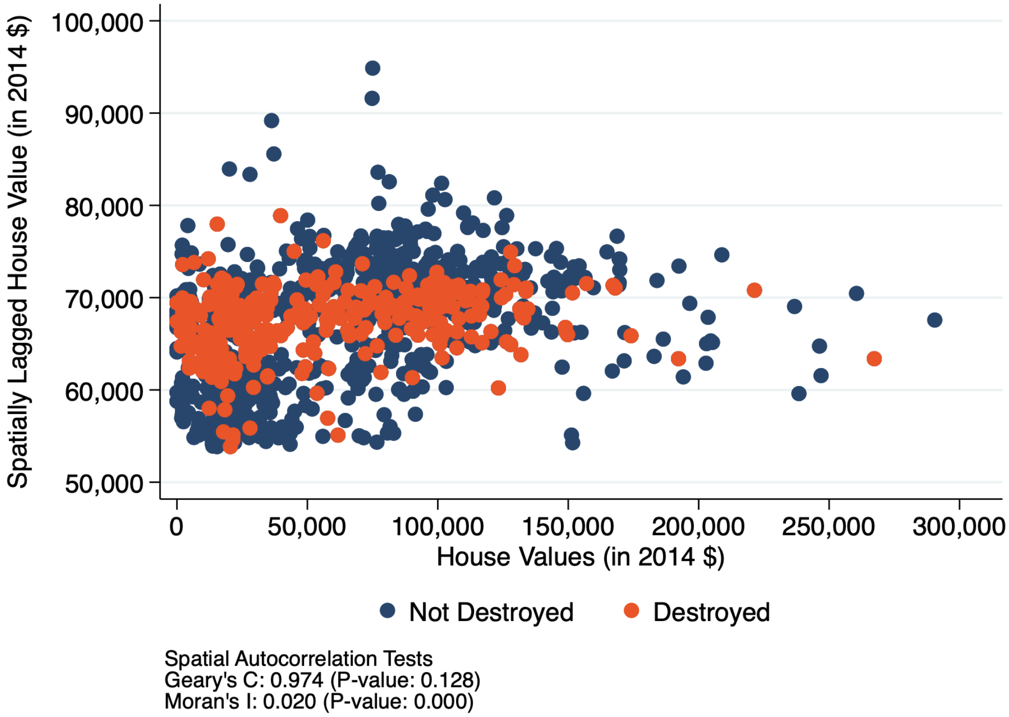


Figure D.1: Moran's I scatter plot

and non-destroyed (blue) regions. There is no systematic difference in the house prices along this margin, consistent with our balance tests.

Spatial correlation may imply that there are fewer "effective observations" than actual observations in our dataset, which could be biasing downward our standard errors. We can quantify this concern using Moran's I as an indicator of how spatially correlated the observations are likely to be (with the caveat that these spatial correlations apply to house prices, not income or education). To do this, we draw on the literature studying the relationship between Moran's I and the "effective number of observations." Griffith and Zhang (1999) report Monte Carlo calculations that relate Moran's I to the spatial autocorrelation coefficient in a first order spatial autocorrelation model, and then relate the spatial autocorrelation coefficient to an approximate effective sample size. A value of Moran's I of 0.02 implies a spatial autocorrelation of roughly the same numerical value, which implies only a tiny adjustment to the effective sample size (see Figure 3 in their paper). For this reason, we have not pursued further adjustments to our standard errors for spatial correlation. To the extent that spatial correlation of income and education is of a similar order of magnitude to house prices, we expect the required spatial adjustment of our standard errors to be very small.

E Uncertain Gains from Education (and Comparative Advantage)

Consider an extension of the model presented in section 6 where the gains from education are uncertain and households have Epstein and Zin (1989) preferences. Specifically, assume that the gains from education in the non-fishing sector are stochastic and distributed

$$\phi(i) \sim \mathrm{N}(\bar{\phi}(i) - \sigma_\phi^2/2, \sigma_\phi^2)$$

and the utility function of the parents is

$$\log(C^p(i)) + \beta \log([\mathbb{E}(C^c(i))^{1-\gamma}]^{1/(1-\gamma)}).$$

where γ measures risk aversion and the elasticity of intertemporal substitution (substitution between own consumption and the consumption of the children in this case) is one. We introduce the shorthand notation $U_k^p(q)$ to represent $\log(C^p(i))$ for households of quantile q that are working in sector k and, analogously, $U_k^c(q)$ to represent $\log([\mathbb{E}(C^c(i))^{1-\gamma}]^{1/(1-\gamma)})$ for households of quantile q that are working in sector k.

