Þjóðarspegillinn 2011

RANNSÓKNIR Í FÉLAGSVÍSINDUM XII

Hagfræðideild

Erindi flutt á ráðstefnu í október 2011

Ritstjóri
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Félagsvísindastofnun Háskóla Íslands

HÁSKÓLI ÍSLANDS

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ISSN 1670-8725
ISBN 978-9935-424-12-9

Öll réttindi áskilin

Greinar í bók þessari má afrita í einu eintaki til einkanota, en efni þeirra er verndað af ákvæðum höfundalaga og með öllum réttindum áskildum.

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Þjóðarspegillinn, hin árlega ráðstefna um rannsóknir í félagsvísindum við Háskóla Íslands, er nú haldin í tólfta sinn á afmælisári Háskóla Íslands. Umfang ráðstefnunnar ber glögg merki hinnar mikillar grósku í rannsóknum á sviði félagsvísinda.

Sérstakt ráðstefnurit fyrir hagfræði kemur nú út í annað sinn. Að þessu sinni eru 5 greinar í ritinu. Nokkrar breytingar hafa verið gerðar á fyrirkomulagi ritstjórnar. Fallið var frá því fyrirkomulagi að bjóða upp á ritrýningu. Ferlið reyndist þungt í vöfum miðað við umfang ráðstefnunnar. Áfram var haldið í þá vinnureglu að einstakir fræðimenn eigi að hámarki tvær greinar á ráðstefnunni. Greinar til birtingar voru valdar á grundvelli útdráttar sem höfundar sendu inn. Markmiðið með forvali er að tryggja gæði þeirra greina sem kynntar eru á ráðstefnunni. Nokkrum greinum var hafnað í forvalinu. Stífar kröfur eru gerðar til lengdar og uppsetningar greina eins og tíðkast hefur fyrri ár. Lengdartakmarkanir setja umfangi og ýtarleik greina nokkrar skorður en nauðsynlegt hefur verið talið að beita slíkum takmörkunum til að halda aftur af heildarumfangi útgáfunnar.

Vinna við frágang og ritrýni greina hefur verið umtalsverð. Vil ég þakka höfundum og þeim sem unnið hafa að útgáfu ráðstefnuritsins með einum eða öðrum hætti fyrir gott samstarf og vel unnin störf. Líkt og undanfarin ár hefur meginþungi vinnunnar við undirbúning ráðstefnunnar og ráðstefnuritsins verið hjá Félagsvísindastofnun og vil ég á þakka starfsfólki hennar fyrir afar gott samstarf og góða vinnu. Sérstaklega vil ég þakka Völu Jónsdóttur og Sóley Lúðvíksdóttur fyrir vel unnin störf, en þær báru hitann og þungann af umbroti ráðstefnuritsins og umsýslu vegna þess.

Ísland er að vinna sig upp úr miklu efnahagslegu áfalli. Fullyrða má að þörfin fyrir hagrannsóknir hafi aldrei verið meiri. Mikil ábyrgð hvílir á Hagfræðideild Háskóla Íslands að vera leiðandi í þeim rannsóknum. *Þjóðarspegillinn* er afar mikilvægur vetvangur til kynningar þeim rannsóknum sem fram fara í hagfræði hér á landi.

Reykjavík í október 2011
Daði Már Kristófersson

Peer Effects and Academic Achievement
Regression Discontinuity Approach

Arna Vardardottir[1]

Peer effects in education are generally accepted to be of importance. Despite this belief there is no general consensus on the direction of the effect peers have on one another. Different theories attempt to explain this and according to some of them the average ability of classmates has detrimental effect on one's schooling outcomes while others imply that it enhances one's achievements (Marsh, 2005). Furthermore, the exact causal mechanism of peer effects in education is also ambiguous. One possible, and most direct, channel for peer effects is that students instruct each other. Other possible channels are for instance classroom disruption and classroom atmosphere. Students could also be indirectly affected by their peers. This can for instance come about through the way teachers react to different groups of students. Another possibility is if students are sorted into classes based on their ability it might allow teachers to match instructions more closely to students' needs because of more homogenous group, which would benefit all students.

In this paper, my primary purpose is to establish empirically the existence and direction of peer effects but not to distinguish the channels by which peer effects operate. The problem when it comes to estimating peer effect is that, as the saying goes, birds of feather flock together[2], and the same applies to students. Most high-school and college students choose their peers and therefore it is difficult to estimate peer-effects in most higher-education settings. In situations where students choose their own peers we are subject to the reflection problem, i.e., if a student's peers have unobserved characteristics that are systematically related to her own, estimation of peer effects cannot be given a causal interpretation. If, for instance, a smart student tends to choose smart peers then it is not feasible to statistically distinguish between the effects of the student's intelligence and the effect of peer's intelligence. In this paper I address this problem by employing a regression discontinuity (RD) design where student assignment into high-ability (HA) classes constitutes the source of identifying information. The basic intuition behind this approach is that, in the absence of program manipulation, students just below the treatment-determining grade cutoff should provide valid counterfactual outcomes for students just above the cutoff, who were assigned to HA classes.

I use data on 5 years of entering students at an Icelandic high school where students are sorted into HA and normal classes, based on their assignment grade. The probability of being assigned to a HA class jumps at the 60^{th} or 70^{th} percentile of the assignment grade and therefore I use a fuzzy RD design to test for peer effects, i.e., whether being assigned to a HA will affect one's grades.

The contribution of this paper is threefold. First, the way I measure peer ability is an improvement over existing studies. The majority of previous empirical evidence on ability peer effects in education comes from studies that are either based on data that does not include class identifiers or they examine the effect of academic ability of peers without having direct measures of their academic ability but rely instead on background characteristics as proxies for this. Since students spend a relatively big part of their time in class their classmates are very likely to be significantly influenced by their classmates.

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[2] The saying describes the tendency of individuals to associate with others who are similar to themselves, a phenomenon known as homophily.

It is therefore very important to be able to identify this group. To the best of my knowledge, this is the first paper that is both able to identify classmates and measure peer ability directly using their test scores from national and school exams at the end of 10th grade. Second, I am not aware of any other study that pursues a fuzzy regression discontinuity strategy to extract the causal impacts of peers' ability on achievement. Finally, this is the first study on peer-effects in Icelandic schools and the first one to study peer-effects in high-school in the Nordic countries.

I find that assigning students to a class with students that are on average of higher ability in comparison to a class where students are on average of lower ability has a positive and significant effect on their academic performance. Visual results also fit with the estimates obtained.

The rest of the paper is organized as follows. In the next section I describe the institutional background and the dataset. Section 3 describes the identification strategy and discusses problems that come up when measuring the causal peer effect. Section 4 reports the main results while section 5 presents concluding remarks.

The dataset

To test whether academic ability of classroom peers are of importance for educational outcomes, I use data on 5 years of entering students at the Commercial College of Iceland in Reykjavik to test for peer effects among classmates. The data set consists of 1353 students, 644 female and 709 male. In their first year all students follow a common curriculum.

Selection into classes is mainly based on students' admission grades, defined as a weighted average of their results on the standardized tests for 10th grade and their school grades in these subjects. There are approximately 270 incoming students each year and they are assigned to 10 different classes, where each class spends the entire school day together. Students are assigned to 3-4 HA classes (depending on the year) or to normal classes. The only difference between being assigned to a normal class and a HA class is therefore that HA classes have peers of higher academic ability. In particular, the same teachers teach normal classes and HA classes, they cover the same material and they take the same exams. The outcome variable of interest is students' academic achievement of which I have 2 measures. The first is the average grade from all the spring exams. The second measure is their year grade that is based on all grades on hand-in assignments, quizzes and Christmas exams. In addition I have information on from which school students come, in which neighborhood they live and their year of birth. Table (1) and (2) show the assignment grades and normalized assignment grades, respectively, for all the classes. Table (3) then shows the number of students in each class. Lastly, table (4) shows the sex ratio, defined as the number of female students divided by the total number of students, in each class. Tables (5) and (6) show descriptive statistics for one discontinuity sample and grades in a range close to the discontinuity point and the full sample, respectively.

Empirical approach

When identifying the causal effect of peer ability on educational outcomes two issues are particularly challenging. First, students self-select their friends and they are likely to select friends whose unobservable characteristics are systematically related to theirs, i.e., the ability of peers is not exogenous to one's own ability and characteristics. If all observable and unobservable factors that determine educational achievements and individual sorting are not accounted for this will result in biased estimates of classroom peer effects. Second, it is difficult to identify the reason for why students who belong to the same group tend to behave similarly. In a pioneer study, Manski (1993) distinguishes between endogenous effects, correlated effects and exogenous (or contextual) effects that all could explain this phenomenon. It could be that similar behavior can be explained by endogenous effects, wherein the propensity of a student to do well varies with the prevalence of high academic achievement in the group. Similar behavior within groups could also stem from correlated effects, wherein individuals in the same group tend to behave similarly because they face similar environments and have similar personal characteristics. Lastly, the reason for similar group behavior could be exogenous effect, wherein individuals in the same group tend to behave similarly because of exogenous characteristics to the group.

One remedy is to randomly assign students to peer groups or assigning students into groups based only on measurable characteristics that can serve as controls in estimation. In recent years several studies have exploited random assignment to groups to overcome the reflection problem and identify the causal effect of peers' ability[3]. However, random class assignment is not that common in higher education, so using this method to test for ability peer effects is seldom feasible and researchers must therefore resort to other methods to identify a causal effect of peers' ability in observational studies. Other approaches are certainly on offer[4]. The previous literature finds peer effects in education ranging from close to zero (Sanbonmatsu et al., 2004), to about 0.50 of standard deviation (Hoxby, 2000; Boozer and Cacciola, 2001). In studies where it was possible to identify classmates, peer effects were found to be of somewhat greater magnitude than those who could only identify peers by school-grade, suggesting that those who do not are possibly missing out on information on the "real" reference group of a student. The critical point in measuring the influence of peers is to identify the "real" peers. Keeping in mind that students spend a relatively big part of their time in class it seems to be a credible assumption that their classmates are a good proxy of their group of peers. However, in some cases there can be significant variation between classes within school-grades and hence the assumption that school grade peers are a good proxy of classmates can be quite strong.

The method highlighted in this paper is a RD design. This is an excellent approach to employ to overcome the identification difficulty when participants are assigned to treatment on the basis of a quantitative measure like in this case and has received a lot of attention in applied economic research in recent years because of the high quality of causal inference it often engenders. The idea behind the RD approach is to use a discontinuity in the level of a treatment related to some assignment variable to get a consistent local average treatment effect (LATE) estimate, by comparing those just qualified for treatment to those just unqualified. It has been a popular method of estimation when evaluating educational intervention since school decision formulas often contain discontinuities.

My empirical approach exploits that there are 3-4 HA classes each year and the main determinant of which type of a class students are assigned to is the assignment grade and hence there is a discontinuity in the probability of being assigned to a HA class at the 60th or 70th percentile of the assignment grade. This cutoff in the sorting of students into HA classes constitutes a valuable source of identifying information. I exploit this to estimate a causal effect of classroom peers. To the best of my knowledge, this has

3 See for instance Sacerdote (2001), Zimmerman (2003), Sanbonmatsu, Kling, Duncan and Brooks-Gunn (2004) and Graham (2008).

4 For instance, Hoxby (2000) exploits exogenous variation in peer composition in elementary schools in Texas, Hanushek, Kain, Markman and Rivkin (2003) rely on student and school-by-grade fixed effects strategy, Ammermueller and Pischke (2009) investigate peer effects in primary schools in several European countries employing a school fixed effect strategy while Lavy, Silva and Weinhardt (2009) analyze whether there is systematic correlation between variation in subject outcomes for a student and the variation in subject ability of his peers.

not been done before. Students to the left of the assignment-determining threshold should provide valid counterfactual outcomes for students on the right side of the cutoff who were assigned to HA classes since the treatment status is randomized in a neighborhood of the threshold. I can therefore estimate the effect of class peers on academic outcomes by comparing outcomes for the students whose grades are just below and just above the threshold of getting into a HA class since they on average will have similar characteristics except for the treatment. Since I am applying the fuzzy RD design, the probability of being assigned to a HA class is given by

$$E[H_{itc}|A_{itc}] = Pr[H_{itc} = 1|A_{itc} = a_{itc}] = \gamma + \delta \cdot 1\left\{\frac{a_{itc}-s_t}{\sigma_{at}} \geq 0\right\} + g\left(\frac{a_{itc}-s_t}{\sigma_{at}}\right) \quad (1)$$

where $1\{\cdot\}$ is the indicator function, taking the value one if the logical condition within the brackets hold and zero otherwise. H_{itc} is a treatment dummy taking the value one if student i in year t and class c was assigned to HA class and zero otherwise, A_{itc} is the admission grade of student i in year t and class c. $1\left\{\frac{a_{itc}-s_t}{\sigma_{at}} \geq 0\right\}$ is the indicator function taking the value 1 if the assignment variable, the admission grade a, exceeds the threshold, s_t, of having a higher probability of getting into a HA class which is given by the 60th or 70th percentile. $g(\cdot)$ is a control function, i.e. some low order polynomial in normalized admission grade, $\frac{a_{itc}-s_t}{\sigma_{at}}$.

Assignment to HA classes can be represented by the following equation

$$H_{itc} = Pr[H_{itc} = 1|A_{itc} = a_{itc}] + u_{itc}$$

where u is an unobserved component which captures everything else influencing the class assignment decision, and academic achievement of students can be represented by the following equation

$$Y_{itc} = \alpha + \varphi_t + \beta X_c + \tau H_{itc} + f\left(\frac{a_{itc}-s_t}{\sigma_{at}} \geq 0\right) + \varepsilon_{itc} \quad (2)$$

where Y_{itc} is an outcome variable for individual i in year t and class c, γ_t is a year specific effect and X_c is a vector of class characteristics and the effect of admission grade is captured by the function $f(\cdot)$, i.e. it is supposed to be an adequate description of $E[Y_{0itc}|A_i]$.

H will be instrumented with the cutoff indicator C, which is defined as

$$c_{itc} = \begin{cases} 0 \; if \; a_{itc} < s_t \\ 1 \; if \; a_{itc} \geq s_t \end{cases}$$

since it captures the higher probability of being in a HA class at the assignment threshold, the 60th or 70th percentile of the admission grade. The interpretation of equation (2) is that it describes the average potential outcomes of students under alternative assignments into HA classes, controlling for any other relationship between admission grade and academic achievement. Since classtypes are not randomly assigned, it is likely to be correlated with the error component. OLS estimates of (2) will therefore not have any causal interpretation. The evaluation problem consists of estimating the effect of the assignment to a HA class on the outcome variable, i.e., τ.

The key identification assumption that underlies the RD approach is that $f(\cdot)$, is a continuous function. Intuitively, the continuity assumption requires that differential assignment into classes is the only source of discontinuity in outcomes around the assignment threshold, 0, so that unobservables vary smoothly as a function of assignment grade and, in particular, do not jump at the cutoff. Formally, the conditional mean functions, $E\left[Y_{1i}\left|\frac{a_{itc}-s_t}{\sigma_{at}}\right.\right]$ and $E\left[Y_{0i}\left|\frac{a_{itc}-s_t}{\sigma_{at}}\right.\right]$ are continuous in $\frac{a_{itc}-s_t}{\sigma_{at}}$ at 0, or equivalently $E\left[\varepsilon_i \left| \frac{a_{itc}-s_t}{\sigma_{at}} \right.\right]$ are continuous in $\frac{a_{itc}-s_t}{\sigma_{at}}$ at 0. Under this assumption

the treatment effect, τ, is obtained by estimating the discontinuity in the empirical regression function at the point where the treatment dummy, H, switches from 0 to 1 at the assignment threshold and can be given a causal interpretation.

As shown in Lee (2008) and Lee and Lemieux (2009), it is sufficient for the continuity assumption to hold if the density of the treatment-determining variable is smooth. In my case, this assumption explicitly allows for students to have some control over their value of assignment grade. As long as this control is imprecise, treatment assignment is randomized around the cutoff. In my case, the continuity of assignment grade density functions also directly ensures that assignment into HA classes is randomized close to the assignment cutoff. An additional concern would be imperfect compliance with the treatment rule, but in my study there is not much scope for this. Each classroom has limited space which is in most cases fully utilized and there is no possibility to switch classes if there is not enough space in another class. Also, a student's outside options are scarce if she decides to leave the school because she was not assigned to HA class. The student will need to wait at least one semester to get into another school and for a whole year if she wants to get into the most popular ones.

It is also helpful to consider how reasonable the continuity assumption is in the context of this paper? Students obviously had an incentive to affect the way school administrators assigned them into classes, and presumably also some control over this. However, it seems implausible that this control was perfect, so the key identifying assumption is likely to hold here. Furthermore, assignment grade is determined after students receive their grades on the standardized exams and school exams so they were unlikely to know the exact location of the HA class cutoff even if they wanted to make sure that they managed to reach the cutoff.

