Intergenerational Earnings Mobilities – How Sensitive are they to Income Measures?

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This article gives various estimates of intergenerational earnings mobility by applying different earning periods, age brackets, and earning components. The methodology enables us to investigate how sensitive results are to different delimitations and, thereby, to make more accurate international comparisons of intergenerational earnings mobility. We find that intergenerational earnings mobility is found to be substantially lower when hourly wage rates rather than annual earnings are used, whether the latter are inclusive or exclusive of public transfers. Moreover, when the same specifications are applied for Denmark as for other countries, we find that intergenerational earnings mobility from father to son in Denmark is on the same level as in Sweden, Norway, and Finland, whereas the intergenerational earnings mobility in all the Nordic countries is found to be higher than in the United Kingdom and the United States.

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Introduction

International comparisons of intergenerational earnings mobility are of great importance for the understanding of how individual opportunities and social structures vary between different countries. Hence, a number of studies have been done

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calculating earnings elasticities, without, however, to our knowledge, considering the impact of using different earnings and income concepts, earning periods, and age groups. For some countries, wage rates have been used as a measurement of individual productivity, whereas for others the measure is annual earnings, either inclusive or exclusive of sickness benefits and unemployment payments.

This article aims first, to remedy the comparison problem by applying the same specifications used for various countries to Denmark and second, to show how sensitive earnings elasticity is to the delimitation of age groups and earnings periods. In our comparisons we use the same earnings periods for fathers and sons, and the same age-group specifications for sons, as in the original studies. This is made possible through the use of information from Danish administrative registers, with the result that the intergenerational earnings mobility comparisons of this article are on more equal terms than those in other studies within this field of research (see, e.g., Solon, 2002).

The definition of 'intergenerational earnings mobility' (or 'social inheritance')[1] applied in this article follows the usual understanding: the position of one generation in a rank order relative to the position of a second generation in its rank order. Thus, if a randomly sampled individual achieves a position in the earnings distribution independent of the position his or her parent achieved, the intergenerational earnings mobility is perfect or complete. In contrast, if that individual's position in the earnings distribution positively correlates with that of the parent in the earnings distribution, the intergenerational earnings mobility is incomplete.

A relatively high degree of intergenerational earnings mobility in a country might be caused by a condensed income distribution, an active labour market policy, free access to the educational system, and/or an equal opportunity-oriented educational policy. Therefore, high intergenerational earnings mobility is found within the Nordic countries, while low mobility is found in countries with other welfare regimes.

The next section of this article reviews the literature of replicable studies. A third section discusses the measurement of mobility, while the data used are described in a fourth section. The following section presents the findings for Denmark relative to those of other countries, and the last section concludes the study.

Previous studies

Research on intergenerational mobility comes mainly in the form of various empirical analyses (e.g., Corak, 2004; Grawe, 2006; Bonke and Munk, 2003; Solon, 1999; 2002; 2004; Munk, 2003a; Bratberg, Nilsen, and Vaage, 2005; 2007; citealp-bjorklund09). Two different approaches are applied: (a) the co-variation between the parents' and their children's economic positions, and (b) siblings' economic position relative to that of non-siblings, given the same background characteristics.

A relatively small variation in siblings' economic positions compared with those of non-siblings indicates low intergenerational earnings mobility (see Feinstein and Symons, 1999). Solon (1999; 2002), and Corak (2006) offer an overview of the child-parent relationship approach, and Björklund, Eriksson, Raaum, and Österbacka (2002) compare the two approaches to intergenerational earnings mobility.