In this case, we have that

$$U_N^p(q) = w_N + A(q) + \alpha(q), \tag{4a}$$

$$U_F^p(q) = w_F + A(q), \tag{4b}$$

$$U_N^c(q) = w_N + \rho_a A(q) - \frac{\gamma}{2}\sigma_a^2 + \rho_s \alpha(q) - \frac{\gamma}{2}\sigma_s^2 + \bar{\phi}(q) - \frac{\gamma}{2}\sigma_\phi^2, \tag{4c}$$

$$U_F^c(q) = w_F + \rho_a A(q) - \frac{\gamma}{2}\sigma_a^2. \tag{4d}$$

The right-hand sides of these expressions differ from those in equations 3a-3d due to the variance terms $\frac{\gamma}{2}\sigma_a^2$, $\frac{\gamma}{2}\sigma_s^2$, and $\frac{\gamma}{2}\sigma_\phi^2$. Here σ_a^2 and σ_s^2 are the variances of the intergenerational shocks to absolute and comparative advantage, respectively, i.e., the variances of $\epsilon^a(i)$ and $\epsilon^s(i)$. In our earlier model, the three variance terms did not appear because of two simplifying assumptions: log-utility and non-stochastic education. Analogous algebra to that in section 6.2 yields an equation for the cutoff points for moving $q^{*\prime}$ and q^* that can be written

$$U_N^p(q) + \Psi(m(i), q) = U_F(q), \tag{5}$$

where

$$\Psi(m(i), q) = \frac{1}{1+\beta}\left[\beta\left(\bar{\phi}(q) - \frac{\gamma}{2}\sigma_\phi^2\right) - m(i) - (1+\beta)f - \beta(1-\rho_s)\alpha(q) - \frac{\gamma}{2}\sigma_s^2\right]. \tag{6}$$

Relative to the expression for $\Psi(m(i), q)$ in our baseline model, there are two additional terms $-\frac{\gamma}{2}\sigma_s^2$ and $-\frac{\gamma}{2}\sigma_\phi^2$. In this model, risk is a source of "moving costs" in the sense that it makes people more reluctant to move for a given expected return to moving.

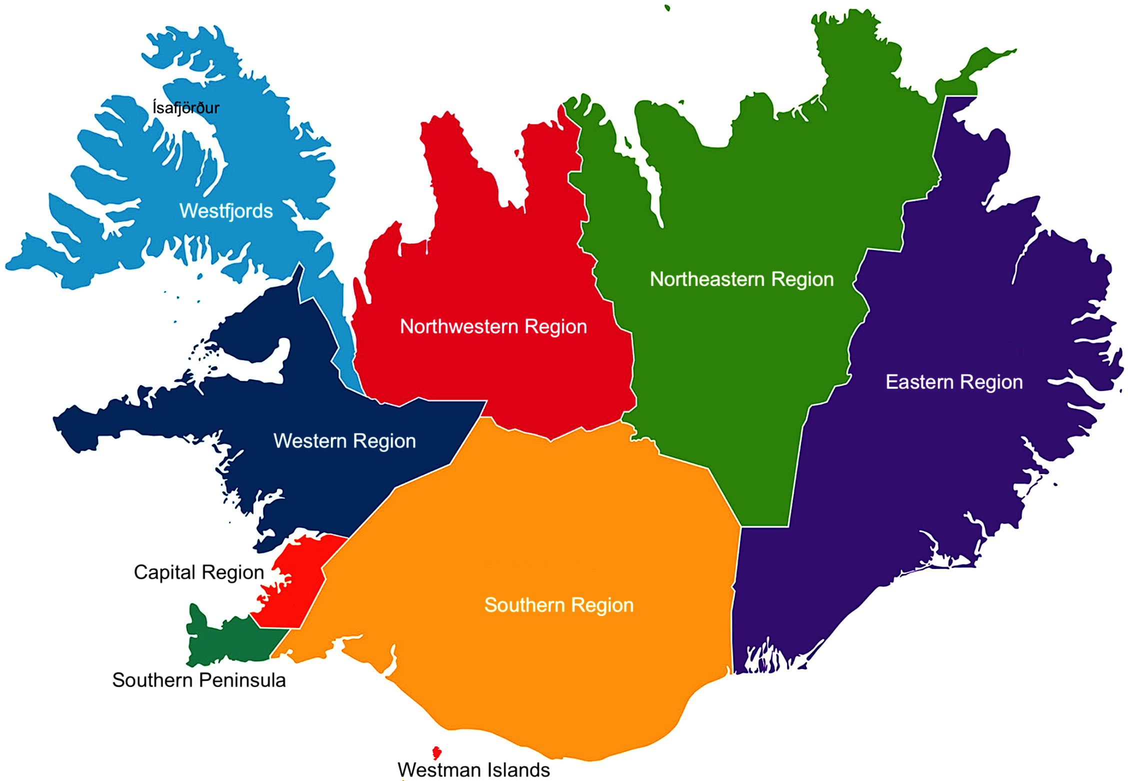
F Price Level in the Westman Islands

To evaluate whether our causal effects on earnings may be explained by compensating differentials, such as differences in cost of living in the Westman Islands relative to Reykjavik, we study regional differences in the prices of goods and services. We draw on data from detailed regional price surveys conducted by the Public Price Control Authority (*Verðlagsstofnun Ríkisins*) – the predecessor of the Competition Authority—dating back to the 1980s.