One might worry that school administrators had incentives to alter the cutoffs to benefit students they favored. It is unlikely, however, that this kind of manipulation would have occurred. For example, in order for administrators to have used the cutoffs to benefit particular students they favored, there would have had to be places on the support of the student grade distribution where favored students had a systematically higher density than other students.

A final potential concern is that other school policies are also related to the same grade cutoffs. To my knowledge, however, there are no programs that use the same cutoff.

Peer effects provide therefore an example of how fuzzy RD can be analyzed in an instrumental variable framework where the IV estimates can be given causal interpretation. In this case, IV estimates of equation (2) use discontinuities in the relationship between assignment grade and assignment into HA classes to identify the causal effect of peers´ ability at the same time that any other relationship between admission grade and academic achievement measured by the end of the first year is controlled for by including a smooth function of admission as a control. In practice, this includes linear, polynomial and local linear functions of admission grade.

Because there are relatively few observations in a local neighborhood of the assignment threshold, the control function approach is my preferred method in my RD analysis. The disadvantage of this approach is that it becomes a major concern whether the specification of the control function, $f(\cdot)$, which determines that slopes and curvature of the regression line and affects therefore the estimated treatment effect, is correct. I therefore use a couple of different specifications when using an extended support. As a further specification test, I will also estimate the effect of being in a HA class using only observations that are +/- 5 percentage points from the assignment grade threshold without any control functions for assignment grade. The idea behind the RD design is that this discontinuity sample will be a close approximation to a randomized trial and therefore it is unnecessary to include the control function. Consequently, the estimate from the discontinuity sample should now be equal (apart from sampling variability) to the estimate from the control function approach, unless the control function is misspecified. However, since the slope of the relationship between the assignment grade and academic achievement is rather steep around the discontinuity, the discontinuity sample would need to be very small for this estimate to give an accurate description of the causal effect of being assigned to a HA class. I therefore also use local linear regression in samples around the discontinuity (+/-- 5 percentage points from the assignment grade threshold), which amounts to running simple linear regressions allowing for different slopes of the regression function in the neighborhood of the assignment-threshold. I follow the suggestions by Imbens and Lemieux (2008) and use a rectangular kernel, i.e. equal weights for all observations in the sample used. A linear control function should be able to capture any other relationship between assignment grade and academic achievement in such a close proximity to the threshold but I also show estimates where I include a second order polynomial in normalized assignment grade as a control.

Results

The first crucial assumption for being able to apply the RD design is that there is an observable assignment variable on which assignment is based and that there is a discontinuity at some cutoff value of the assignment variable in the level of treatment. This assignment rule is graphically displayed in Figures (2)-(7) and fits the treatment allocation rule of the fuzzy RD design. The assignment as a function of the normalized admission grade, $\frac{a_{itc}-s_t}{\sigma_{at}}$, contains a jump at a known threshold values for $\frac{a_{itc}-s_t}{\sigma_{at}}$, namely 0, so this first assumption is fulfilled.

As a first exploration for possible effect of classroom peers on educational outcomes, I plot the average grades by the end of the first year as a function of the average assignment grade and see whether they exhibit a similar trend around the threshold value. I do this by using binned local averages in figure (8). The figure shows that there is a discontinuity in normalized spring exam result and year grade around the assignment threshold and therefore present evidence that academic achievement, as measured by spring exam results or year grade, is affected by being assigned into a HA class. A second exploration for a possible effect of ability peer effects is to compare outcomes of discontinuity samples around the HA class threshold. I use discontinuity samples that are between+/- 5and+/- 0.5 percentage points from the assignment threshold and there is considerable difference between the outcomes for the two class types in all of them. Although graphical illustration suggests that classtype, induced by the percentile assignment rule, affects student achievement measured by the end of the first year, they do not provide a framework for formal statistical inference. Table (7) shows the results from instrumental variable regressions of academic achievement on class-type (i.e., equation (2)). The control function approach is my preferred method since there is only a limited number of observations close to the threshold in the data set (i.e. there are only 712 observations within +/- 5 percentage points from the threshold).

For the discontinuity sample the standard errors are about 110% larger than when using the full sample. This explains why the control function approach is the preferred method since it is much more efficient than just comparing the average outcomes in a small neighborhood on either side of the treatment threshold. The fact that we obtain positive and significant estimates fit with the visual results which suggested that there was a positive treatment effect on academic performance from assigning students to HA classes.

The treatment effect is sizable, the difference between the normalized assignment grade of normal- and HA classes is 0.55 but the treatment effect for spring exam results and year grade is approximately 0.213-0.246 and 0.221-0.235, respectively. This suggests that if a student with assignment grade just below the HA class threshold would instead of being assigned to a normal class go to a HA class, where students have admission grades that are on average 0.55 standard deviations higher than in normal classes, this would lead to more than 0.2 standard deviation increase in spring exam and year grade results.

Conclusions

In this paper, I have estimated ability peer effects using data for five cohorts of age 16 in an Icelandic high-school where I measure peers' ability by their academic ability as recorded by standardized test scores and test scores from their previous schools (elementary school).

From a methodological perspective, I view my main contribution to be the approach taken to measure peer effects, where student assignment into HA classes constitutes the source of identifying information. As far as I know, this has never been done before.

In terms of findings, my results suggest that assigning students to classes with peers of higher academic ability increases their own academic performance. The conjecture that peers' ability cause differentials in academic performance is therefore substantiated empirically; tracking students into classes does seem to exacerbate inequality among students who ex ante are of equal ability. In more detail, my estimates suggest that a 1 standard deviation increase in the average ability of peers would increase one's own outcomes by approximately 0.42 standard deviations. My results therefore fall within the range of peer effects in the previous literature but are close to the upper end, which is consistent with the fact that those studies where it was possible to identify classmates are found to be of somewhat greater magnitude than those who could not.

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Overview of the structure of microsimulation models and a tax-benefit microsimulation model for the Icelandic labour market

Eyjólfur Sigurðsson
Helgi Tómasson

In this paper the concept of microsimulation models is reviewed. It provides an overview of microsimulation models, with special emphasis on the structure and application of models for evaluating redistribution policies. In addition, we introduce a tax-benefit microsimulation model for the Icelandic labour market.

The Icelandic Tax Benefit Micro Simulation Model (ICETAXSIM) is a static microsimulation model with behavioural changes. At the heart of ICETAXSIM is a set of procedures for the tax-benefit schedules current for the years included in the Icelandic Longitudinal Income Database (ICELID), allowing for some optional inputs. This is an independent part, which in combination with ICELID can function as a standalone arithmetic microsimulation model. The behavioural components consist of a binary choice model for the work participation state and models that describe changes in working hours and welfare participation.

With the use of ICETAXSIM it is possible to estimate the impact of recent and proposed changes to the tax benefit system in Iceland. It is possible to separate how the effect might affect different groups based on socio-economic and demographic aspects.

Microsimulation Models

Microsimulation refers to simulating the actions of individual units. In general terms, the simulation is a computerized task where information is fed to a set of procedures that predict the response of the agents within the system being modelled. The distinctive feature of microsimulations, compared to other simulations, is that the simulated units are at the individual level. Depending on the purpose of the simulation, the units can be people, households, vehicles or firms (Klevmarken, 2001; Williamson, 2007).

Microsimulation models, also known as microanalytic simulation models, were pioneered by Guy Henderson Orcutt. He first describes what he had envisioned in "A new type of socio-economic system", Orcutt (1957). It is a culmination of ideas, drawn from his background in physics and engineering, research in autocorrelation using Monte Carlo simulations, and neoclassical economics training. He realised that aggregate time-series could not assess how the impact of policies is distributed among non-homogeneous groups. Subsequently, he dedicated much of his career to constructing and perfecting microsimulation models, most notably DYNASIM (Watts, 1991; Wolfson, 2009).

Application for microsimulation models in economics has primarily been in estimating the impact of specific changes to policies. The most common subjects are concerning changes in taxation or benefit programs. Other notable applications are for long term projections of pension or student benefit/-loan plans. These models are then typically person or household oriented, while in a different setting there are also firm based microsimulation models. Typical applications for microsimulations in engineering are for traffic simulations (Microsimulation, n.d.), and in health sciences they are for the impact of health intervention and policies at the population level (Statistics Canada, n.d.). Links to various microsimulation models under active development can be found on the website of the International Microsimulation Association (http://www.microsimulation.org).

What Constitutes a Microsimulation Model?

Bourguignon & Spadaro (2006) list three elements which microsimulation models (specified for redistribution analysis) are commonly comprised of. These elements are:

Micro-data sets.
The rules to be simulated.
Theoretical models.

A micro-data set could either be from a survey or registry based information. Importantly, it should contain economic and socio-demographic characteristics of individuals and/or households that are affected by the policy changes being evaluated. Note that for a 'fully equipped' microsimulation model this need not be personal information. It might suffice to use information about cohorts. The rules refer a set of procedures, stipulating the rules of the tax- and/or benefit policies under consideration. A key factor in a redistribution analysis is a procedure that calculates the budget constraint each agent is faced with. At the heart of microsimulation models are theoretical models of the behavioural response of agents affected by the policy changes. Behavioural response which is most relevant to a tax-benefit model would be labour supply, while depending on the purpose it might also include savings and household composition.

Types of Microsimulation Models

Microsimulation models are in general categorized as being static or dynamic. The former refers to cross-sectional tax-benefit calculators that provide a detailed evaluation of the distributional impact of changes in state fiscal and welfare policies at a given point in time. While the latter refers to models that include an updating process which is based on population characteristics of the individuals in the model (such as ageing, birth, mortality and mobility). The process is iterated to generate long-term projections.

Bourguignon and Spadaro (2006) make a special mention of the so-called arithmetical models. Essentially, this is referring to simulations that are without theoretical models. As the name suggests, they are arithmetic recalculations with a new set of rules. Since they ignore the behavioural response they are in a sense not true microsimulation models. But their simplicity and ease of construction is rather appealing. For a theoretical justification of an arithmetic microsimulation models one would have to assume that the behaviour of each individual agents being affected by the change in policy is unchanged.

In addition to static and dynamic models, Williamson, Zaid, and Harding (2009) state micro-macro as the third basic type of microsimulation models. Such models feed the output from microsimulations as input into macroeconomic models to incorporate individual behaviour, and reversely, from macroeconomic models into microsimulations to take into account the macroeconomic environment which the agents operate in.

Most microsimulation models might be considered partial equilibrium models. That is, they do not assume that the change in supply resulting from the policy reforms will affect prices. Conversely, general equilibrium models can for example take into account the response of labour demand to a shift in labour supply due to changes to the tax-benefit system. Models can in this way address general equilibrium in a subset of the market. For models with a broader scope, the microsimulation model could be linked to a computable general equilibrium model for an economy-wide policy analysis.

To proclaim this list of three types of microsimulation models being exhaustive would be an oversimplification (as noted by Williamson et al., 2009). Model types are largely decided by their intended use, and their application ranges from estimating rural poverty, analysing welfare effects of changing social security financing, to assessing the affects of complying with the Kyoto protocol (Zaidi, Harding, & Williamson, 2009).

Notable Microsimulation Models

The first large scale dynamic microsimulation model was constructed at the Urban Institute under the direction of Guy Orcutt. It is the aforementioned Dynamic Simulation of Income Model (DYNASIM). Work on its construction began in 1969, and the first version was completed in 1975. It was later further developed into the CORSIM model (Orcutt, Caldwell, & Wertheimer, 1976; Klevmarken, 2001).

The microsimulation tax and benefit model (TAXBEN) in the UK has been operated by the Institute for Fiscal Studies (IFS) since 1983. It was given substantial revisions in 1990 and a range of extra features added since in order to enhance its power as a tool for policy analysis. It has also been used as the basis for the development of tax and benefit models for Poland and the Czech Republic (Giles & McCrae, 1995). Another example is Fördelningsanalytisk statistiksystem för inkomster och transfereringar (FASIT) in Sweden. FASIT is developed and used by Statistics Sweden (SCB) and the Swedish Ministry of Finance. Further information on FASIT is available (in Swedish) at the SCB website (http://www.scb.se). In 1997 the Swedish Ministry of Finance in collaboration with researchers from different universities started a project that was the development of the dynamic microsimulation model SESIM. SESIM was initially used in estimation of student grants and loans, but has since then been used in forecasting long term pension expenditures, life-cycle analysis and pension projects in light of ageing population. Information regarding SESIM, documentation, publication and some source codes are available on the projects website (http://www.sesim.org). The EUROMOD is a tax-benefit microsimulation model for the European Union (EU). It enables cross-national research.

The National Centre for Social and Economic Modelling in Australia (NATSEM) operates the microsimulation models STINMOD and APPSIM. STINMOD is a static tax-benefit model for Australia, while APPSIM is a dynamic social/fiscal model for ageing populations. The webpage of NATSEM is an excellent source for further information (http://www.canberra.edu.au/centres/natsem).

Statistics Canada operates a microsimulation unit where they have developed a framework called Model Generator (Modgen). It is a generic microsimulation programming language that supports creation, maintenance and documentation of dynamic microsimulation models. See the microsimulation portal at Statistics Canada for further information (http://www.statcan.gc.ca/microsimulation).

The Icelandic Tax Benefit Micro Simulation Model

The Icelandic Tax Benefit Micro Simulation Model (ICETAXSIM) is a static microsimulation model with behavioural changes. The primary use of ICETAXSIM is to evaluate the impact of changes in the tax-benefit system on individuals, households or other specified demographic groups. Conversely, it can be used to evaluate government tax-revenues in alternative tax-benefit systems. In addition, the output from a simulation in ICETAXSIM could readily be used as input in a social welfare function.

The main source of inspiration for the work on ICETAXSIM is a recent tax/benefit microsimulation model for Sweden, SWEtaxben (Ericson, Flood, & Wahlberg, 2009; Ericson & Flood, 2009). Both models use micro data sets from register-based longitudinal databases that are of similar construct, and both use similar types of econometric models. But work on the two models was conducted independently, several aspects of their designs are dissimilar, and while SWEtaxben is mature, in the sense that its application has been published, ICETAXSIM is still under active development.

Micro Data

The Icelandic Longitudinal Income Database (ICELID) is developed and maintained by Statistics Iceland (Hagstofa Íslands). The institution administers official statistics in Iceland and collects, processes and disseminates data on the economy and society. One of the main advantages with ICELID is that given the detailed and length of the data, it still has the rare feature that it is not a sample, but covers the entire population. The small size of the nation is an appealing aspect when it comes to population wide estimation, yielding ICELID comparative advantage when it comes to manageability of size. Included are information about individual income, both vocational and financial, tax and benefits, debts and assets; demographical information such as age, gender, marital status and residence; vocational information such as monthly income, duty factor, employer (and self employed), industry and vocation; and information about education.

At the time of writing there exists no publicly available documentation of ICELID. Eyjólfur Sigurðsson & Helgi Tómasson (2008) gives an overview of the core variables in ICELID, but as the preceding paragraph suggests it has since been extended.

Set of Rules

The ICETAXSIM rules is a collection of functions that calculate the various types of tax and benefits. Implementation of it is in the form of procedures that take in a user defined list of individuals and calls on the desired functions for each individual taxable unit. Each function call takes instructions in the form of parameters, such as year, age, income, capital and other characteristics required for the calculation of the specific tax or benefit for any given individual. As an example, the procedure required for the theoretical models described below is the one which returns the budget constraints each agent is faced with.

Several problems need to be addressed in the development of the various types of processes. Besides the more practical problems, such as choice of language, structure and algorithm, there are several less obvious problems. For any given year we have several types of tax and benefits in effect, but in practise, some of them do not come into affect in the year they apply to. In a "pay as you go" system (staðgreiðslukerfi) the transactions are performed within the year which the rules apply. This applies to most of the income tax in Iceland (as of 1988), and some of the capital income tax (introduced in 1997). Most other taxes and benefits are paid in the preceding year, but there are exceptions that stretch out for multiple years. Depending on what the user intends with the output, he can choose procedures that return taxes and benefits either when they apply or when they accrue.

Since the implementation of ICETAXSIM is on an annual basis there might be problems with rules that are changed within the year. This could be dealt with by using additional variables, but labour supply models generally do not support this fragmented output. Thus, unless it is somehow parameterized, procedures provide the possibility of averaging such rules.

There are a few peculiarities with how taxes and benefits are in praxis calculated by the tax authorities. Since currency generally is an integer value, one such peculiarity is concerning the rules for rounding figures. Although this is of insignificant importance for estimations, measures were taken to try to match where and when figures are rounded or truncated.