The child-parent relationship approach ideally requires information on the permanent incomes of both generations. As, however, most longitudinal datasets cover short time periods, only approximations to permanent incomes are possible. In particular, finding incomes for the younger generation is difficult, since people in this generation are pursuing either more education or are at the start of their labour-market career. Therefore, most studies on intergenerational earnings mobility use only one or a few cohorts with small generational age-differentials. The exception is Bratberg, Nilsen, and Vaage (2005), who analyse data for several cohorts and show that earnings mobility between fathers and sons increases over time. Another problem is that most datasets include too few cases to analyze variations over the whole income distribution. Again, Bratberg, Nilsen, and Vaage (2005) have managed to overcome this data problem and find the greatest mobility – the least social inheritance – in the middle of the distribution, and the most persistence at the top and bottom ends, while Bratberg, Nilsen, and Vaage (2007), applying different earnings periods for the two generations and different earnings components, find the greatest mobility in the bottom end.

Yet another issue in the intergenerational mobility literature is the problem of life-cycle bias (cf. Haider and Solon, 2006; Grawe, 2006; and Böhlsmark and Lindquist, 2006). For instance, Böhlsmark and Lindquist (2006) show that the widespread use of current income as a proxy for lifetime income leads to inconsistent parameter estimates, even when the proxy is used as the dependent variable. In addition, Mazumder (2005) has recently shown that an intergenerational elasticity based on short-term averages of fathers' earnings produces estimates which are too low – for the United States, around 0.4. However, the elasticities are downward biased by 30 per cent or more due to persistent transitory fluctuations, and the true estimates should be around 0.6, indicating lower intergenerational earnings mobility.

Although most studies focus on the earnings mobility between father and son, an increasing number of studies now estimate the earnings mobility between father and daughter and between mother and daughter/son, see e.g., Corak (2001), Chadwick and Solon (2002), Deding and Hussain (2005), and McIntosh and Munk (2007). The earnings mobility between sons' and daughters' individual as well as family earnings, and their parents' and grand-parents' earnings, have also recently been investigated (Raaum, Bratberg, Røed, Österback, Eriksson, Jäntti, and Naylor, 2007).

An important question is how much of the mobility observed is attributable to

genes and how much to socio-economic or environmental conditions (the nature-nurture discussion). From Swedish adoption data, which include information on background characteristics for both biological and adoptive parents, and for the adoptees themselves, Björklund, Lindahl, and Plug (2006) demonstrate that both pre- and post-birth factors, such as childhood environment, contribute to intergenerational transmission of income and education (see also Plug and Vijverberg, 2003; 2005; and Björklund, Jäntti, and Solon, 2007, for similar findings). Björklund, Lindahl, and Plug (2006) in fact show that among pre-birth factors, transmission of the mother's education is found to be more important than transmission of the father's income, as the latter is primarily affected by post-birth environment. Plug (2002; 2004), Behrman and Rosenqweig (2002),[2] and McIntosh and Munk (2007) have also shown that parents' education has a greater impact than income on children's position in their distributions. In addition, to show the importance of both pre- and post-birth factors, a recent paper by Björklund, Jäntti, and Solon (2007) shows strikingly high estimates for the relationship between biological parents and their children in the intergenerational transmission of education, and the estimates are substantial, even for biological parents who are partly or completely absent from the post-birth environment.

The mechanisms leading to resource transmission from parents to children are still only vaguely identified (see Munk, 2003b; Björklund, Jäntti, and Solon, 2007; and McIntosh and Munk, 2009). One explanation focuses on the transmission of economic capital from one generation to the next, while another focuses on the transfers of social and cultural capital. As proposed by Corak (2001), the transmission of social and cultural capital is probably best elucidated by comparing parents' earnings with their children's earnings, while the transmission of economic capital is best captured by comparing the incomes, i.e. wages, unearned income, and private transfers, for the two generations. A clarification based on empirical evidence is of importance for the development and implementation of policies within this field, e.g., "breaking the negative social inheritance".

Measurement of mobility

In principle, two different methods are available within intergenerational mobility studies: the first estimates the destination of young peoples' position in the earnings/income distribution given their family background, while the second applies an aggregate measure derived from a statistical procedure.

The first measure ranks individuals in both generations – the 1st and the 2nd generations - in quantiles according to their income. This ranking is shown using a mobility matrix. This matrix shows the correlations between the positions of the two generations at two points: one, when the children in the 2nd generation are still living at home with their parents, and two, when the 2nd generation has left home

and established its own households.