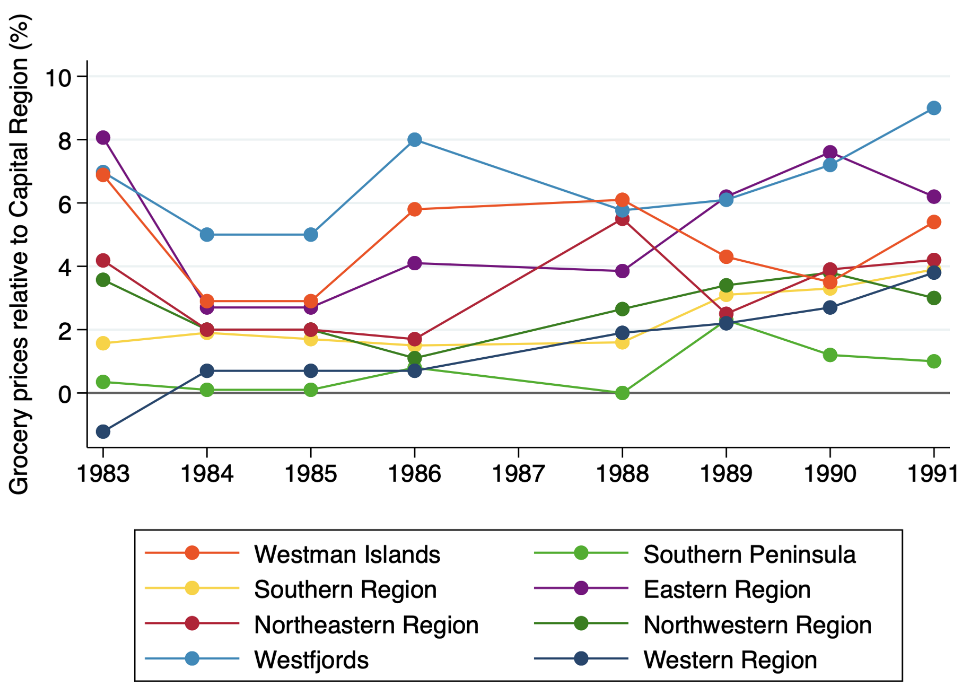
Figure F.2, panel (a), shows a regional map of Iceland and panel (b) documents the price level for the corresponding regions. To be informative for our main results, we present the price level in each region in relative terms to that in the Capital Region and treat the Westman Islands, which generally is part of the Southern region, as a separate region. The survey conducted by the Public Price Control Authority records prices of 370 common products in grocery stores all over Iceland. Regional price level is measured as an average of prices of a basket of food and beverages, consumption-weighted based on a standard family, across all stores surveyed in a give region. Figure F.2 documents that prices in the Westman Islands were among the highest in Iceland over this sample period, about 4-6 percent higher than in the Capital Region. The prices in the Westman Islands are similar to what is found in the regions that are furthest away from Reykjavik, the Westfjords and the Eastern Region. They are considerably higher than in the rest of the Southern region that is geographically closest to the Westman Islands, but where, e.g., land transport is possible.[1] This price difference is likely to reflect a general pattern. Indeed when looking at prices of other goods and services surveyed by the Public Price Control Authority we find similar price difference. Prices of a standard basket of breads and cakes in bakeries was 9.4 percent higher in the Westman Islands than in the Capital Region, and prices of standard haircuts was 6 percent higher on average.

Figure F.2 paints a clear picture of a higher cost of living in the Westman Islands than in the Capital Region. Does this difference in the average price level reflect a large price difference of a narrow set of goods? Or are differences in prices widespread? Figure F.3 plots price differences

[1] Simple linear regression shows that for every 100km travelled from Reykjavik the price level increases by between 0.67 and 0.83 percent.



(a) Regions of Iceland



(b) Regional price level relative to price level in the Capital Region

Figure F.2: Regional Price Level

Notes: Panel (a) is a map of the regions of Iceland. Panel (b) plots the regional price level relative to the price level in the Capital Region, based on price surveys carried out by the Public Price Control Authority. Data was not available for all regions in 1987. See text for more details.

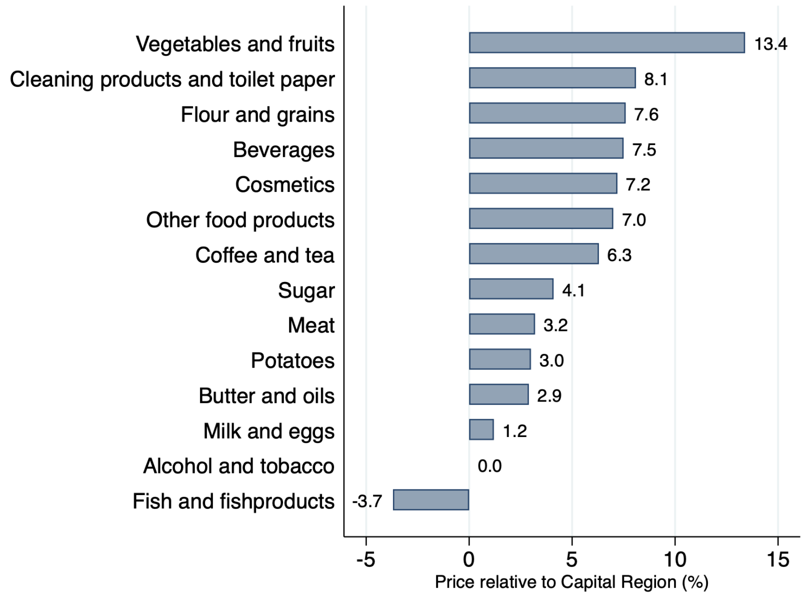


Figure F.3: Price level by product group relative to prices in the Capital Region

Notes: The figure plots the price level difference by product groups in all regions outside the Capital Region relative to the price level in the Capital Region. Data is from price surveys carried out by the Public Price Control Authority. See text for more details.

by product group in regions outside of the Capital Region relative to that in the Capital Region. The figure documents that almost all products are more expensive outside of the Capital Region, except fish and fish products which are products that are most likely to the produced locally is almost all regions.[2]

While the data shows a clear and general tendency for almost all goods to be more expensive in the Westman Islands than in the Capital Region, this will not reflect true differences in the cost of living if those living in the Westman Islands do not buy goods locally. The Public Price Control Authority carried out a survey in 1990 to analyze local markets in the regions of Iceland, which is helpful in shedding light on this issue (Public Price Control Authority, 1990). The survey documents that people living in the Westman Islands bought 85% of their goods locally and the remainder mostly in the Capital Region. These numbers are similar to other regions that are far from Reykjavik, such as the Westfjords (85%) and the Eastern Region (82%), whereas in regions closer to Reykjavik this share is much lower (e.g. 51% in the Southern Peninsula).