The ICETAXSIM rules can be used as a standalone application. It is useful in highlighting specific aspects of the tax-benefit system, such as marginal or average tax rates for hypothetical cohorts. When used in conjunction with the aforementioned ICELID it is an arithmetic model. But for a comprehensive microsimulation model we need to take into account the behavioural response of the agents that will be affected by the policy changes under consideration.

Theoretical Models

The ICETAXSIM incorporates two types of econometric models. The first type is binary choice models. As the name suggest, such models produce a discrete, yeas or no outcome. Their application is for the prediction of whether individuals are in or out of the labour market and whether they are unemployed or not. The second type is structural discrete choice models, which is used for predicting labour supply.

Whether an individual is in or out of the labour market is determined by his age, capacity, circumstances and opportunity cost. These aspects are factored in binary choice models with unobserved heterogeneity (model estimation methods described in Wooldridge, 2002). The initial condition problem is addressed, following Wooldridge (2005). An equivalent model is then used to assess whether an individual has employment or not. Labour supply is modelled for different household types with discrete choice models, following van Soest (1995). Household types and model specifications is described in Eyjólfur Sigurðsson (2010).

Both the binary choice models and the discrete choice models are by construct generating probabilities for alternative outcomes. In order to evaluate the alternative choices the estimation requires the ICETAXSIM rules described in the previous section. Thus, the rules are used both in parameterisation of the models and in their application within ICETAXSIM.

The Structure of ICETAXSIM

The workings of ICETAXSIM can be described as a stepwise process. Prior to the start the user chooses the relevant procedures and sets of rules. We need rules for the evaluation and for comparison. In general this would be the rules of the policy change which are under consideration and the rules that are currently in effect.

The model process starts with reading in data. This would be the micro-data set from ICELID. The next couple of steps require the ICETAXSIM rules. Effectively, they are used to generate input variables, such as disposable income, for the theoretical models. First off the occupational status of each individual is evaluated. Binary choice models determine whether the individual is out of the labour market. If any of the questions asked turns out yes then the labour supply (hours worked) that particular individual is set to zero. Changes to amount and eligibility rules for alternative income, such as old age pension and disability benefits, will affect the outcome of these models. Note that changes to income tax will affect this likewise. Increased income tax reduces the opportunity cost of being out of the labour market. With an equivalent model it is determined whether the individuals on the labour market have employment. The last theoretical model is the structural labour supply model. Those individuals that are on the labour market and have employment get imputed hours of work. Based on the resulting hours of work, zero or imputed, the resulting disposable income is generated for each individual.

A flowchart diagram describing the structure of ICETAXSIM is presented in Figure 1. It is somewhat of a simplification, but gives a good general understanding of the workings of the microsimulation model.

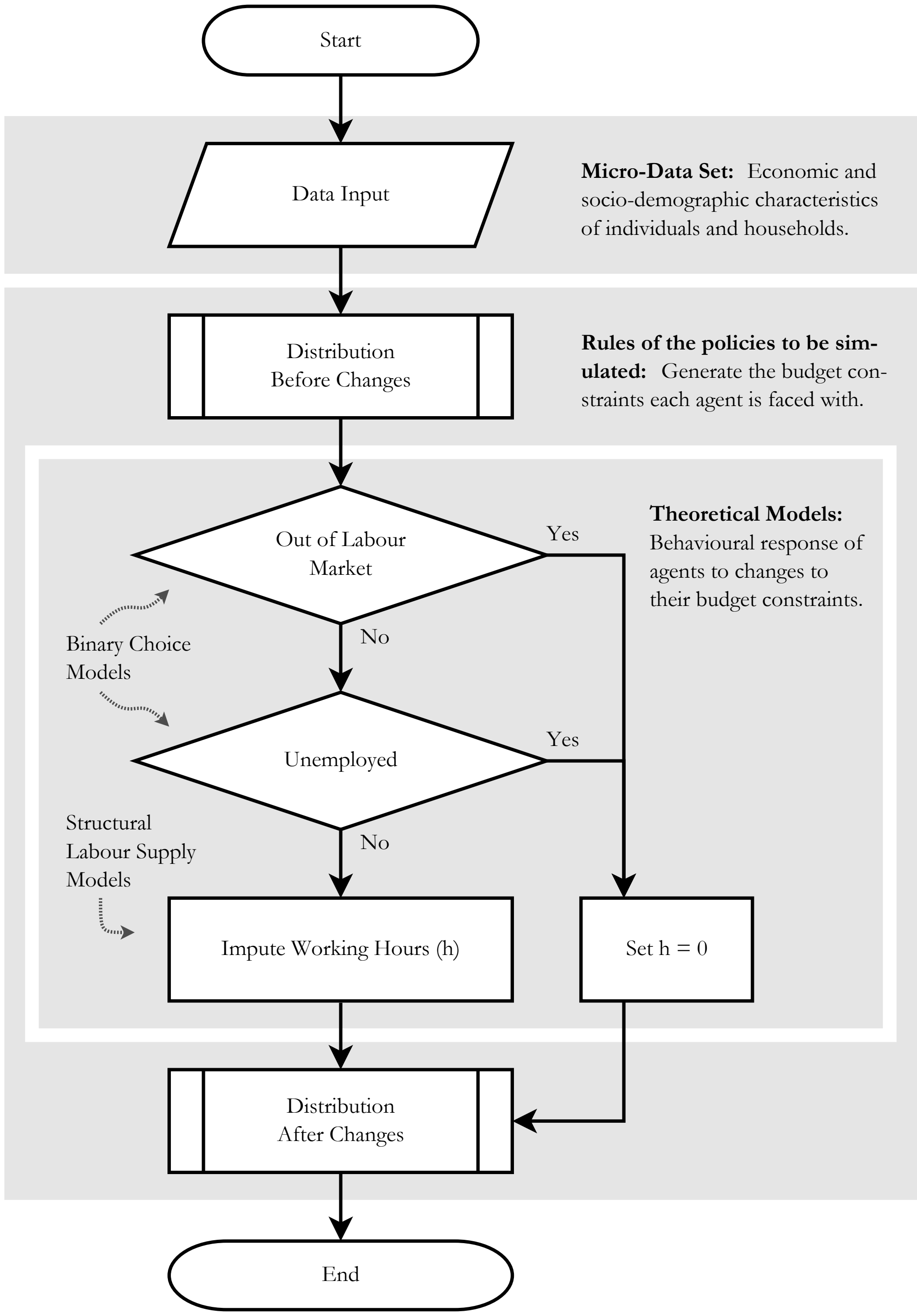

Figure 1. The structure of ICETAXSIM

The Application

The application for which ICETAXSIM is intended for is to evaluate proposed policy changes to the tax-benefit system in Iceland. It is a tool that enables the analysis of how the impact of policy changes is distributed throughout the market, not just the average outcome. With it one can assess who might be affected by the policy change, and by how much. This can lead to refinements prior to the implementation of policy changes. An example of which is from a tax revision in the Netherlands. As described in van Soest and Das (2001), the authors gave the Dutch government warnings about its proposed revision to the income tax. They found out that it would have a negative effect on married women in part-time jobs. Subsequently, in order to not push these women out of the labour market, amendments were made to the proposal before it went to the parliament. An example of a more broad evaluation is from Sweden. The Swedish "make work pay" reform in 2007, with further reinforcements in 2008 and 2009, was shown by Ericson et al. (2009) to both increase household income and reduce income inequality, albeit they found that the reforms were far from being self-financed.

In the preceding decades considerable changes have been made to the tax and benefit system in Iceland. The income tax has been steadily decreased and more recently increased, high income taxes was imposed, then dismantled, and more recently re-imposed. In addition there were rather generous increases to certain benefits recently. The system is intangible, and the effects of these changes are hard to predict beforehand. Since the tax benefit system is under constant revision there is ample use for an Icelandic microsimulation model.

Acknowledgements

Statistics Iceland provided resources and facilities for conducting research and development. The Gender Equality Fund (Jafnréttissjóður) provided financial support for the construction of the longitudinal database ICELID. Financial support was provided by the University of Iceland Research Fund, the Eðvarð Sigurðsson Memorial Fund and the Nordic Tax Research Council.

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Determinants of Household Allocation of Income in Iceland

Helga Kristjánsdóttir

The research objective is to analyze how families divide their income to individual members of the family under crisis conditions such as experienced recently in Iceland. The Icelandic situation since late 2008 has been one of great uncertainty, with job loss, income loss, and currency volatility. Such conditions are likely to have an effect on the female and male heads of household, as well as any children. The research objective is to account both for couples with and without children like in comparable foreign studies (Bonke & Browning, 2009b, 2009c). In addition to conventional expenditure studies the idea is to add measures accounting for the background of the participants, such as the family situation during their upbringing, plus the length of the time they have been living with their spouse. Moreover, the objective is to capture management issues of the household by capturing the autonomy the couples have to individually delegate resources, that is if they believe that what they earn is theirs alone to decide how to allocate. I also intend to analyze how the income allocation decisions are affected by a sudden income increase or decrease.

Outcomes for men and women will be studied specifically in a game theoretical setting, in order to obtain family measurements of household expenditure pattern. These empirical results will then be used to test current economic theories. The research model is based on a unique Danish household survey, which provides a valuable opportunity to put Icelandic households in an international setting both on a micro and macro-economic level. Such a study can potentially guide the design of governmental finance policies intended to increase the welfare of families.

Although it is similar to a Danish study, the societies are not identical. There are certainly some similar factors, such as generous social benefits, and many single parents who often participate most in those social benefits. However, Iceland is faced with deeper recession than Denmark has experienced during the times studied previously. Currently the government of Iceland has to cut back on spending across all sectors-schools, healthcare, and most importantly to this study, family benefits. The incentive to study this data in Iceland is that it can potentially help the government in lowering costs with the minimum impact on the essential family benefits. In comparison to the Danish study, which has used fairly stable and constant data, I expect to find the Icelandic data and results to be rather more volatile.

This paper is based on a conglomeration of several previous studies. First used is a research study by Lundberg, Pollak and Wales (1997) who investigate the level of pooling between couples. This current research applies investigations by Thomas (1990), Bonke (2008), Bonke and Browning (2009a) who focused on the distribution of well-being and income within the household. Moreover, research by Bonke and Uldall-Poulsen (2007) and Bonke and Browning (2009b, 2009c) focusing on pooling of income and expenditure allocation.

The research provides an opportunity to increase the efficiency of welfare transfers, potentially leading to substantial savings for the government. The project, which has never been attempted before in Iceland, provides an opportunity for active research co-operation on an international level. Ultimately, the data will give the chance for interesting international comparisons of government policies.

The paper is organized as follows: First there is a review of the literature in the field, then the methodology and data, and finally a wrap-up with a summary and conclusions.

Literature Review

With the primary objective to determine the income allocation of Icelandic homes, the study will be based on a research by Lundberg et al. (1997) who compared patterns in household expenditure before and after policy change by Thatcher's government in the UK and find the income received by each spouse to effect family expenditure pattern. They therefore reject the unitary model implying pooling of income and common preferences.

In their analysis, Browning and Gørtz (2006) study family expenditures together with spending of time, in order to examine how couples balance their consumption and leisure dependent on difference in preferences or productivity, or power bargaining between the household heads.

This current research also takes into account the study of Thomas (1990), Bonke (2008) and Bonke and Browning (2009a) who focused on the distribution of well being and income within the household, finding that it differs how spouses report their financial satisfaction.

Moreover, Bonke and Uldall-Poulsen (2007) examine pooling of income within households in Denmark, applying the Danish Household Expenditure Survey. Their exploration suggests there is income pooling to some degree in majority of Danish households, and the degree of pooling is dependent on existence of children, length of relationship, previous marriage, and factors like education, labor market status and age.

Furthermore, Bonke and Browning (2009b) conducted an intensive survey in Denmark on expenditures for individual household members as to determine allocation within the household. They expand the Danish Household Expenditure Survey by also conducting a survey investigating whether expenditure is contributed to the male or female head of the household, as well as contribution to children and something outside the household. Their extensions include analysis on how the household is managed, family background and autonomy. Furthermore, Bonke and Browning (2009b) examine how the distribution of clothing expenditure is connected with distribution of other goods. Their findings indicate it to be beneficial to examine for whom at the household the good was bought.

The concept of income pooling is known in both economic literature (Becker, 1991) and literature on economic psychology, an in economic psychology it implies household management of finances, whereas in economics the focus is more on outcomes (Bonke & Browning, 2009c). Bonke and Browning (2009c) find that although the wife's share in income is about 43% the wife's share in consumption is 52%, and their findings also indicate that the more the wife earns relative to the husband, the higher is her share in consumption.

The Beckerian pooling model, also referred to as the unitary model, assumes that household members have analogous preferences and act as an individual in decision making (Bonke & Browning, 2009c). But there is a broad belief that the household as an aggregate does not make unitary decisions and the Beckerian model, implying that the household makes unitary decisions, has been tested by researchers like Bourguignon et al. (1993), Browning et al. (1994), Bourguignon, Browning, Chiappori and Lechene (1993), Browning, Bourguignon, Chiappori and Lechene (1994), and Browning and Chiappori (1997), Lundberg et al. (1997) and Thomas (1990). Interesting research also includes Browning, Chiappori and Lechene (2006), Bonke and Fallesen (2010), and Gregg, Waldfogel and Washbrook (2005).

Methodology and Data

This research uses similar methodology as the Danish Time Use and Consumption Survey DTUC-2008/9. The Social Science Research Institute at the University of Iceland has offered to conduct the survey. The plan is to expand the Danish survey questionnaire, by adding questions related to the economic recession effects.

A random sample will be drawn from the National Register of men and women 18-74 years old and we expect response rate of 65-70%. Minimum of 1200 individuals will be included in the gross sample size. The survey will be conducted both over phone and through the internet. Respondents will be asked to take part in an internet survey, however if they don't have internet access a phone survey will be offered.

The idea is also to apply categories used in other similar research, such as by Vogler and Pahl (1994).

In co-operation with the Social Science Research Institute, a questionnaire will be formed based on the questionnaire used in Denmark.

It is popular in expenditure surveys to analyze the expenditure on clothing, see for example Lundberg et al. (1997). It therefore makes sense to look at the expenditure on clothing in Iceland, and also the expenditure on shoes as an example of goods allocated to the male, female and children.

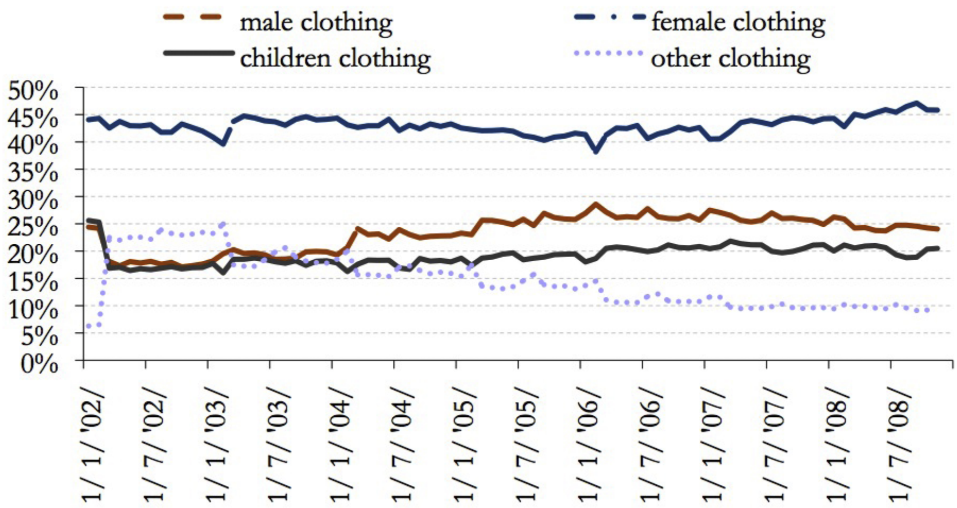

Figure 1. Resource Allocation to Clothing within the Household 2002-2008 (Statistics Iceland, 2008a)

Figure 1. exhibits the expenditure percentage to clothing within the household during the period from 2002 to 2008. The figure exhibits that there is a notable increase in the share of male clothing until the beginning of the period until 2006 when there is a minimal decrease to about 25% share. Female's percentage share in clothing appear to be remain slightly more stable, however with seasonal fluctuations. And it appears that the female's share increase is somewhat at the cost of male clothing ending in about 45%. However, children clothing expenditure allocation mostly varies seasonally, although a slight increase can be identified from 2002 to 2008 ending in about 20% share. The substantially higher share of women in clothing when compared to men is not unique for Iceland. In comparison, a research by Bonke and Browning (2009b) finds the wife's share in clothing to be about 35.5% the husband's share 21.7% and share of the children 28.5%.