The second measure of intergenerational mobility uses an aggregate measure from a regression equation:

$$\log E_i = \alpha + \beta \log y_{0i} + \varepsilon_i, \tag{1}$$

where $\log E_i$ represents the natural logarithm of the permanent income for a child in family i, $\log y_{0i}$ represents the natural logarithm to a parent's permanent income, ε_i is a random error term, and the slope β is the intergenerational elasticity-coefficient, i.e., changes in the child's permanent income in relation to changes in the parent's permanent income. The estimated elasticity measures the percentage change in the second generation's income generated by a one percent change in the first generation's income. If this coefficient is 0, intergenerational mobility is complete, whereas a value above 0 indicates some intergenerational persistence, i.e., the origin of the parent in his/her earnings distribution predicts the destination of the child in his/her earnings distribution. In order to assure comparability with broadly similar studies, we apply the regression-method equation.[3]

As earnings usually vary from year to year, average income for a longer period of time – the estimated permanent income – is the preferred measure (Haider and Solon, 2006). The ages of the two generations are also important, because it takes some time in life to obtain a more stable income. Choosing people who are too young increases the earnings variation and thereby makes the measure of mobility more uncertain. Thus, it is important both to apply average incomes and to correct for the age of parents and children, to avoid having short-term variations in their incomes affect the results. Finally, as taxes and income transfers affect the distribution of income, the earnings or income measure applied, i.e. gross earnings or net earnings, gross incomes or net incomes (Roemer et al., 2003), is critical, and the more so, the longer the time-span between the different generations. Moreover, the use of unclear income concepts – together with the use of different tax and income transfer systems – increases the uncertainty of international comparisons of intergenerational earnings mobility.

Data

For further Danish intergenerational earnings mobility studies, data can be obtained from numerous available sources, including different longitudinal surveys (e.g., the Danish youth-cohort study) and the administrative registers at Statistics Denmark. Data from the administrative registers include very detailed information on each individual living in Denmark, including information on demographics, education, health, income, taxes, benefit payments, and the labour market. Each Danish resident or citizen has a unique personal ID number, which enables the information in the registers to be linked anonymously to the individuals concerned as well as

to their parents. This is what makes it possible to analyze intergenerational mobility issues. Moreover, by using data from Statistics Denmark we can obtain very detailed information on relevant components of income, family background, etc. for the entire population of Denmark for the period 1984-2002. This enables us to select the most appropriate cohorts and generations for analysis at different times. Moreover, using register information solves the problems of coverage and attrition because the information covers the whole population.

The earnings concepts used in the analyses are either (a) annual earnings (wage rate multiplied by the hours of work), including or excluding sickness pay and unemployment insurance benefits or (b) hourly wage rates, taken as a proxy for individual productivity.

We exclude incomes from self-employment because, due to their relatively large yearly variations influenced by specific tax rules for this type of income, these figures are not as reliable as wage earnings.

In the analyses, we included all sons aged 30-40 years in 2002 and their parents within the age interval of 30-66 years in 1984. Thus, the earnings we use for sons are from 2002, whereas we calculate the earnings for their fathers as averages for 1984-1988. The earnings are adjusted for inflation using the consumer price index and taking 2002 as the baseline year.

Table 1 gives an overview of the statistical information in the Danish data.

Table 1
Descriptive statistics for Denmark (Annual wages)

	Mean	**Standard Deviation**
Son		
Age in 2002	34.84	3.13
Annual earnings 2002, DKK	317,793	172,656
Log annual earnings 2002	12.48	0.83
Father		
Age in 1984	45.34	6.28
Annual earnings 1984-1988, DKK	381,067	187,365
Log annual earnings 1984-1988	12.73	0.59
Number of observations	**165,774**	

Methodology

The calculation of intergenerational earnings mobility applies the elasticity coefficient method in Equation 1 because this method allows comparisons between different countries, most of which are included in Solon (2002). Some studies using the same method are, however, excluded from the comparison because they included quite young adult sons within the second generation (Couch and Dunn, 1997)[4] or applied the earnings for parents for a single year only (Blanden, Gregg,

and Machin, 2005). The variations in the age brackets of the generations and the earning periods for the second generation within the remaining studies are controlled for by using the same delimitations in the Danish calculations as in the different comparative studies. This is possible due to the richness of the Danish dataset.