Why are prices in the Westman Islands so much higher than in the Capital Region? One possible reason is transportation and inventory costs. In 1987 the Public Price Control Authority

[2]Prices of alcohol and tobacco are influenced by the fact that these goods are sold by the *State Alcohol and Tobacco Company of Iceland*, which is a state owned company with a monopoly on the sale of alcoholic beverages and tobacco.

conducted a specific investigation into the roots of price differences in the two locations where in earlier surveys they had found prices to be highest: Ísafjörður in the Westfjords (see map in Figure F.2, panel (a)) and the Westman Islands (Public Price Control Authority, 1987). The report finds similar explanations for higher prices in the two locations: higher transportation costs and markups. Transportation costs are high and somewhat higher in the Westman Islands than in the Westfjords. At the time there were seven grocery stores and several smaller neighborhood stores in the Westman Islands. In 98% of cases prices were higher in supermarkets and larger grocery stores in the Westman Islands than in the Capital Region, and in 88% of cases when comparing prices in larger neighborhood stores across locations. It is only in smaller shops, where markups are likely to be high in general, where prices are most comparable. Moreover, there is very little price dispersion across stores in the Westman Islands—much less than in other municipalities—indicating limited competition. With limited changes in transportation costs and the competition environment these regional price differences have been very persistent.

G Supplementary Tables

Table A.1: First Stage Estimates for Dependents, Household Heads and Descendants

	All		Dependents		Household Heads		Descendants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Destroyed$	0.151***	0.160***	0.107***	0.121***	0.195***	0.203***	0.058***	0.058***
	(0.030)	(0.029)	(0.035)	(0.034)	(0.030)	(0.029)	(0.017)	(0.017)
Not-destroyed group mean	0.269	0.269	0.286	0.286	0.251	0.251	0.621	0.621
Controls	No	Yes	No	Yes	No	Yes	No	Yes
F-statistic	17.9	21.1	8.9	11.3	27.6	29.8	10.4	12.3
N	4,807	4,807	2,392	2,392	2,415	2,415	3,740	3,740

Notes: This table reports coefficients from OLS regressions of $Moved$ on $Destroyed$. For the original inhabitants $Moved$ is an indicator for having moved away as of 1975 and $Destroyed$ is an indicator for living in a house that was destroyed by the eruption. For descendants, $Moved$ is an indicator for living outside the Westman Islands when first observed in the administrative records, while the definition of $Destroyed$ is more involved and is described in section 4. The set of controls includes gender, age, a dummy for having changed houses after 1960, and a dummy for being born in the Westman Islands. Robust standard errors clustered by address are reported in parentheses.*** p<0.01, ** p<0.05, * p<0.1

Table A.2: Effects on the Logarithm Earnings – Cohorts Younger than 25 at Time of Eruption

	Reduced Form		IV		OLS	
	(1)	(2)	(3)	(4)	(5)	(6)
$Moved$			0.812*	0.866***	-0.060	-0.031
			(0.484)	(0.421)	(0.046)	(0.043)
$Destroyed$	0.094*	0.110**				
	(0.048)	(0.044)				
Controls	No	Yes	No	Yes	No	Yes
Observations	2,570	2,570	2,570	2,570	2,570	2,570

Notes: The dependent variable in all cases is the natural logarithm of life-time labor earnings. The set of controls includes gender, a dummy for having changed houses after 1960, and a dummy for being born in the Westman Islands. Robust standard errors clustered by address are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.3: Effects of Moving on Earnings – Descendants

	Reduced Form		IV		OLS	
	(1)	(2)	(3)	(4)	(5)	(6)
$Moved$			29,070	27,034	-7,038***	-5,471***
			(25,205)	(22,234)	(1,262)	(1,156)
$Destroyed$	1,833	1,762				
	(1,355)	(1,210)				
Not-destroyed group mean	31,681	31,681	31,681	31,681	—	—
Controls	No	Yes	No	Yes	No	Yes
Age fixed effects	No	Yes	No	Yes	No	Yes
Year fixed effects	No	Yes	No	Yes	No	Yes
Observations	20,192	20,192	20,192	20,192	20,192	20,192

Notes: We control for gender. Age fixed effects refer to a set of dummy variables for each age. Robust standard errors clustered by individual are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.4: Other Outcomes – Cohorts 25 and Older at Time of Eruption

	IV	OLS	Not-Destroyed Group Mean
	(1)	(2)	(3)
Pension Recipient	0.000	-0.020**	0.40
	(0.048)	(0.009)	
Early Death	-0.018*	0.000	0.008
	(0.010)	(0.001)	
Married	0.106	0.005	0.700
	(0.102)	(0.021)	
Number of Children	0.137	-0.170**	1.08
	(0.307)	(0.059)	
Earnings > 0	0.016	-0.023**	0.622
	(0.050)	(0.011)	