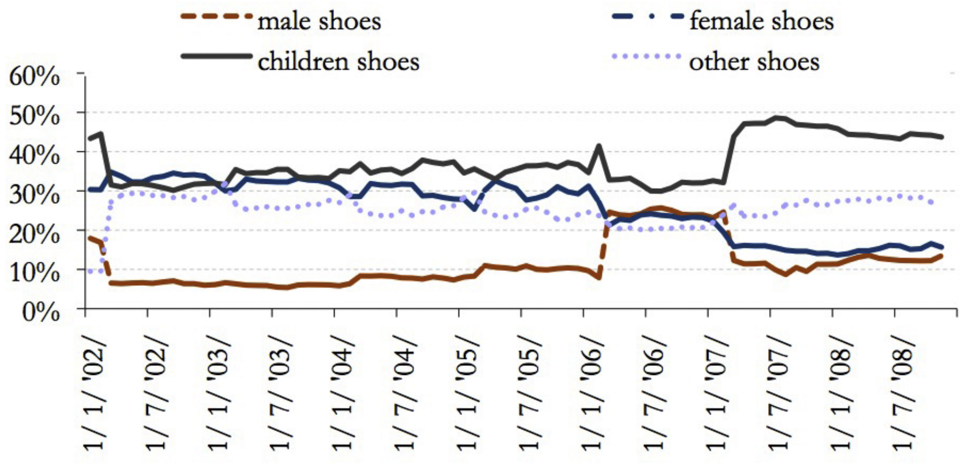

Figure 2. Resource Allocation to Shoes within the Household 2002-2008 (Statistics Iceland, 2008b)

What is notable in Figure 2 is that the percentage share of female shoes is gradually decreasing over the time period from 2002 to 2008, ending in about 15% share. The share of male shoes is considerable lower than that of women for most of the time, but doubles in the boom during 2006-2007, and then reaches similar level of 10% again in 2007 with a slight increase until the end of 2009 ending in about 11%. The percentage share of children shoes has considerable seasonal variation and has a share of about 30-40% in the beginning of the period, and takes off in 2007 when it reaches the high levels of about 48% and ends in about 45%.

However when undertaking research of this kind, one needs to be aware that goods like clothing tends to be bought infrequently and this needs to be considered (Bonke & Browning, 2006) and also the distribution needs to be carefully accounted for (Bonke & Uldall-Poulsen, 2007).

By applying survey questions already imposed in Denmark, the research provides valuable comparison of Iceland with another Nordic country.

Data analysis and reporting SPSS or ASCII files will be produced for data processing.

The Social Science Research Institute will be responsible for the questionnaire design, sampling, data collection (CATI and CAWI), data cleaning and the data file produced as SPSS or ASCII. Further data processing will be performed using the statistical software package STATA.

Summary

This research focus is on expenditures of families and potential crisis effects on how household expenditures are divided between the husband and wife, as well as the children and other goods outside the household. Like other research in the field, this study looks at what share the husband, wife and children have had in clothing and other life necessities within the household. By doing so it is possible to examine the crisis effects on the expenditure pattern within the household.

Preliminary results show that in Iceland clothing expenditures trends indicate that the parents are getting higher share than the children. By the end of the period in 2008 the females had about 45% share, the males with about 25% and the children with about 20% share. Furthermore, developments in shoe expenditures to different family members suggest children have the highest share ending in about 45% in 2008 and female about 15% and male about 11%.

The timing of this project is very important due to the current economic crises in Iceland, since the country needs to target its social welfare programs so as to benefit those in need under conditions of extreme fiscal restraint. Increasing the effectiveness of the social welfare programs is important under these conditions.

The project has an important academic value since it offers measurements and policy suggestions for countries moving out of crisis. The survey results can be used to help governments design policies directed towards families with children. With better knowledge of the inner workings of families, funding for families can be streamlined so as to save money and ultimately benefit the target group more effectively.

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Hagrænir ferlar einstaklinga:
Hermunarlíkön byggð á slembiferlum

Helgi Tómasson

Markmið þessarar greinar er að kynna notkun slembiferla (*stochastic processes*) við hermun á hagrænum einstaklingsferlum. Hugmyndin er sótt í fræðin um Markov-keðjur. Markov-keðjur eru líkindafræðilegt hugtak sem lýsa óvissu hlöðnu hreyfimynstri. Víðfeðm stærðfræði er til um Markov-keðjur en á seinni árum hefur hagnýting þeirra rutt sér til rúms í bayesískri tölfræði. Í bayesískri tölfræði hefur hermun á Markov-keðjum, MCMC (Markov-Chain-Monte-Carlo), verið notuð til að reikna dreifingu bayesískra metla, sjá t.d. Gelman, Carlin, Stern og Rubin (2004). Í þessari grein er sýndar nokkrar einfaldar útfærslur á hvernig skilgreina megi Markov-ferli sem hafa eiginleika sem minna á eiginleika einstaklingsferla.

Á 19. öld voru vísindamenn að leita að „Diffurjöfnunni"(hinni einu sönnu) sem átti að lýsa hreyfilögmáli (dynamics) fyrirbæra í náttúrunni í tíma. Markov hugmyndin gengur út á að tengja líkindafræði og hreyfilögmál í tíma. Hagnýting líkindafræði er að búa til reglur um óvissuna. Vísindin um óvissuna eru „exact" vísindi.

Helstu efnahagsstærðir í lífsferli nútíma einstaklings eru tekjur og eignir (skuldir má túlka sem neikvæðar eignir). Þessar stærðir þróast yfir ævina því gefur eykur það skilning á eðli þessara stærða að skoða feril þeirra í tíma. Einstaklingar eru ekki allir eins og því er framtíðarferill hvers og eins sveipaður óvissu. Líkindafræðin býður upp á hlutlæg tól til að lýsa eðli óvissu. Grunneiginleiki Markov líkana er að framtíðarþróun er háð nútímaástandi. Ástandsrúmið, mengi mögulegra ástanda, getur verið strjált (*discrete*), þ.e. að einstaklingurinn stekkur milli ástanda. Ástandsrúmið getur einnig verið samfellt (*continuous*), þ.e. að öll gildi á tilteknu talnabili eru möguleg.

Greinin er skiplögð með eftirfarandi hætti. Fyrst er skilgreining á Markov eiginleikanum rifjuð upp með einföldu dæmi. Næst er lýst hreyfimynstri í strjálu ástandsrúmi (*state space*) í samfelldum tíma. Lifun og hjónabandsstaða eru strjál ástandsdrúm og má lýsa hreyfimynstri í þeim með Markov ferlum. Ýmsar hagstærðir eru í eðli sínum samfelldar. Nokkur einföld líkön í samfelldum tíma eru kynnt.

Markov slembiferli

Deterministískt hreyfilögmál getur t.d. verið á forminu.

$$X_{t+1} = g(X_t, X_{t-1}, \ldots, t)$$

Ef hægt er að draga saman allar fortíða upplýsingar í eina stærð,

$$X_{t+1} = g(X_t, t), \text{ eða time-homogeneous } X_{t+1} = g(X_t).$$

Þá er sagt að lýsa megi ástandinu með (X_t, t). Eftirfarandi dæmi sýnir einfalda líkindafræðilega útfærslu á þessari hugmynd. X_t er hending (random breyta) sem bara tekur gildi 0 eða 1.

$$P(X_{t+1}|X_t, X_{t-1}, \ldots) = P(X_{t+1}|X_t),$$

þ.e. líkindadreifing X_{t+1} gefin öll fortíð er eingöngu háð X_t. Það að einungis takmörkuð fortíð skipti máli er það sem einkennir Markov eiginleikann. Segjum að:

$$P(X_{t+1}=1|X_t=1)=p,\;\; P(X_{t+1}=0|X_t=1)=1-p,$$
$$P(X_{t+1}=1|X_t=0)=1-q,\;\; P(X_{t+1}=0|X_t=0)=q.$$

Ástandið á tíma t er því aðeins gildið á X_t. T.d. gæti $X_t=0$ þýtt lág laun og $X_t=1$ há laun. Eiginleikum hreyfilögmálsins (milli launaflokka) sem sett er fram með jöfnukerfi (1) má þá lýsa með ákveðnu fylki (transition-matrix=tilfærslufylki):

$$T=\left[\begin{array}{cc} p & 1-p \\ 1-q & q \end{array}\right].$$

Í þessu tilfelli er til jafnvægisdreifing. Þ.e. líkindadreifing sem tilfærslufylkið T heldur fastri. Einföld algebra gefur að í jafnvægi þá er:

$$\begin{aligned} P(X_t=1) &= \frac{1-q}{(1-q)+(1-p)} \qquad \text{og} \\ P(X_t=0) &= \frac{1-p}{(1-q)+(1-p)}. \end{aligned}$$

Ef t.d. $p=1$ þá verða allir að lokum með há laun. Ef jafnframt allir byrja með lág laun og q er nálægt 1 þá verður aðlögun að jafnvægi hæg. Það má hugsa sér að ástandsrúmið innihaldi bara tvö stök, 1 og 2 (lág og há laun). L=lágnmarkslaun, laun= $L(1+X_t)$. Væntanlegt gildi framtíðargildis, X_{t+1}, gefin staða nútímans, X_t er:

$$E(X_{t+1}|X_t=1)=p, \quad E(X_{t+1}|X_t=0)=1-q.$$

Þetta má umrita:

$$\begin{aligned} &E(X_{t+1}|X_t)=pX_t+(1-q)(1-X_t)= \\ &1-q+(p+q-1)X_t=\mu+\phi X_t. \end{aligned}$$

Þetta er sístætt (*stationary*) AR(1) ferli ef $\phi<1$. Jafnvægisdreifing þessa ferli s er Bernoulli dreifing:

$$\begin{aligned} E(X_t) &= \frac{\mu}{1-\phi}=\frac{1-q}{2-p-q}=\pi_H \\ V(X_t) &= \pi_H(1-\pi_H). \end{aligned}$$

Hreyfilögmálinu milli lágra launa og hárra má því lýsa með:

$$\Delta X_{t+1}=\kappa(\pi_H-X_t)+\varepsilon_{t+1}.$$

Gildin á p og q, eða umritað κ og π_H ákvarða eiginleika hreyfimynstursins. Meðaltal jafnvægisdreifingarinnar er π_H og κ lýsir aðlögunarhraða að langtímajafnvægi. Þetta kerfi má nefna slembna mismunajöfnu (*stochastic* difference equation) því að tíminn er strjál (*discrete*) stærð.

Með því að hugsa sér að dt tímaeiningar eru á milli mælinga þá er breyting á tímaeiningu:

$$\Delta X_{t+dt}/dt=\kappa(\pi_H-X_t)+\varepsilon_{t+dt}.$$

Þetta má setja fram sem hliðstæðu í samfelldum tíma sem slembna diffurjöfnu (*stochastic* diffurjafna, SDE):

$$dX(t) = \kappa(\beta - X(t))dt + \text{"noise"}$$

Þar sem væntanlegt gildi á "noise" er 0. Hliðstæð deterministísk diffurjafna er

$$dX = \kappa(\beta - X(t))dt.$$

Eiginleikar ferlisins ákvarðast af κ, β og σ.

Champernowne (1953) gerði fræga grein byggða á þessari hugmynd þar sem hann lýsir raunhæfu hreyfilögmáli og sem leiðir af sér að tekjudreifing sé Pareto-dreifð. Margir höfundar höfðu áður undrast hvað tekjudreifingar hefðu líkt form. Whittle (1992) rekur í kennslubók (bls. 185) dæmi sem hann og Wold hönnuðu í grein (Wold og Whittle, 1957). Dæmið gengur út á að einstaklingar hafi einungis fasta prósentu í fjármagnstekjur og að líftíminn sé exponential dreifður (lífshættan er fasti), þ.e. mismunandi ævilengd er eina uppspretta óvissunnar/dreifingarinnar. Allir eignast m afkomendur, hver verður tekjudreifingingin? Svar: Pareto dreifing. Í næsta dæmi á eftir bæta höfundarnir aukaóvissu bætt við, þ.e. fjöldi afkomenda má vera breytilegur. Þá fæst dreifing, ekki Pareto-dreifing en dreifing með Pareto-tail (*heavy-tail*).

Nánar má lesa um Markov ferli í líkindafræðibókum eins og t.d. Whittle (1992).

Lífshættan

Líftíma einstaklings er lýst með hendingunni T. Dreififall hendingarinnar er $F(t) = P(T \leq t)$, þéttifallið er $f(t) = F'(t)$ og þá er lífshættan (*hazard funtion*) sem fall af aldri:

$$h(t) = \frac{f(t)}{1 - F(t)}$$

Hér er rakin hermun á einföldu líkani fyrir líftíma. Í þessari hermun er gert ráð fyrir mjög einföldu formi lífshættunnar. Gert er ráð fyrir að hún sé fasti upp að ákveðnum aldri og síðan tvöfaldist hún með ákveðnu aldursbili eftir það. Þessi hugmynd byggir á Gompertz frá 1825. Í stuttu máli gengur hún út frá að fyrir allar lífverur sé lífshættan á forminu:

$$\lambda(t) = \underbrace{\lambda_0}_{A} + \underbrace{\alpha_1 exp(\alpha_2 t)}_{B}.$$

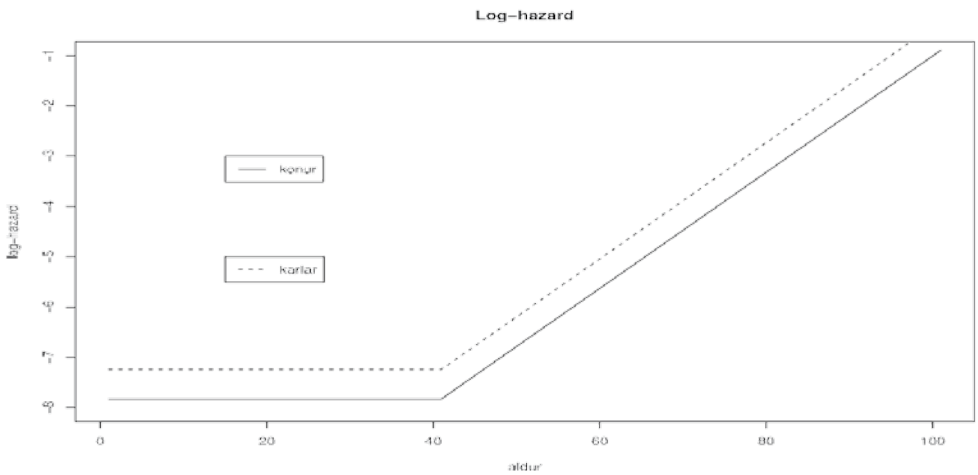
A hluti í (2) lýsir því a fyrri huta ævinnar er lífshættan nálægt því að vera fasti óháð aldri. Sú lífshætta lýsir hættunni á slysum, að verða étinn af annarri lífveru, o.s.frv. B hlutinn í (2) lýsir því að líkami lífverunnar slitnar þegar líður á ævina og þá bætist við hætta vegna slits á líffærum.

Samkvæmt nýlegum töflum frá Hagstofu Íslands virðist ekki út í hött að giska á að 2% kvenna og 4% karla deyi fyrir 48 ára aldur. Ef gert er ráð fyrir að karlar séu 1.8 faldri lífshættu á við konur allt lífið þá verður lífshættu kvenna lýst með:

$$\lambda_{f,m}(t) = \begin{cases} \lambda_0 = 0.0004 & t < t0 = 40 \\ \lambda_0 2^{(t-t_0)/6} & t > t0 \end{cases} .$$

og lífshættu karla með $\lambda_{m,m}(t) = 1.8\lambda_{f,m}(t)$. Lífshætta skilgreind með þessum hætti hefur þann eiginleika að væntanlega ævilend karla er 79 ár og kvenna 83 ár.

Box (1979) setti fram hina frægu setningu, „all models are wrong, but some are useful". Það á við hér. Jafna (3) setur fram einfalt lögmál um lífshættu sem hefur þann eiginleika að áhættuhlutföll kynja, dánarlíkur fyrir 48 ára og væntanleg ævilengd eru af raunhæfri stærðargráðu. Þetta líkan hefur sínar takmarkanir en ætti til dæmis að duga til að ákvarða hversu stór Hjartadeild Landspítalans þarf að vera árið 2050. Augljós galli er til dæmis að þetta líkan spáir að of margar konur nái 100 ára aldri. Logaritmi þessarar lífshættu er sýndur á mynd 1.



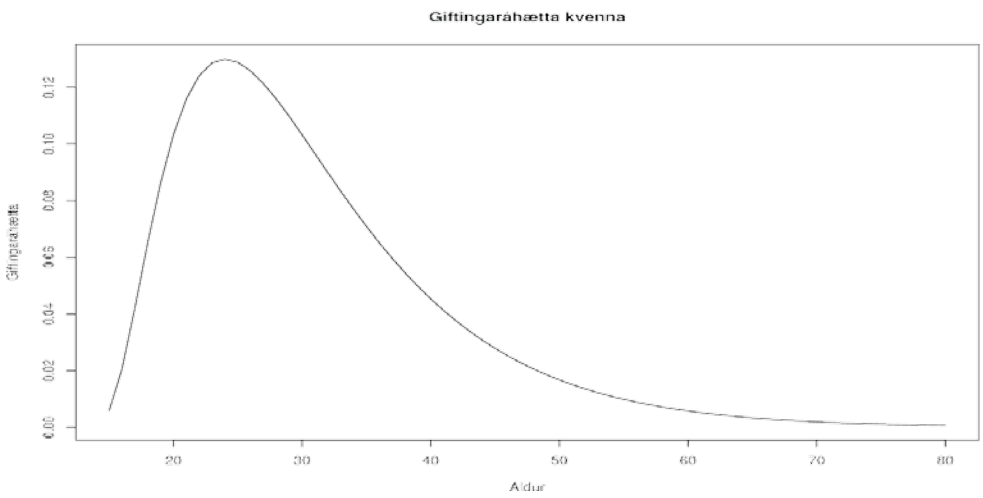
Mynd 1. Logaritmi lífshættu karla og kvenna

Hjónabandsáhættan

Hjónabandsstaða hefur áhrif á stefnumótun einstaklinga í efnahagsmálum og hugsanlega eru mikilvægar ákvarðanir í mörgum tilfellum teknar sameiginlega af hjónum. Til að hafa bókhald yfir hegðun einstaklinga þarf að lýsa því hvernig hjónabandsstaða breytist. Hér er notast við lítillega breytta útgáfu af dönskum tryggingafræðistaðli, Bergegninsgrundlag G-82. Danska útfærslan byggir á útreikningum frá árinu 1972 og breytingin hér felst í því að lágmarksaldur fyrir hjónaband var hækkaður. Hjónabandsáhættan, þ.e. hættan á að lenda í hjónabandi fyrir einhleypar konur var ákveðin á forminu:

$$\lambda_{f,p}(t) = 0.13 \times 10^{\frac{(t-24)^2}{20(t-12)}} .$$

Mynd 2 sýnir þessa áhættu. Þetta líkan hefur þann raunhæfa eiginleika að giftingarhættan vex hratt og nær hámarki upp úr tvítugu. Síðan lækkar hún stöðugt. Líkanið segir að rúm 90% kvenna muni giftast endist þeim aldur til.

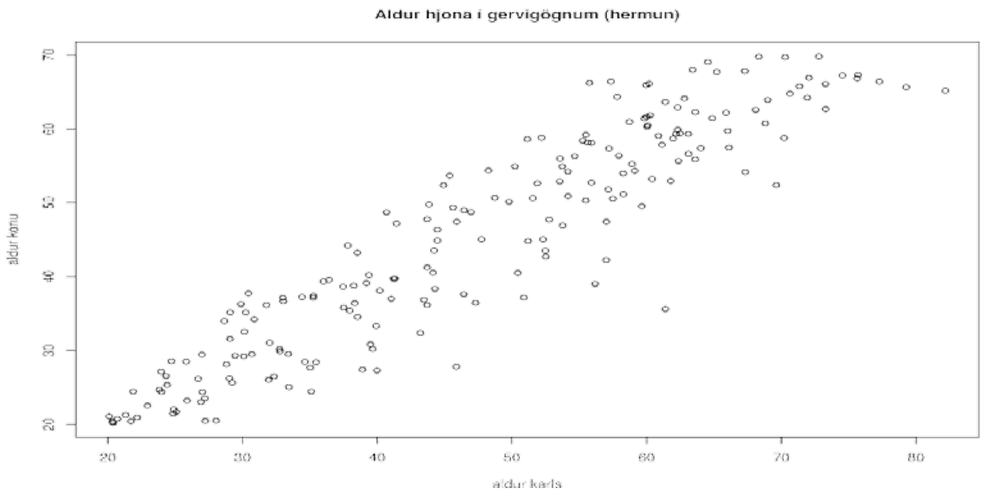


Mynd 2. Giftingaráhætta kvenna

Í greinum um giftingarlíkön er gjarnan gengið „one-sex model", þ.e. eingöngu er horft til annars kynsins. Í samfélaginu er sambúð hjóna efnahagsleg eining sem að hluta býr við sameiginlegar ákvarðanir. Til að gera líkanið raunhæfara verður því að útfæra einhvers konar hjónabandsáhættu fyrir karla. Það er hægt á ýmsa vegu. Hér er stungið upp á þeirri leið að fyrir hverja konu sem giftir sig sé karl sem hún giftist og að karlar sem séu nálægir konunni séu í meiri hættu en aðrir. Hér er hugtakið „nálægur" látið tákna nálægð í aldri. Aldur karlsins, T_m, sem giftist konu á aldri t_f er hending sem er skilgreind:

$$T_m = \alpha_0 + \alpha_1 t_f + \varepsilon.$$

Gengið var út frá að staðalfrávik ε væri fall af t_f og að dreifingin væri tiltekin gammadreifing (til að fá mátulegt skewness). Giskað út frá þekktum gögnum. Hugsanleg útkoma úr hermuðum gögnum eru sýnd í mynd 3.



Mynd 3. Aldur hjóna við upphaf hjónabands í hermun

Einföld AR(1) líkön í samfelldum tíma

Hjónaband breytan og lífsbreytan taka aðeins tvö gildi. Þær eru því í eðli sínu strjálar breytur. Laun/tekjur eru í eðli sínu samfelld stærðar. Því er eðlilegt að í líkanagerð sé leitast við að vinna með líkön í samfelldum tíma fyrir þær stærðir. Nokkrar einfaldar útgáfur að fyrsta stigs slembnum línulegum diffurjöfnum eru:

$$dX(t) = \kappa(\beta - X(t))dt + \sigma dW$$

Ornstein-Uhlenbeck, normaldreift (W=Wiener/Brownian)

$$dX(t) = \kappa(\beta - X(t))dt + \sigma\sqrt{X}dW$$

Square-root process, CIR, jafnvægisdreifing gamma

$$dX(t) = \kappa(\beta - X(t))dt + \sigma X dW$$

CEV, jafnvægisdreifing inverse-gamma, heavy-tail

$$dX(t) = \kappa(\beta - X(t))dt + \sigma dS$$

AR(1) drifið áfram með stable-dreifingu, heavy-tail

Allir þessir ferlar eru slembnar útgáfur af diffurjöfnunni,

$$\begin{aligned} &dX(t) = \kappa(\beta - X(t))dt, \\ &\beta = \text{ jafnvægi }, \\ &\kappa = \text{ aðlögunarhraði }. \end{aligned}$$

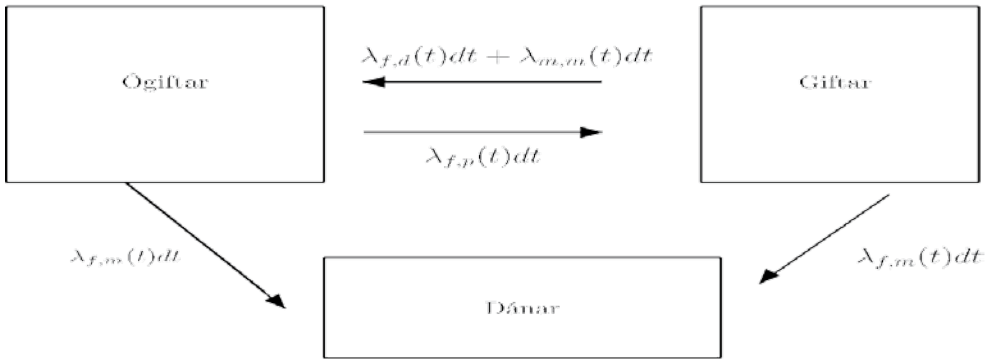
Eiginleikar „noise" liðarins lýsa hvernig einstaklingur bregst við óvæntum atvikum. Ef notast er við CEV formið þá verður $X(t)$ alltaf jákvæð og jafnvægisdreifingin er „inverse-gamma". Sú dreifing hefur Pareto-hala, þ.e. þungan hala (heavy tail) og því eru mjög há gildi möguleg. Gildi stikans σ ákvarðar viðbragð breytunnar $X(t)$ við áreiti (*innovation*).

Hugsanleg tengsl hjónabandsstöðu og annara breyta

Í hjónabandi er karlinn oftar eldri. Hjónabandið má líta á sem efnahagsbandalag. Hjóna skipta með sér verkum þannig að tekjur hámarkist. Þá er skynsamlegt að láta þann aðila sem er eldri (með hærra kaup) vinna meira. Hugsanlegt er að ógiftir einstaklingar þrói tekjur sínar með:

$$\begin{aligned} &L(t) = (1 + X(t)) \\ &dX(t) = \kappa(\beta - X(t))dt + \sigma X dW \end{aligned}$$

Þegar hjónabandið hefst er líklegt að eldri einstaklingurinn sé með hærra X. Hjónin geta e.t.v. ákveðið að skipta þannig með sér verkum að β verði hærri og e.t.v einnig að klifurstuðullinn κ verði stærri. Hjónabandsstaða getur breyst á þann veg að einhleypir einstaklingar giftast eða gift fólk skilur eða verður ekkjur/ekklar. Mynd 4 sýnir þetta fyrir konur.



Mynd 4. Hættur á ástandsbreytingum kvenna

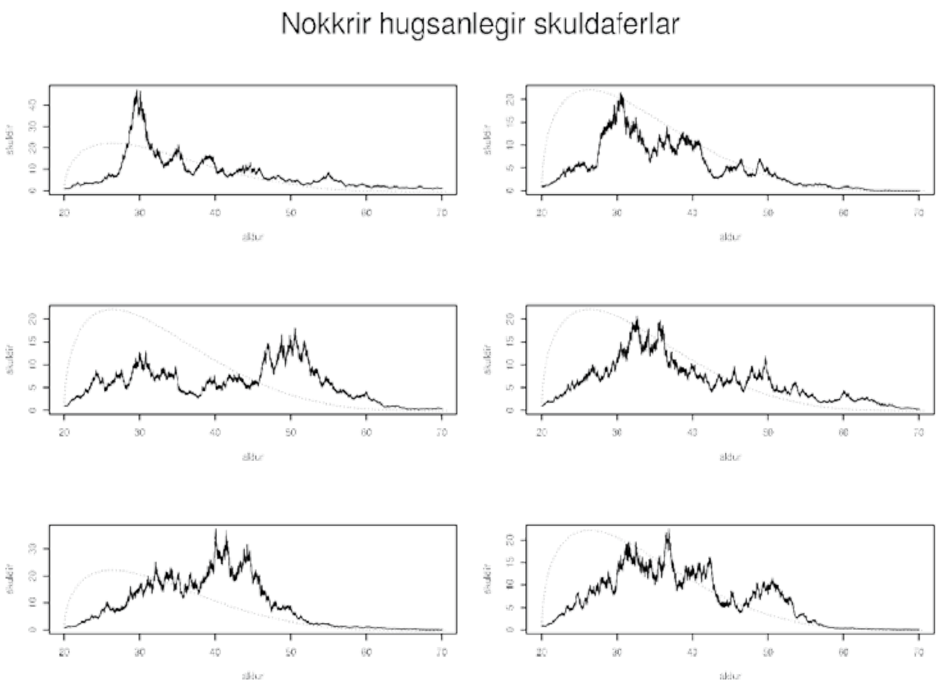
Á myndinni táknar $\lambda_{f,m}(t)dt$ hættu á að kona á aldri t deyi á tímabilinu $(t, t + dt)$. Á sama hátt táknar $\lambda_{f,p}(t)dt$ hættuna á að ógift kona pari sig, $\lambda_{f,d}(t)dt$ hættu á að gift kona skilji og $\lambda_{m,m}(t)dt$ hættu á að karlmaður deyi. Gift kona verður ógift með því að skilja eða það að makinn látist. Hættan á því er er $\lambda_{m,m}(t)dt + \lambda_{f,d}(t)dt$. Auðvelt er að hugsa sér að stuðlar í AR(1) líkani séu háðir hjónabandsstöðu.

Samfelldar breytur í samfelldum tíma

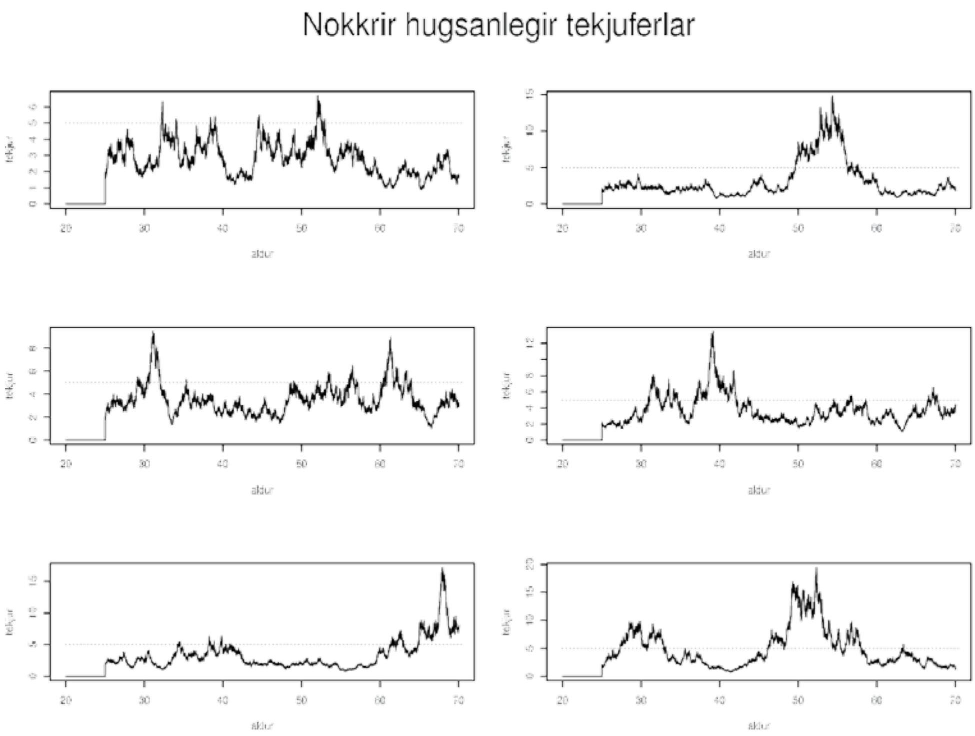
Skuldir eru langtímahagstærð. Ef skuldir eru miklar þá er eðlilega að í nálægri framtíð verði skuldir einnig miklar. Ákvörðun einstaklings um skuldsetningu eru einnig háð því hvar á æviskeiðinu einstaklingurinn sé staðsettur. Snemma á ævinni er einstaklingur sem á framtíðina fyrir sér er hæfari til að standa undir skuld. Eðlilegt er að lánsfjármarkaðurinn átti sig á þessu og setji fram einhvers konar aldursháð skuldastöðuviðmið. Til að herma hugsanlega skuldaferla má hugsa sér sömu hugmynd og áður:

$$dX(t) = \kappa(\beta(t) - X(t))dt + \sigma X(t)dW.$$

Hér er κ eins og áður aðlögunarhraði einstaklingsins, en $\beta(t)$ ákvarðar viðmið skuldastöðunnar fyrir gefinn aldur t. Breytingarnar ákvarðast af stærðinni $\sigma X(t)$, þ.e. að ef skuldin er lág þá er ferill lítt breytilegur. Í mynd 5 eru sýndar hermanir á nokkrum ferlum. Reglulegi ferillinn á myndunum er $E(X(t))$, úr jöfnu (4), sem ákvarðar hvernig $\beta(t)$ er reiknað út. Það er rétt að benda á að þessir ímynduðu skuldaferlar eru án nokkurra tengsla við eignir eða tekjur. Hliðstæðar hermanir er mögulegar fyrir eignir. Til dæmis mætti auðveldlega herma hlutfalla eigna og skulda þannig að til dæmis 50% fólks undir 40 ára væru með neikvæða eiginfjárstöðu og og 30% fólks undir 50 ára væri með neikvæða eiginfjárstöðu.