Notes: Each coefficient estimate corresponds to a regression of the dependent variable indicated in the top panel on $Moved$. *Pension Recipient* is a dummy for receiving pension income in a given year. *Early Death* is a dummy for dying before age 50. The regression with *Early Death* as the dependent variable is estimated only for those born before 1965, since this group has reached age 50 by the end of our sample period. *Married* is an indicator of being registered as married in the National Registry. *Number of Children* is number of children born after the eruption, i.e., in 1973 or later. The regressions control for gender, a dummy for having changed houses after 1960, a dummy for being born in the Westman Islands, year dummies, and age dummies. Robust standard errors clustered by address are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.5: Effect of Pension on Earnings Estimates – Cohorts Younger than 25 at Time of Eruption

	Reduced Form		Wald	2SLS	OLS	
	(1)	(2)	(3)	(4)	(5)	(6)
Moved			22,459	24,229**	-2,528**	-1,871*
			(14,560)	(12,240)	(1,131)	(1,015)
Destroyed	2,561*	2,990**				
	(1,445)	(1,227)				
Not-destroyed group mean	34,297	34,297	34,297	34,297	—	—
Controls	No	Yes	No	Yes	No	Yes
Age fixed effects	No	Yes	No	Yes	No	Yes
Year fixed effects	No	Yes	No	Yes	No	Yes
Observations	62,172	62,172	62,172	62,172	62,172	62,172

Notes: The dependent variable in all cases is labor earnings, which is set to missing in all years when individuals receive pension payments. Coefficient estimates are reported in US dollars as of 2014 (125 ISK = 1 USD). The set of controls includes gender, a dummy for having changed houses after 1960, and a dummy for being born in the Westman Islands. Age fixed effects refer to a set of dummy variables for each age. Robust standard errors clustered by address are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.6: Payroll Taxes by Industry

	Westman Islands	Capital Region	Other Regions
Fishing and Agriculture	23.2%	1.2%	13.7%
Fish and Food Processing	46.5%	3.4%	15.6%
Construction	2.5%	4.2%	8.5%
Manufacturing	3.7%	6.2%	10.8%
Trade and Transport	5.4%	18.3%	10.7%
Hospitality and Recreation	1.7%	3.6%	5.0%
Information Services	0.3%	6.6%	0.7%
Professional Services	1.0%	8.9%	0.4%
Finance	2.0%	10.7%	2.3%
Government	12.8%	34.4%	26.5%
Other	0.9%	2.4%	4.4%

Notes: Average share of payroll taxes by industry, 2008-2014. *Source*: Directorate of Internal Revenue, Iceland.

H Supplementary Figures

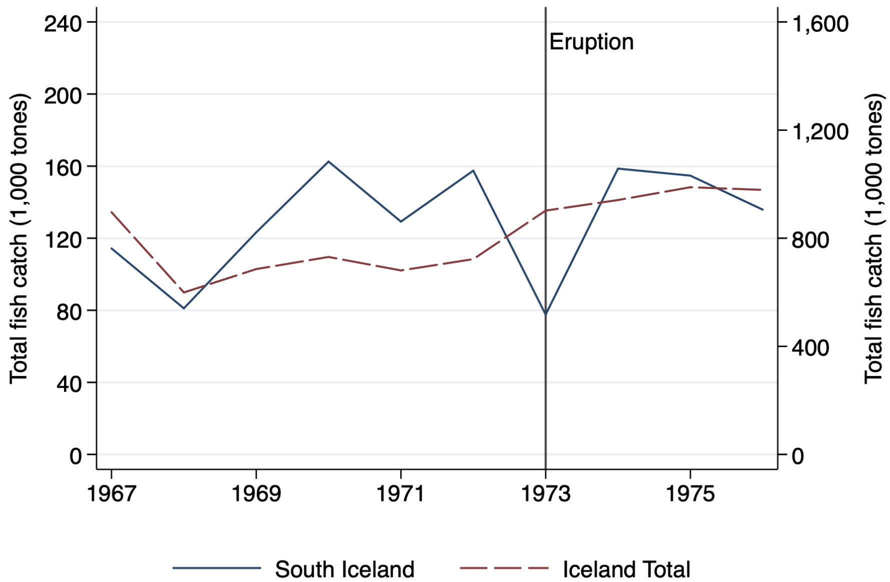


Figure A.1: Fish Catch by Year

Note: Total fish catch in thousands of tones per year in Southern Iceland (left axis) and all of Iceland (right axis). Westman Islands accounts for 60-85% of all fish landed in harbors in South Iceland. These data were obtained from Fiskifélag Íslands and various issues of *Útvegur*.

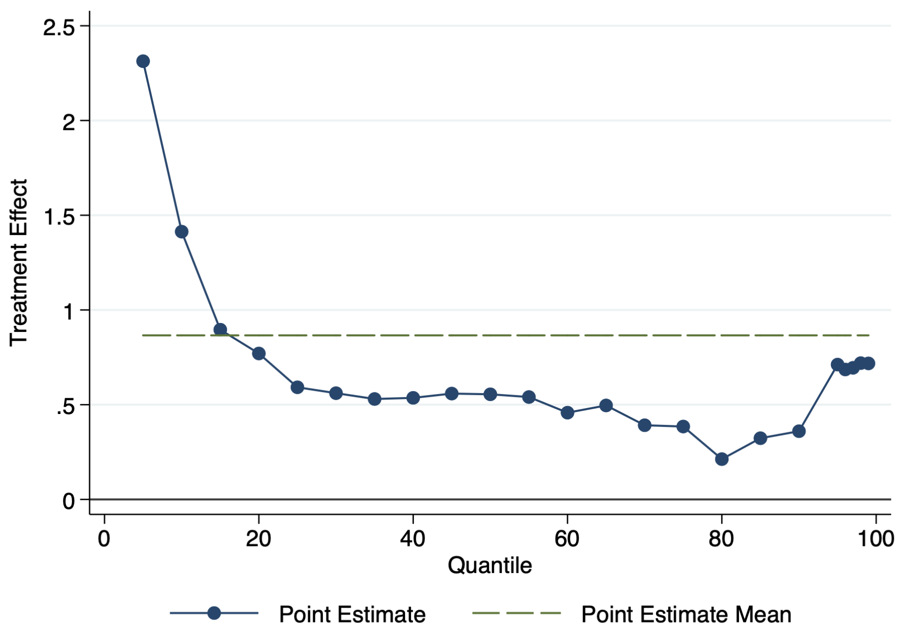
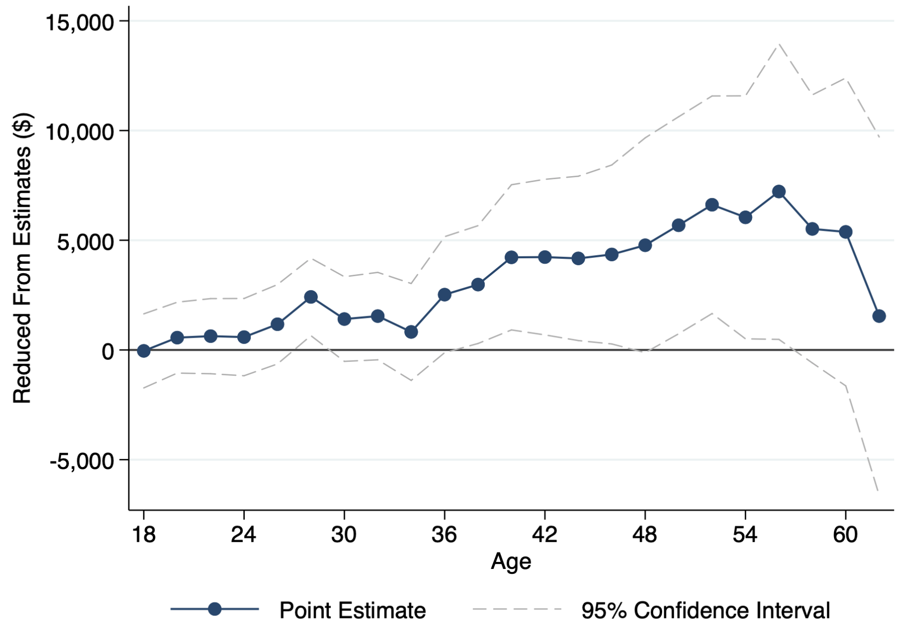
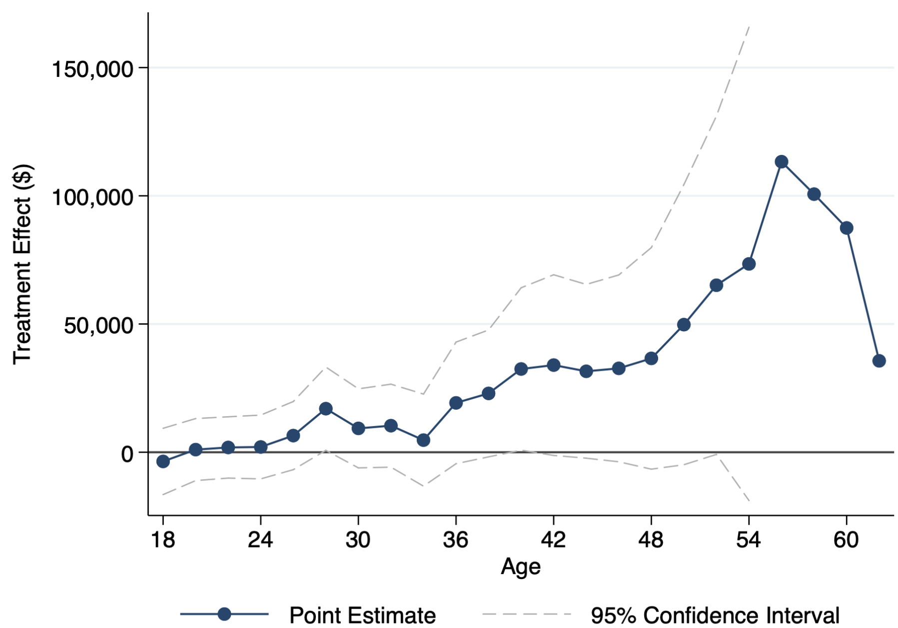


Figure A.2: IV Quantile Effects for Log(Earnings) – Cohorts Younger than 25 at time of Eruption

Note: The figure plots quantile treatment effects using the estimator proposed by Abadie, Angrist, and Imbens (2002) for the 5th to the 99th percentile. The effects are estimated in 5 percentile increments up to the 95th percentile, and in 1 percentile increments for 96th to 99th percentile. The green horizontal dashed-line plots the mean effect (2SLS) for comparison.