Mynd 5. Nokkrir hugsanlegir skuldaferlar



Mynd 6. Nokkrir hugsanlegir tekjuferlar

Ímynd 6 er sýndir nokkrir hugsanlegir ferlar úr CEV líkani með $\beta = 5$, $\kappa = 0.1$ og $\sigma = 0.4$. Gert er ráð fyrir að allir hafi 0 tekjur upp að 25 ára aldri og fái þá upphafstekjur 2. Sem hreyfimynstur fyrir tekjur er þetta aðeins öfgakennt dæmi. Jafnvægisdreifingin er inverse-gamma með stikana, $1 + 2\kappa/\sigma^2$ og $2\kappa\beta/\sigma^2$. Jafnvægisdreifingin hefur Gini stuðul 0.45. Meðaltal jafnvægidreifingarinnar er $\beta = 5$. Hugmyndin með því að gefa þetta öfgakenndadæmi er að sýna að það er eðlilegt að margir einstaklingar séu langt frá meðallaunum alla sína ævi. Einingarnar í þessum dæmum voru valdar þannig að það mætti hugsa sér að 5 þýði 5 milljónir á ári.

Niðurlag

Hér hafa verið rakin nokkur einvíð sýnidæmi um Markov líkön. Þau sýna að mjög einföld líkön af slembiferlum geta skapað mjög fjölbreytta ferla. Hermun slíkra ferla er heppilegt tól til að gera hugmyndir manna um möguleg gildi áþreifanlegar. Dæmin hér á undan eru einvíð. Þ.e. að hugsanleg sambönd t.d. skulda og tekna. Margvíð Markov líkön eru í eðli sínu flóknar því að nauðsynlegt er að setja fram tengsl milli einstakra hnita kerfisins. Þó að margvítt fræðilegt ferli sé Markov ferli, þá er ekki víst að mælingar einstakra hnita séu Markov ferli. Þetta atriði og fleiri gera umgengni við margvíð ferli vandasöm. Útfærslur á margvíðum kerfum kalla því á viðameiri uppsetningu en rúmast í þessari grein. Einnig blasir við að tíminn er tvívíð stærð. Aldur einstaklingsins og almanaksárið geta skipt máli. Það að taka tillit til þess eykur flækjustigið.

Heimildir

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Vinnumarkaður Vesturlands
Menntun og arðsemi

Vífill Karlsson
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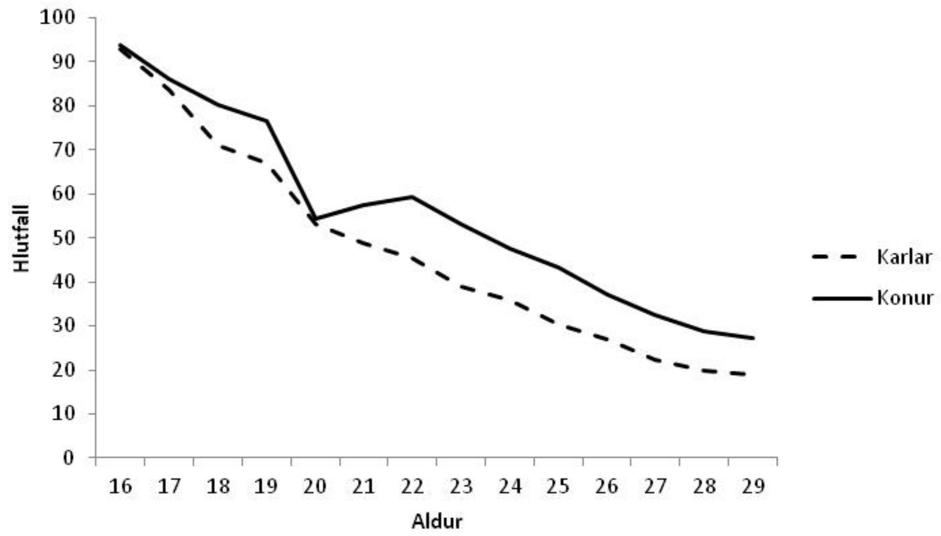
Er menntun metin að verðleikum á Vesturlandi? Margt bendir til þess að menntunarstig vinnuafls sé miklu lægra úti á landi en á höfuðborgarsvæðinu. Venjulega hefur það verið útskýrt með takmarkaðri tækifærum menntamanna þar. Felur það í sér að úrval starfa sé takmarkaðra, launin séu lægri eða jafnvel að launamunur sé lítill á milli faglærðra og ófaglærðra utan höfuðborgarsvæðisins?

Hagfræðistofnun Háskóla Íslands (2004) komst að þeirri niðurstöðu að framhalds- og háskólamenntun skilaði bæði einkaarðsemi og samfélagslegri arðsemi, en þó var grunnskólakennaramenntun ekki arðbær þegar greiningin var brotin upp. Þær fáu erlendu rannsóknir sem litið var til staðfesta svipaða tilhneigingu víða erlendis (Brunello og Comi, 2004; Quinn og Rubb, 2006).



Mynd 1. Skólasókn árganga 16–29 ára haustið 2008. Tölur Hagstofu Íslands

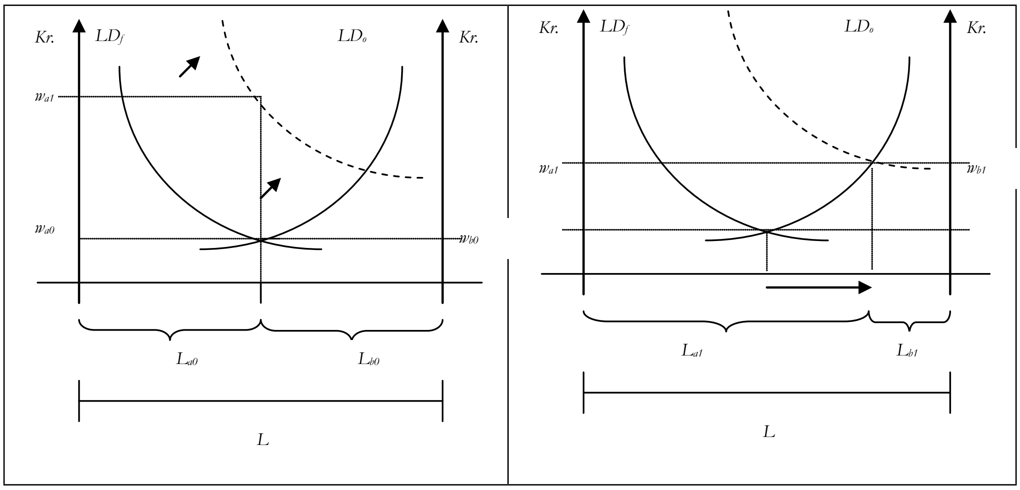
En hvers vegna eru 35% vinnumarkaðarins án formlegrar framhaldsskólamenntunar ef arðsemi hennar er svona mikil? Þetta hlutfall hefur vissulega farið lækkandi hérlendis, var 42% árið 1991. Langflestir (93%) hefja nám í framhaldsskóla að loknum grunnskóla á 16. ári en það kvarnast tiltölulega hratt úr hópnum (mynd 1). Hinsvegar eru eingöngu 50% 20 ára karla og kvenna í skóla sem er vísbending um hversu margir hefja háskólanám. Brottfall úr framhaldsskólum landsins skólaárið 2001-2002 var 20% samkvæmt þeim tölum sem til eru hjá Hagstofu Íslands.

Er þessa háa hlutfalls ófaglærðra á vinnumarkaði að leita í lágri arðsemi menntunar utan höfuðborgarsvæðisins? Þriðjungur þjóðarinnar býr þar, þrátt fyrir allt. Sjómenn og sumt landverkafólk hafa haft hærri laun en ýmsar stéttir faglærðra. Arðsemi menntunar fyrir landið allt kann að missa út blæbrigði sem þessi. Í þessari rannsókn verður horft til Vesturlands sem dæmi um samfélag utan höfuðborgarsvæðisins, en þar er flest það sem hún hefur að geyma: sjávarbyggðir, landbúnaðarhéruð og lítil samfélög með nokkuð blandað atvinnulíf.

Skýrsla þessi er unnin á grundvelli spurningakannanna Samtaka sveitarfélaga á Vesturlandi árin 2010 og 2007. Anna Steinsen, Guðný Anna Vilhelmsdóttir og Guðrún Ólafsdóttir komu að vinnslu kannananna ásamt höfundum.

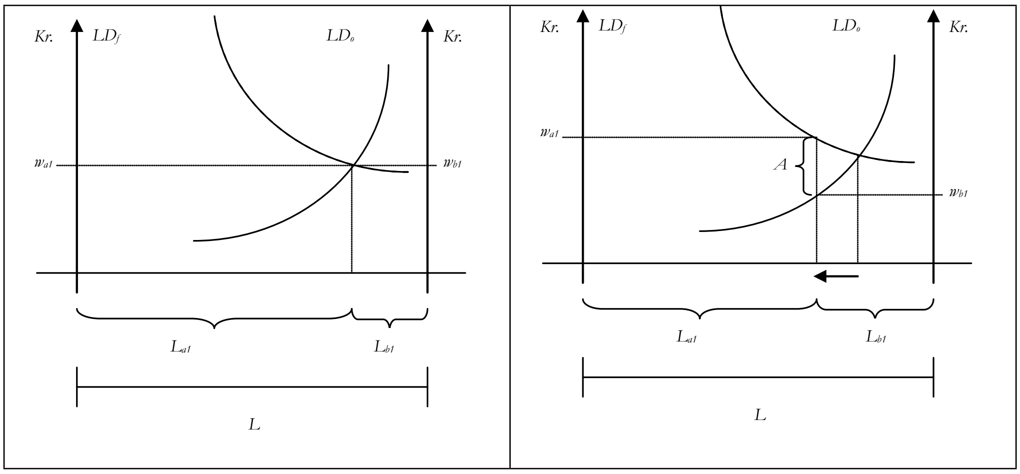
Fræðilegur bakgrunnur

Vinnumarkaður innanlands er ólíkur alþjóðlegum vinnumarkaði. Hreyfanleiki er gleggsta dæmið. Hann er meiri á vinnumarkaði milli svæða innanlands en milli landa vegna hindrana á borð við tungumál, menningarmun og upplýsingar um færni umsækjenda. Af þessum sökum ætti launamunur vera minni á milli svæða en landa. Gefum okkur hagkerfi tveggja svæða og beitum ójafnvægislíkaninu svokallaða. Ef framleiðni starfsgreinar eykst á einu svæði, eykst eftirspurn eftir vinnuafli (mynd 2, til vinstri). Við þetta verða laun hærri á svæðinu en sitja eftir á hinu. Þá flytur fólk til hálaunasvæðisins og laun lækka þar því framboð vinnuafls eykst vegna vaxandi samkeppni um störfin. Hinsvegar hækka launin á láglaunasvæðinu því framboð vinnuafls dregst saman. Fólksflutningarnir halda áfram á meðan launamunur er á milli svæðanna (McCann, 2001).



Mynd 2. Ójafnvægislíkanið

Út frá þessu hefur jafnvægislíkanið þróast. Samkvæmt því getur svæðisbundinn launamunur orðið viðvarandi. Þetta hefur verið útskýrt m.a. með tilvist staðbundins skynvirðis (*amenity value*). Það eru ýmis staðbundin gæði eða þægindi sem fást undir markaðsvirði (Kong, Yin og Nakagoshi, 2007) eins og gott veðurfar, falleg náttúra og friðsæld. Þá getur opinber þjónusta verið dæmi um það líka. Við þetta myndast langtíma jafnvægi þar sem launin verða lægri á því svæði sem hefur hærra skynvirði (*A* í mynd 3) (Greenwood, Hunt, Rickman og Treyz, 1991; McCann, 2001; Roback, 1982). Fyrirtæki sem staðsetja sig í borgum, greiða því „þéttbýlisálag" á laun vegna þess að skynvirði er oft lægra þar (Cohen og Paul, 2005).



Mynd 3. Jafnvægislíkanið með skynvirði (A)

A er árlegt jafnvirt núvirði skynvirðis. Þess vegna stöðvast búferlaflutningar þegar launamunurinn nær *A* og búseta á báðum svæðum því jafn mikils virði þegar tekið hefur verið tillit til launa og skynvirðis. Rannsóknir í Bandaríkjunum hafa sýnt fram á 19% (Yankow, 2006) og 25% (Glaeser og Mare, 2001) launamun milli þéttbýlis og strjálbýlis.

Stærðarhagkvæmni getur aukið framleiðni og þar með laun. Staðbundin stærðarhagkvæmni er venjulega kölluð samsöfnunarhagræði (*agglomeration economies*) og tengist ekki einstaka fyrirtækjum með beinum hætti, heldur hefur áhrif á öll fyrirtæki innan ákveðins svæðis (McCann, 2001). Segja má að samsöfnunarhagræði sé ávinningur af staðsetningu og byggir á lækkun flutningakostnaðar í breiðum skilningi (Glaeser, 2010). Þéttbýlið eykur framleiðni fyrirtækja vegna lægri flutningskostnaðar og talin ein helsta skýring þéttbýlismyndunar (Glaeser og Mare, 2001). Þetta sjáum við m.a. á bæði ójafnvægis- og jafnvægilíkaninu, þar sem samsöfnunarhagræði flytur eftirspurnarferilinn stöðugt út til hægri (mynd 2 til vinstri).

Samsöfnunarhagræði er skipt í tvo flokka:

> *Staðbundið samsöfnunarhagræði* þegar meðalkostnaður fyrirtækja lækkar vegna nábýlis við fyrirtæki í sömu atvinnugrein og *þéttbýlis samsöfnunarhagræði* þegar meðalkostnaður fyrirtækja lækkar vegna nábýlis við fyrirtæki í öðrum atvinnugreinum og er rakið til þriggja megin þátta; upplýsingaleka, staðbundinna aðfanga og aðgengi að sérhæfðu vinnuafli (McCann, 2001).

Gould (2007) telur að ef búseta í þéttbýli geri einstakling að einhverju leyti samkeppnishæfari, t.d. í gegnum þekkingarleka, ættu starfsmenn borga að geta flutt hæfni og þekkingu til strjálbýlis, a.m.k að hluta. Rannsókn (Cingano, 2003) var gerð á hvort hæfileikar starfsmanna aðrir en þeir sem teljast mjög almennir eða hæfileikar sem teljast mjög sérhæfðir væru metnir í launum. Hún sýndi að sérhæfð þekking var mikils metin, almenn starfsreynsla ekki en starfslengd innan sama fyrirtækis virtist skýra launahækkanir að mestu.

Launamunur milli þéttbýlis og strjálbýlis virðist vera minni hjá verkamönnum en hjá sérmenntuðum. Í strjálbýli er starfsreynsla sérmenntaðra meira metin ef hún er úr borgum en strjálbýli en enginn munur er á þessu gagnvart verkamönnum. Því má ætla að borgir veiti fólki verðmæta starfsreynslu sem eykur framleiðni þeirra og að það geti verið skynsamlegt fyrir sérmenntaða að flytja til borgarinnar þó það væri ekki nema til að fjárfesta í henni (Gould, 2007).

Fyrirtæki sem vilja starfa í þéttbýli og greiða hærri laun hljóta að gera það annaðhvort vegna lægri framleiðslukostnaðar, t.d. vegna lægri flutningskostnaðar eða hærri tekna t.a.m. vegna meiri þekkingarleka milli fyrirtækja eða hærra vöruverðs. Einstaklingar velja sér búsetu þar sem afkoman er best – þ.e. há laun að teknu tilliti til framfærslukostnaðar og skynvirðis (Glaeser og Mare, 2001).

Samkvæmt Carter (1998) hækka tekjur einstaklinga við flutning úr dreifbýli í þéttbýli jafnvel þótt atvinnuleysi sé til staðar í þéttbýlinu. Afleiðing þessa í mörgum löndum er að munurinn milli svæðisbundins atvinnuleysisstigs hefur tilhneigingu til að minnka þegar hagkerfi landsins alls stækkar og aukast þegar hagkerfið dregst saman (McCann, 2001). Carter sagði líka launahækkanir í þéttbýli smiti yfir í strjálbýli. Skýringa á af hverju laun eru hærri í þéttbýli er að finna í kenningum um framfærslukostnað (Gould, 2007) og skynvirði: Í þéttbýli eru almennt verðlag og húsnæðiskostnaður hærri en skynvirði lægra og munur þá á velferð íbúa þéttbýlis og dreifbýlis nánast enginn.

Fræðimenn hafa skipt fyrirtækjum og staðbundnum vinnumörkuðum upp á milli þjónustu og útflutnings: þeirra sem hafa tekjur sínar af heimamönnum og íbúum utan svæðisins (Glendon og Vigdor, 2003; McCann, 2001). Staðbundin launalækkun minnkar launakostnað fyrirtækja en dregur líka úr staðbundinni neyslu og slær því á eftirspurn þjónustufyrirtækja og lækkar þar með tekjur þeirra en ekki útflutningsfyrirtækja. Áhrif launabreytinga eru því augljóslega mismunandi á útflutnings- og þjónustufyrirtæki og svæðisbundin áhrif ráðast því af vægi þeirra á svæðinu (McCann, 2001).