(a) Reduced Form by Age



(b) Treatment Effect by Age

Figure A.3: Earnings Effect Over the Life Cycle – Cohorts Younger than 25 at time of Eruption

Note: Panel (a) plots the reduced form earnings effect by age. Panel (b) plots the causal effect of moving by age. Robust standard errors are clustered at the house level. To aid visibility in panel (b), we only plot the 95% confidence intervals out to age 56. The confidence intervals for the older age groups are even wider.

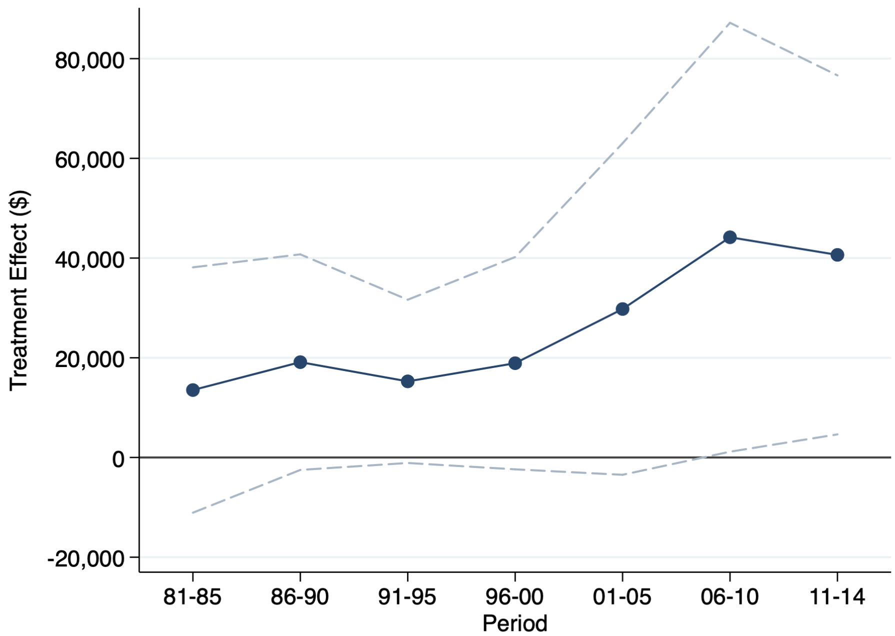


Figure A.4: IV Earnings Effect by Year – Cohorts Younger than 25 at time of Eruption.

Note: The figure displays the evolution of the treatment effect over time. The dashed lines plot the 95-percent confidence interval. Robust standard errors are clustered at the house level.

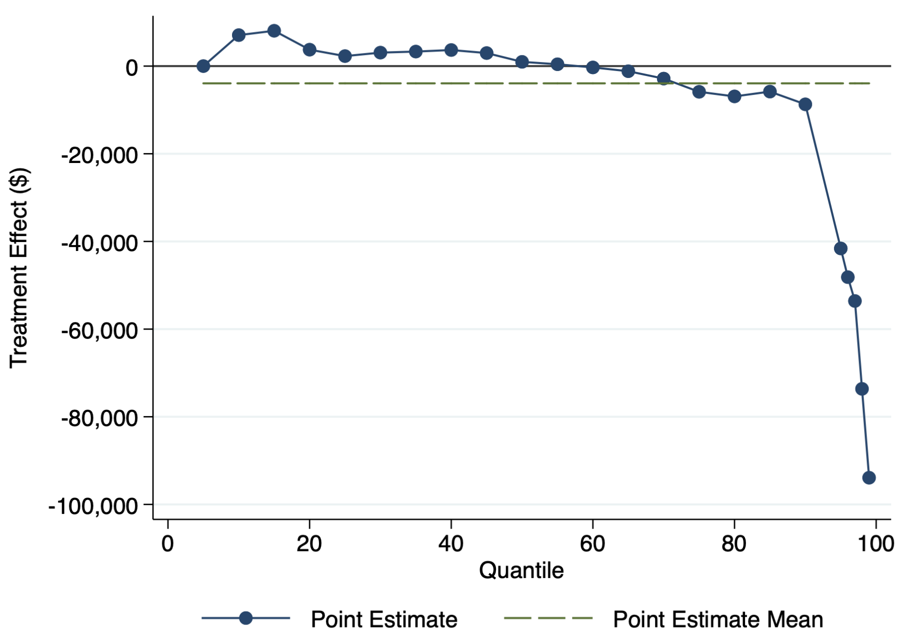
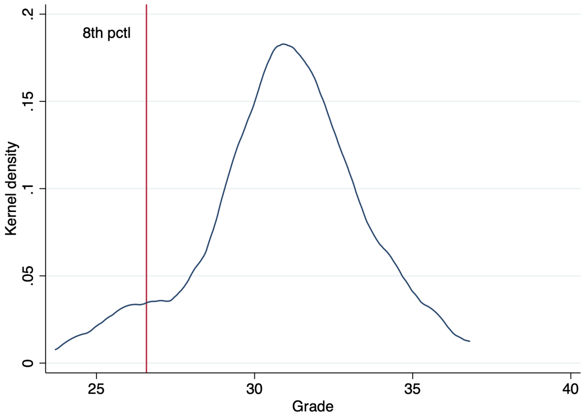
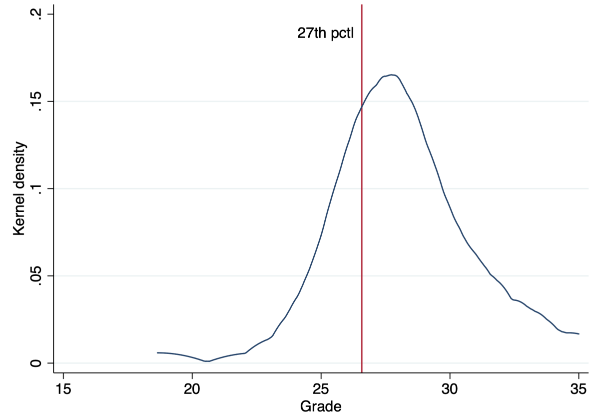


Figure A.5: IV Earnings Quantile Effects – Cohorts 25 and Older at time of Eruption

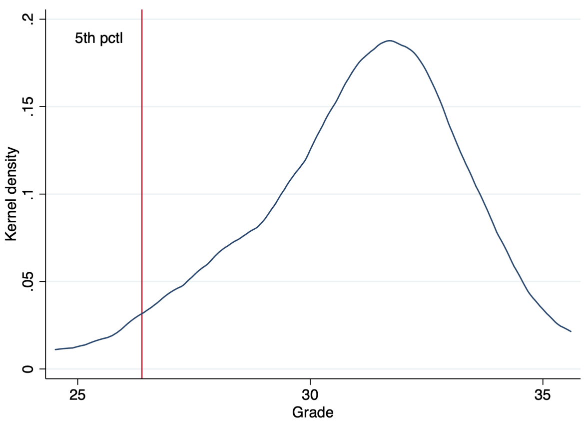
Note: The figure plots quantile treatment effects using the estimator proposed by Abadie, Angrist, and Imbens (2002) for the 5th to the 99th percentile. The effects are estimated in 5 percentile increments up to the 95th percentile, and in 1 percentile increments for 96th to 99th percentile. The green horizontal dashed-line plots the mean effect (2SLS) for comparison.



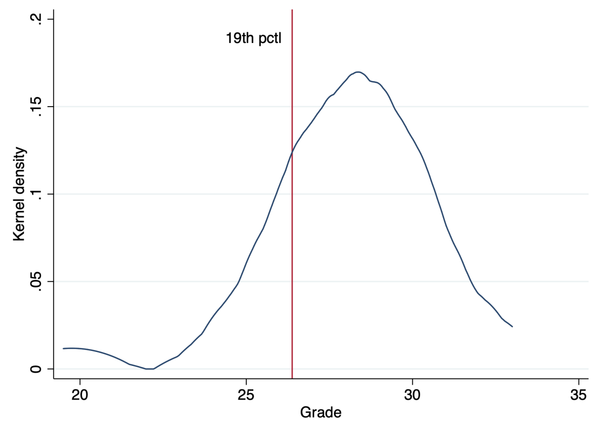
(a) Mathematics – Capital Region



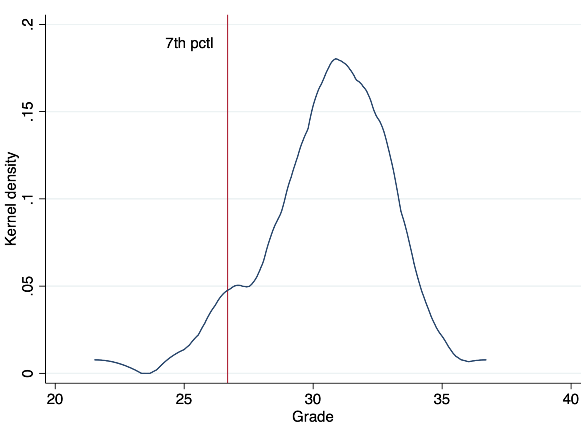
(b) Mathematics – Other Regions



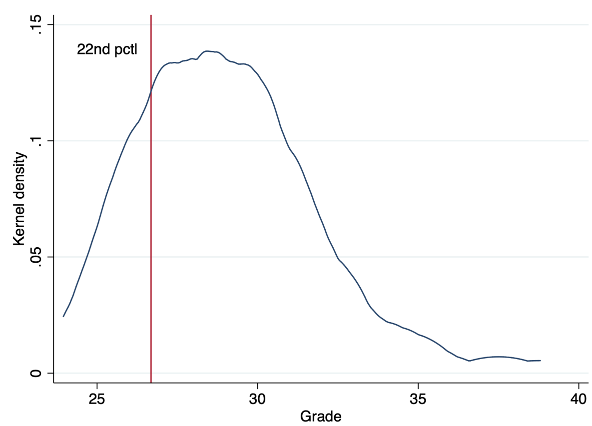
(c) English – Capital Region



(d) English – Other Regions



(e) Icelandic – Capital Region



(f) Icelandic – Other Regions

Figure A.6: Results from Standardized Tests

Notes: Distribution of average grade by school for 2010-2014 on 10th grade standardized tests in Mathematics, English and Icelandic. National average score is 30. The red vertical line represents the average test scores in the Westman Islands in the respective distribution. *Source*: Directorate of Education, Iceland.

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