Gögn og aðferð

Rannsóknin byggir á spurningakönnun sem framkvæmd var meðal íbúa á Vesturlandi. Vesturlandi var skipt upp í fjögur svæði: Akranes og Hvalfjarðarsveit mynduðu eitt svæði, Borgarbyggð og Skorradalshreppur annað, kallað Borgarfjörður. Sveitarfélagið Dalabyggð myndaði Dali en önnur Snæfellsnes (tafla 1).

Tilviljunarkennt úrtak var tekið úr þjóðskrá. Úrtakið var á meðal allra íbúa sem náð höfðu 18 ára aldri. Reynt var að hafa úrtakið nægjanlega stórt til þess að svörunin endurspeglaði viðhorf íbúanna á viðkomandi svæðum með nokkuð áreiðanlegum hætti (tafla 1).

Tafla 1. Yfirlit úrtaks og þýðis 2007

Svæði	Sveitarfélög	Mannfjöldi 1. des 2007	18 ára +	Úrtak	Svör	Svarhlutfall
Akranes og Hvalfjörður	Akranes og Hvalfjarðarsveit	7.028	5.085	420	142	33,8%
Borgarfjörður	Borgarbyggð og Skorradalshreppur	3.802	2.748	400	143	35,8%
Snæfellsnes	Eyja- og Miklaholtshreppur, Snæfellsbær, Grundarfjarðarbær, Helgafellssveit og Stykkishólmsbær	3.912	2.891	400	131	32,8%
Dalir	Dalabyggð	710	538	275	90	32,7%
Óskilgreint					37	
Vesturland		15.452	11.262	1495	543	36,3%

Endanlegt svarhlutfall var í kringum 36% (tafla 1). Vægi svara var í nokkru samræmi við vægi úrtaks, nema helst í Borgarfirði þar sem það var heldur hærra og á Snæfellsnesi heldur lægra. Skipting svarenda eftir kyni, uppruna og aldri hefði geta endurspeglað betur hina raunverulegu dreifingu á viðkomandi svæðum á Vesturlandi. Það verður að hafa í huga við túlkun svara. Þrátt fyrir þennan galla má segja að svörin endurspegli viðhorf á viðkomandi svæðum með viðunandi hætti. Niðurstöður fyrir árið 2010 voru mjög svipaðar (tafla 2).

Tafla 2. Yfirlit úrtaks og þýðis 2010

Svæði	Sveitarfélög	Mannfjöldi 1. des 2010	18 ára +	Úrtak	Svör	Svarhlutfall
Akranes og Hvalfjörður	Akranes og Hvalfjarðarsveit	7.212	5.212	420	162	38,6%
Borgarfjörður	Borgarbyggð og Skorradalshreppur	3.575	2.646	400	167	41,8%
Snæfellsnes	Eyja- og Miklaholtshreppur, Snæfellsbær, Grundarfjarðarbær, Helgafellssveit og Stykkishólmsbær	3.919	2.94	400	137	34,3%
Dalir	Dalabyggð	698	524	275	77	32,6%
Óskilgreint					13	
Vesturland		15.404	11.322	1435	556	37,6%

Upp úr þessari könnun voru unnin gögn sem hentuðu til línulegrar aðhvarfsgreiningar. Skýristærðin var heildarlaun en svarendur gáfu ekki allir upp laun eins og við var að búast. Þátttakendur svöruðu eftirfarandi spurningu: Hverjar eru heildartekjur heimilisins fyrir skatta á mánuði? Innan sviga var síðan sett; „Allar launatekjur, lífeyrir, námslán og atvinnuleysisbætur en ekki barnabætur eða aðrar félagslegar bætur“. 431 af 543 (460 af 556 2010) svöruðu spurningunni. Samkvæmt svörunum voru tekjur 257 þ.kr. (330 árið 2010) að jafnaði á mánuði og staðalfrávikið 155 (266 árið 2010) sem gefur til kynna að launin séu verulega breytileg frá einum svarenda til annars (tafla 2).

Tafla 3. Lýsing á gögnum

Breyta	Lýsing	Meðaltal 2007	Staðalfrávik 2007	Meðaltal 2010	Staðalfrávik 2010
Tekjur	Heildartekjur fyrir skatta á mánuði í þúsundum króna	256,91	155,48	330,21	265,64
Stutt framhaldsnám	Próf af styttri námsbrautum framhaldsskóla, leppbreyta	0,19	0,39	0,21	0,40
Iðngrein	Próf í iðngrein, leppbreyta	0,16	0,36	0,16	0,36
Stúdentspróf	Leppbreyta	0,07	0,25	0,10	0,30
Háskólapróf	Háskólanám (fyrsta háskólagráða), leppbreyta	0,18	0,39	0,19	0,40
Háskólapróf - master	Framhaldsnám á háskólastigi (meistaragráða, doktorsgráða eða sambærilegt), leppbreyta	0,03	0,18	0,08	0,27
Skipstjórapróf	Leppbreyta	0,02	0,15		
Búseta sveitarfélagi	Hve mörg ár búið í sveitarfélagi	31,23	21,49	29,62	19,65
Fæðingarland	Þrír möguleikar: Ísland (1), Evrópa (2), og utan Evrópu (3).	1,03	0,18	0,03	0,16
Fjöldi barna	0-5	0,93	1,15	1,14	1,26
Hjúskaparstaða	Leppbreyta, 1 fyrir einhleypa	1,20	0,40	0,79	0,41
Svæði	Vesturlandi skipt upp í 4 svæði, 1 fyrir svæði næst höfuðborgarsvæðinu	2,34	1,06	2,24	1,03
Kyn	Leppbreyta, 1 fyrir konur	1,51	0,50	0,54	0,50
Atvinnurekandi	Leppbreyta	0,15	0,35	0,13	0,34
Nemi	Leppbreyta	0,06	0,25	0,08	0,27
Atvinnulaus	Leppbreyta	0,01	0,09	0,03	0,16
Öryrki	Leppbreyta	0,03	0,16	0,04	0,20
Ellilífeyrisþegi	Leppbreyta	0,15	0,36	0,08	0,27
Annað á vinnumarkaði	Leppbreyta	0,03	0,16	0,04	0,20
Símenntun	Fjórir möguleikar: Aldrei (0), 1-3 daga (1), 4-7 daga (2), meira en 7 daga (3)	1,29	1,33	1,19	1,28
Aldur	Sex möguleikar: 18-24 ára (1), 25-34 (2), 35-44 (3), 45-54 (4), 55-64 (5) og 65 ára og eldri (6)	3,82	1,54	46,97	14,77

Flestar skýribreytur voru leppbreytur. Þær breytur sem ekki voru leppbreytur voru búseta í sveitarfélagi, fjöldi barna, svæði, símenntun og aldur (tafla 3). Búseta í sveitarfélagi er talin í fjölda ára. Þarna er verið að reyna að meta hugsanleg áhrif kunningjasamfélagsins. Ef þessi breyta verður marktæk og með jákvæðu formerki er það vísbending um að þeir sem hafa búið lengi í sveitarfélaginu og þekkja betur íbúana eigi meiri möguleika á að fá hærri laun vegna kunningsskapar eingöngu. Þessi breyta gæti líka verið að endurspegla starfsreynslu og eins að upplýsingar um færni og getu viðkomandi séu betri.

Breytuna fyrir fjölda barna þarf ekki að útskýra í smáatriðum. Breytan yfir svæði tók mið af fjarlægð frá höfuðborgarsvæðinu; svæðið sem stóð næst fékk gildið 1 og svo hækkaði það í 2, 3 og 4 eftir því sem fjær dró.

Í könnunni var spurt hvort viðmælandi hefði sótt eða varið tíma í sí- og endurmenntun, t.d. í formi námskeiða, fyrirlestra, formlegs náms o.s.frv. á sl. tveimur árum. Breytan yfir símenntun fékk gildið 0 ef svarið var neitandi, 1 ef svarið var játandi og 1-3 daga, 2 ef það voru 4-7 dagar og 4 ef það voru meira en 7 dagar.

Breytan fyrir aldur hljóp á sex tölugildum; 1 fyrir þá sem voru 18-24 ára , 2 fyrir 25-34 ára, 3 fyrir 35-44 ára, 4 fyrir 45-54 ára, 5 fyrir 55-64 ára og 6 fyrir 65 ára og eldri.

Líkan og niðurstöður

Framkvæmd var hefðbundin línuleg aðhvarfsgreining á gögnunum. Líkanið sem ég prófaði var með eftirfarandi hætti:

$$\ln T = \alpha + x_i'\beta$$

Þar sem logaritminn af tekjum, $ln\,T\,ln\,T$, var skýrður með fjölda mismunandi skýribreyta, $x_i' x_i'$ eins og sjá má í töflu 2 hér að ofan. Engin marglínuleiki var til staðar. Misdreifni var hinsvegar vandamál og þá var keyrslan endurtekin með veginni aðferð minnstu kvaðrata (*weighted least square*). Innri fylgni (*endogeneity*) var ekki verið prófuð vegna upplýsingaskorts. Niðurstaðan er með eftirfarandi hætti:

Tafla 4. Niðurstöður greiningarinnar fyrir árið 2007

Breyta	Stuðull	Staðal-frávik	t-gildi	p-gildi	95% neðri vikmörk	95% efri vikmörk
Stutt framhaldsnám	0,021	0,063	0,34	0,735	-0,102	0,145
Iðngrein	0,147	0,073	2,03	0,043	0,004	0,290
Stúdentspróf	0,170	0,096	1,78	0,077	-0,018	0,358
Háskólapróf	0,359	0,069	5,25	0,000	0,225	0,494
Háskólapróf - master	0,529	0,144	3,67	0,000	0,245	0,812
Skipstjórapróf	0,352	0,152	2,32	0,021	0,054	0,651
Búseta sveitarfélagi	-0,002	0,001	-1,36	0,174	-0,005	0,001
Fæðingarland	-0,334	0,115	-2,89	0,004	-0,561	-0,107
Fjöldi barna	0,006	0,022	0,25	0,801	-0,038	0,049
Hjúskaparstaða	0,027	0,062	0,43	0,668	-0,095	0,148
Svæði	-0,053	0,022	-2,46	0,015	-0,096	-0,011
Kyn	-0,454	0,048	-9,54	0,000	-0,548	-0,361
Atvinnurekandi	-0,047	0,069	-0,68	0,495	-0,184	0,089
Nemi	-0,899	0,109	-8,26	0,000	-1113	-0,685
Atvinnulaus	1102	0,201	-5,50	0,000	-1497	-0,708
Öryrki	-0,601	0,128	-4,68	0,000	-0,854	-0,349
Ellilífeyrisþegi	-0,663	0,086	-7,71	0,000	-0,832	-0,494
Annað á vinnumarkaði	-0,461	0,163	-2,82	0,005	-0,783	-0,140
Símenntun	0,033	0,018	1,84	0,066	-0,002	0,067
Aldur	0,032	0,024	1,35	0,178	-0,015	0,080
Fasti	6,451	0,183	35,33	0,000	6,092	6,810

Leiðrétt $R^2 R^2$ var 0,50, sem er mjög ásættanleg fylgni. Þegar horft var til menntunar kom í ljós að fólk hefur fengið umbun fyrir hana á vinnumarkaði Vesturlands. Þetta átti við um iðnmenntun grunngráðu frá háskóla, meistaragráðu frá háskóla og skipstjórnarpróf. Þeir sem höfðu iðnmenntun voru með 15% hærri laun en ófaglærðir, grunngráðu frá háskóla 37% og meistaragráðu 53%. Þá höfðu einstaklingar með skipstjórnarréttindi 35% hærri laun en ófaglærðir. Þá má segja að þeir sem höfðu stúdentspróf sýndu veik merki um umbun sem nemur 17% hærri launum en ófaglærðir höfðu. Stutt framhaldsnám virtist ekki skila sér í launaumslagið með marktækum hætti.

En hvað getum við sagt um arðsemi menntunar út frá þessu? Er þessi launamunur nægur til að borga tilkostnað við menntunina? Ráðist var í útreikninga á arðsemi iðnnema, stúdenta og háskólanema með grunngráðu. Ekki var gerð tilraun til að meta arðsemi meistaragráðu á háskólastigi vegna þess hve fáir svarendur voru með það próf. Vinnutap er hæsti einstaki kostnaðarliður nemanda (og samfélagsins) við nám. Vinnutap iðnnema og stúdenta felst því í launum ófaglærðra. Þau laun voru að jafnaði 210 þ.kr. á mánuði samkvæmt könnuninni. Vinnutap háskólanemenda eru laun stúdenta – þ.e. næsta námsstig á undan. Þau voru 17% hærri en laun ófaglærðra eins og áður sagði. Að auki var gert ráð fyrir 4% afvöxtunarstuðli, námskostnaði í framhaldsskólum upp á 50 þ.kr. á ári en 100 þ.kr. hjá háskólanema og að iðnnemar væru 3 ár á skólabekk að jafnaði og hefðu 90% af launum verkamanns í eitt ár á meðan þeir lykju nauðsynlegri starfsreynslu Ekki var gert ráð fyrir að nemandinn tæki sér frí á milli námsstiga. Á grundvelli þessa var arðsemi iðnnáms neikvæð um 15%, stúdentsprófs neikvæð um 20% og háskólanáms jákvæð um 4%[1].

Tafla 5. Niðurstöður greiningarinnar fyrir árið 2010

Breyta	Stuðull	Staðal-frávik	t-gildi	p-gildi	95% neðri vikmörk	95% efri vikmörk
Stutt framhaldsnám	0,110	0,08	1,43	0,16	-0,04	0,26
Iðngrein	0,093	0,09	1,07	0,28	-0,08	0,26
Stúdentspróf	0,153	0,09	1,62	0,11	-0,03	0,34
Háskólapróf	0,514	0,08	6,48	0,00	0,36	0,67
Háskólapróf - master	0,564	0,11	5,28	0,00	0,35	0,77
Skipstjórapróf	0,726	0,17	4,16	0,00	0,38	1,07
Búseta sveitarfélagi	0,000	0,00	-0,26	0,79	0,00	0,00
Fæðingarland	-0,240	0,17	-1,42	0,16	-0,57	0,09
Fjöldi barna	0,043	0,02	1,95	0,05	0,00	0,09
Hjúskaparstaða	-0,052	0,07	-0,77	0,44	-0,19	0,08
Svæði	-0,021	0,03	-0,82	0,41	-0,07	0,03
Kyn	-0,396	0,05	-7,36	0,00	-0,5	-0,29
Atvinnurekandi	-0,104	0,08	-1,38	0,17	-0,25	0,04
Nemi	-0,967	0,11	-8,84	0,00	-1,18	-0,75
Atvinnulaus	-0,417	0,15	-2,76	0,01	-0,71	-0,12
Öryrki	-0,269	0,13	-2,13	0,03	-0,52	-0,02
Ellilífeyrisþegi	-0,350	0,11	-3,32	0,00	-0,56	-0,14
Annað á vinnumarkaði	0,119	0,15	0,81	0,42	-0,17	0,41
Símenntun	0,028	0,02	1,39	0,17	-0,01	0,07
Aldur	0,000	0,00	-0,11	0,91	0,00	0,00
Fasti	12,679	0,11	113,43	0,00	12,46	12,9

Árið 2010 var könnunin endurtekin og spurningum fjölgað til þess að ná fram raunhæfara líkani. Fyrst var líkan keyrt, sambærilegt því sem keyrt var árið 2007. Fylgnin var ásættanleg (leiðrétt R^2R^2 0,40). Fjöldi athugana var 400. Nú virtist arðsemi háskólaprófs hafa aukist en iðnmenntunar lækkað og jafnvel stúdentsprófs lítið eitt.

Þá var líkanið keyrt með öllum viðeigandi breytum sem völ var á fyrir könnunina 2010 (tafla 6). Þær sem bættust við voru þættir yfir atvinnugreinar, starfsgreinar og fjarlægð til og frá vinnu.

[1] Samkvæmt innri vaxtaaðferðinni ber iðnnám 3,2% afvöxtunarstuðul (eða arðsemiskröfu), stúdentspróf 3,0% og háskólanám 4,2%.

Tafla 6. Niðurstöður ýtarlegri greiningar fyrir árið 2010

Breyta	Stuðull	Staðal-frávik	t-gildi	p-gildi	95% neðri vikmörk	95% efri vikmörk
Stutt framhaldsnám	0,021	0,06	0,32	0,75	-0,10	0,15
Iðngrein	-0,112	0,08	-1,37	0,17	-0,27	0,05
Stúdentspróf	0,045	0,08	0,56	0,58	-0,11	0,20
Háskólapróf	0,342	0,08	4,28	0,00	0,18	0,50
Háskólapróf - master	0,376	0,10	3,82	0,00	0,18	0,57
Skipstjórapróf	0,175	0,15	1,20	0,23	-0,11	0,46
Búseta sveitarfélagi	-0,001	0,00	-1,06	0,29	0,00	0,00
Fæðingarland	-0,258	0,15	-1,67	0,10	-0,56	0,05
Fjöldi barna	0,023	0,02	1,23	0,22	-0,01	0,06
Hjúskaparstaða	-0,098	0,06	-1,70	0,09	-0,21	0,02
Svæði	-0,030	0,02	-1,37	0,17	-0,07	0,01
Kyn	-0,377	0,05	-7,06	0,00	-0,48	-0,27
Atvinnurekandi	-0,070	0,07	-1,00	0,32	-0,21	0,07
Nemi	-0,298	0,12	-2,47	0,01	-0,54	-0,06
Atvinnulaus	-0,406	0,17	-2,44	0,02	-0,73	-0,08
Öryrki	-0,165	0,14	-1,20	0,23	-0,43	0,11
Ellilífeyrisþegi	-0,149	0,13	-1,11	0,27	-0,41	0,12
Annað á vinnumarkaði	0,356	0,19	1,89	0,06	-0,02	0,73
Símenntun	0,020	0,02	1,18	0,24	-0,01	0,05
Aldur	0,000	0,00	-0,47	0,64	0,00	0,00
Fjarlægð til vinnu	0,001	0,00	1,84	0,07	0,00	0,00
Landbúnaður	-0,218	0,08	-2,61	0,01	-0,38	-0,05
Fiskveiðar	0,448	0,09	5,01	0,00	0,27	0,62
Fiskvinnsla	0,251	0,12	2,02	0,05	0,01	0,50
Annar iðnaður	0,140	0,08	1,77	0,08	-0,02	0,30
Veitur	0,361	0,22	1,67	0,10	-0,06	0,79
Mannvirkjagerð	0,135	0,12	1,11	0,27	-0,11	0,38
Verslun	0,050	0,09	0,57	0,57	-0,12	0,22
Hótel	-0,154	0,17	-0,91	0,37	-0,49	0,18
Flutningar	-0,022	0,13	-0,17	0,87	-0,27	0,23
Fjármál	0,236	0,12	1,90	0,06	-0,01	0,48
Viðskipti	0,359	0,36	1,00	0,32	-0,35	1,07
Opinber stjórnsýsla	0,148	0,10	1,52	0,13	-0,04	0,34
Fræðsla	-0,131	0,07	-1,77	0,08	-0,28	0,01
Heilbrigðisþjónusta	0,114	0,07	1,65	0,10	-0,02	0,25
Önnur þjónusta	-0,051	0,09	-0,56	0,58	-0,23	0,13
Stjórnandi	0,165	0,07	2,40	0,02	0,03	0,30
Sérfræðingur	0,094	0,07	1,26	0,21	-0,05	0,24
Tæknir	0,054	0,14	0,37	0,71	-0,23	0,34
Skrifstofumaður	-0,039	0,08	-0,46	0,64	-0,21	0,13
Afgreiðslumaður	-0,035	0,08	-0,45	0,65	-0,19	0,12
Iðnaðarmaður	-0,023	0,10	-0,23	0,82	-0,22	0,17
Verkamaður	-0,112	0,07	-1,52	0,13	-0,26	0,03
Starfsreynsla	0,001	0,00	0,62	0,54	0,00	0,01
Lágmarkslaun	-0,846	0,09	-9,22	0,00	-1,03	-0,67
Fasti	12837	0,12	107,11	0,00	12,60	13,07

Við þetta breyttist leiðrétt R^2R^2 í 0,62, sem er enn ásættanlegri fylgni. Fjöldi athugana var 305. Engin samfylgni var til staðar. Misdreifni ekki heldur eins og Breuch-Pagan/ Cook Weisberg próf staðfesti með gildi upp á 1,78. Þegar horft var til menntunar mátti greina að marktækur munur væri eingöngu á milli ófaglærðra og háskólamanna. Þeir sem höfðu þriggja ára háskólapróf voru með 34% hærri laun en ófaglærðir. Þeir sem höfðu fimm ára háskólapróf (meistarapróf o.þ.h.) voru með tæplega 38% hærri laun en ófaglærðir. Þetta skilaði fyrri hópnum 8,2% arðsemi en arðsemin var neikvæð um 2,6% hjá seinni hópnum.

Sambærileg arðsemi kom fram í skýrslu Hagfræðistofnunar (2004) fyrir einstaklinga með þriggja ára háskólapróf en lægri fyrir aðra menntun: Einkaarðsemi háskólamenntunar rúmlega 8% (karlar 5,5% og konur 10,8%) framhaldsskólamenntunar tæplega 6% (karlar 7,2% og konur 4,2%). Niðurstöðurnar voru því á vissan hátt vonbrigði og áhyggjuefni fyrir menntun Vestlendinga; lág arðsemi fælir frá.

Fleira athyglisvert kom fram í íbúakönnuninni og í samræmi við væntingar og niðurstöður annarra rannsókna. Þar sem tekinn var logaritminn af háðu breytunni, heildartekjum, var auðvelt að túlka niðurstöður. Þeir sem störfuðu í landbúnaði voru með 22% lægri atvinnutekjur að jafnaði en sambærilegir starfsmenn í öðrum atvinnugreinum. Hins vegar voru sjómenn með 45% hærri tekjur og þeir sem unnu í fiskvinnslu 25% hærri en sambærilegur starfskraftur í öðrum greinum. Þá voru stjórnendur með 16% hærri tekjur en fólk í öðrum störfum og nemendur og atvinnulausir með marktækt lægri „laun“ en ófaglærðir.

Enn fremur kom fram veikari marktækni (10% marktektarkrafa í stað 5%) fáeinna annarra áhrifaþátta: Þeir sem voru í öðrum iðnaði voru með 14% hærri tekjur, veitustarfsmenn 36%, starfsmenn fjármálafyrirtækja 24%, heilbrigðisstarfsmenn 11% en kennarar (kennsla/fræðsla) með 13% lægri tekjur en sambærilegur starfskraftur í öðrum atvinnugreinum. Einnig kom fram að einhleypir voru með 10% lægri laun en fólk í sambúð. Fólk sem fætt var utan Íslands var með 26% lægri laun.

Athyglisvert var að sjá að þeir sem sóttu vinnu um langan veg virtust við það ná að hækka tekjur sínar að einhverju leyti. Það sást á því að áhrifaþátturinn fjarlægð frá vinnu skilar veikri marktækni upp á 0,001: Tekjur hækka því um 0,1% fyrir hvern kílómetra sem vinnustaðurinn fjarlægist heimili viðkomandi.

Þá mældust konur með 38% lægri laun en karlar. Bent skal á að galli er á rannsókninni þar sem ekki var leiðrétt fyrir vinnuframlag, en ætla má að vinnuframlag kynjanna sé mismunandi. Þessi munur hefði því átt að vera eitthvað lægri. Það er því verkefni framhaldsrannsóknar að bæta starfshlutfalli þátttakenda við.

Aðrir þættir stóðust ekki kröfur um marktækni um áhrif á þróun launa. Þó voru formerki flestra stuðlanna í samræmi við væntingar: Þeir sem tóku námskeið hjá sí- eða endurmenntun voru með hærri laun en þeir sem gera það ekki, þeir sem áttu fleiri börn hærri tekjur en þeir sem áttu færri og laun lægri eftir því sem fjær dregur höfuðborgarsvæðinu, svo eitthvað sé nefnt.

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Growth of intangible assets by industry in Iceland 2003-2009

Þórólfur Matthíasson[1]

Most firms need to spend some money on research and development (R&D) in order to survive in a competitive and dynamic environment. If well spent R&D expenditure will eventually result in increased market value of the firm. If the firm is publicly traded its market value will exceed its book value. If the firm is not traded on the stock market the value of intangible assets will only become visible as the firm is merged with other firms or if it goes from one set of owners to others. Then the difference between the price of the firm and the book value of its assets is registred as good-will or some other form of intangible assets. Valuation of intangible assets is by nature more subjective than valuation of tangible assets. Intagible assets are more common in some industries than others. Hence it is interesting to see the development of R&D expenditure and of size of intangible assets by industry through out the boom and bust cycle of the Icelandic economy.

In-tangible assets by industry

Table 1 gives non-tangible assets as percentage of total assets in selected Icelandic industries for the period 2003 to 2007. Table 2.2 gives the same for the years 2008 and 2009. Note that the industry classification has been changed in the interim.

[1] Jón Skafti Gestsson contributed with able help in preparing the text and collecting data.

Table 1. Intangible assets by industry, 2003 to 2007 (Icelandic Tax Authority)

Industry (selected)	2003	2004	2005	2006	2007
Agriculture and forestry	4,6%	4,0%	3,7%	3,5%	3,5%
Fishing	22,0%	25,3%	29,0%	35,3%	34,9%
Food, beverages and tobacco	16,4%	22,7%	28,9%	23,7%	31,0%
Textiles	0,7%	1,6%	2,0%	9,5%	9,0%
Leather	46,1%	44,6%	42,4%	0,0%	0,0%
Paper industry and publication	3,8%	8,5%	9,4%	8,0%	10,4%
Chemical industry	10,6%	2,9%	2,3%	2,0%	1,8%
Plastics	0,4%	0,3%	1,2%	0,9%	7,1%
Glass	3,2%	10,6%	4,8%	4,5%	7,0%
Motors	3,4%	4,7%	7,6%	29,6%	25,7%
Electricity and electronics	10,9%	10,3%	4,6%	7,7%	1,2%
Electricity production and distribution	19,1%	1,0%	0,1%	0,6%	1,2%
Building industry	1,7%	0,7%	0,4%	0,3%	0,2%
Wholesale and retailing	6,9%	9,2%	9,6%	8,9%	10,6%
Communication	5,5%	3,0%	28,3%	25,4%	20,1%
Education	2,8%	2,6%	1,0%	16,7%	11,7%
Other service activities	8,9%	11,4%	9,0%	7,3%	7,5%
Unspecific activity		14,9%	4,6%	2,4%	34,2%

Fishing quotas constitute a big share of the intangible assets in fishing. The tax-code stipulates that asset value of quota can only be booked if the quota has been paid for. Quotas were grandfathered into the fisheries during the period of 1984 to 1990. Hence value of quotas can only enter the asset side of the accounts if bought or if the firm has been subject to merger and acquisition. We see that value of intangible assets in fishing increases from 22% of total assets in 2003 to 35% in 2007 which is consistent with widespread management buy-out activity in the industry during this period. We see big fluctuations in the ratio of non-tangible to total-assets in many other industries. That might also reflect the results of merger and acquisation in those industires. Some of the oldest and most respected firms in Iceland were transformed into holding companies (Shipping companies and airliner). The driver behind increases in ratio of intangible assets to total assets was not stipulations of the tax-code as in the case of the fishing firms. The driver was rather the bubble-driven assumed increase in the value of intangible assets of those firms.

Table 2. Intangible assets by industry, 2008 and 2009

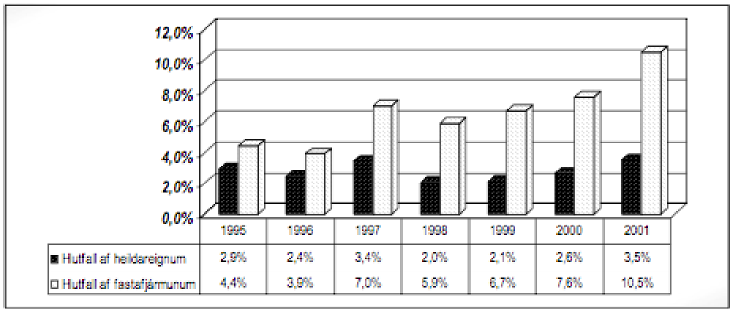
Industry	2008	2009
AGRICULTURE, FORESTRY AND FISHING	30,2%	30,0%
MINING AND QUARRYING	1,6%	5,2%
MANUFACTURING	11,8%	11,8%
ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	2,0%	2,0%
WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	5,1%	4,8%
CONSTRUCTION	3,6%	1,4%
WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES	9,2%	11,0%
TRANSPORTATION AND STORAGE	2,4%	4,0%
ACCOMMODATION AND FOOD SERVICE ACTIVITIES	2,5%	2,0%
INFORMATION AND COMMUNICATION	34,4%	39,3%
PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES	1,5%	1,5%
ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	6,2%	9,5%
EDUCATION	5,6%	4,6%
HUMAN HEALTH AND SOCIAL WORK ACTIVITIES	0,7%	0,6%
ARTS, ENTERTAINMENT AND RECREATION	10,6%	11,2%
OTHER SERVICE ACTIVITIES	1,3%	1,1%
UNSPECIFIED ACTIVITY	18,5%	16,3%

Table 2 reflects the same trend as table 1. Note that Agriculture and fisheries are now treated as one category.

One can envision a realignment of valuation of intangible assets in the vake of the restructuring of the balance-sheets of Icelandic firms that follows the collapse of the financial system in 2008 and the pursuing sharp devaluation of the krona. Such changes will reflect a real devaluation of goodwill and other intangible assets.

In-tangible assets and the collapse of the financial sector

Einar Guðbjartsson (2003) looked at development of intangible assets of publicly traded firms during the period 1995 to 2001. He did summarize his findings in the following diagram. The black columns show the size of intangible assets as percentage of total assets in stock-exchange registered firms in Iceland



Mynd 1. Hlutfall óefnislegra eigna – miðað við 31. desember ár hvert

Figure 1. Intangible assets as percentage of total assets (black columns) and fixed assets (white column) at end of each year

The figure shows that in-tangible assets were in the range of 2 to 3,5% of total assets during the decade prior to the rise of the Icelandic financial bubble.

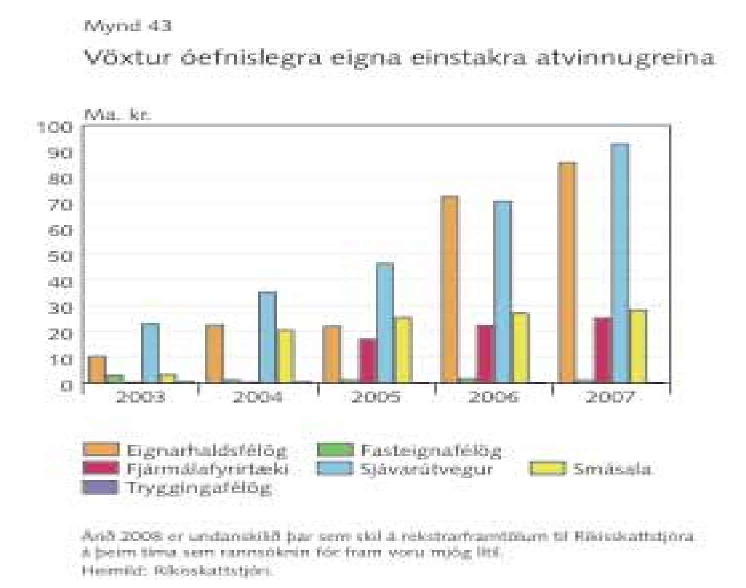


Figure 2. Growth of intangible assets by type of activity, Holding comapanies (Eignarhaldsfélög), Real estate (Fasteignafélög), Financial institutions (Fjármálafyrirtæki), Fishing (Sjávarútvegur), Retail (Smásala), Insurance (Tryggingarfélög)

Figure 2 is reproduced from the report of the Special Investigation Commission of Althingi on the events leading up to the fall of the Icelandic banks in October 2008. The figure indicates a dramatic growth of intangible assets in Holding companies and in fishing companies during the period. Intangible assets of financial companies starts to grow from 2005 and onwards.

Few conclusion

It seems fair to conclude that growth of intangible assets has helped to fuel the financial bubble that engulfed the Icelandic economy and collapsed in 2008. Growth of the item intangible assets on balance sheets of both listed and non-listed companies on the stock exchange seems to be one of the indicators of a bubble in the economy.

Intangible assets can in some cases be written off (does not apply to booked value of fishing quotas in the Icelandic legislature). Hence, inflating the size of that assets-post can prove favourable with respect to the size of the tax bill. There are therefore considerable public interest in avoiding overblown size of that asset post.

Heimildir

Einar Guðbjartsson. (2003). Þróun óefnislegra eigna á íslenska hlutabréfamarkaðnum á árunum 1995 til 2001. Í Ingjaldur Hannibalsson (ritstjóri), *Rannsóknir í félagsvísindum IV: Viðskiptafræðideild* (bls. 97-114). Reykjavík: Háskólaútgáfan.