Besides the international comparison of intergenerational earnings mobility, the new calculations for Denmark also allow study of the sensitivity of earnings elasticity to the delimitation of age-groups and earnings periods.

Results

The different earnings concepts applied in this analysis allow us to study how sensitive results are to the definition of 'earnings'. This sensitivity is illustrated by 1) a significant difference between the father-son earnings elasticity based on wage rates amounting to 0.224 and 2) the corresponding estimated elasticity based on annual earnings exclusive of unemployment and sickness benefits, which amounts to 0.123 (see Table 2). The latter concept is applied in most other studies of intergenerational mobility. The elasticity increases to 0.136 when sickness payment and unemployment benefits are included in annual earnings, as in the Norwegian case. This means that intergenerational earnings mobility is actually lower when different kinds of benefits are included, which indicates that social heritage is stronger in the lower end of the earnings distribution. Obviously, the two generations do not necessarily experience the same legislation and labour market regimes, due to the implementation of labour market reforms, and for this reason the evaluation of earnings mobility, in particular at the bottom end of the distribution, is not straightforward. This is confirmed in some ways by the different findings in Bratberg, Nilsen, and Vaage (2005) and Bratberg, Nilsen, and Vaage (2007), where the first article shows the greatest social inheritance in the bottom - and the top - ends of the distribution, and the second article shows the *lowest* level of social inheritance at the bottom end of the distribution. Hence, the second article suggests that there is higher intergenerational mobility at the bottom of the distribution.

The relatively high elasticity coefficient found when using wage rates shows that this proxy for individual productivity is inherited from the parents to a larger degree than are annual earnings and the receipt of public income transfers. This finding is not surprising, since wage rates correlate more with educational attainment than annual earnings, and intergenerational educational mobility is lower than intergenerational earnings mobility, as several studies have shown (see, e.g., Belzil and Hansen, 2003 and McIntosh and Munk, 2007).

Table 2
Intergenerational father-son earnings elasticity in Denmark, applying different earnings concepts (standard errors in parenthesis)

	Hourly wage	**Annual wage**	**Annual wage, UI, and sickness benefit**
	Father	**Father**	**Father**
Son	0.224	0.123	0.136
	(0.004)	(0.004)	(0.004)

Note: Sons are aged 30-40 years in 2002 and their log earnings are from 2002. Fathers' log 5-year average earnings are from 1984-88.

Table 3
Intergenerational father-son earnings elasticity in Denmark relative to other countries, controlling for different age brackets and earning periods

	Elasticity for DK applying the same characteristics as in the comparative source	Elasticity applying national data	Elasticity differentials between DK and the country under comparison	Son	Father	Source
	β^{DK}	β	$\beta^{DK} - \beta$			
Norway	0.09	0.13	-0.04	Log 5-yr. annual earnings in 1991-95, ages 31-35 yrs.	Log 5-yr. mean annual earnings	Bratberg et al. (2005)
Norway	0.08	0.16	-0.08	Log 2-yr. annual earnings in 1992 and 1999, ages 34 and 41 yrs.	Log 2-yr. mean annual earnings	Bratberg et al. (2007)
Sweden	0.07	0.13	-0.06	Log 3-yr. annual earnings; ages 25-51 yrs.	Log 3-yr. annual earnings	Österberg (2000)
Sweden	0.12	0.28	-0.16	Log annual earnings in 1990; ages 29-38 yrs.	Log annual earnings: Estimated from education and occupation	Björklund & Jäntti (1997)

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	Elasticity for DK applying the same characteristics as in the comparative source	Elasticity applying national data	Elasticity differentials between DK and the country under comparison	Son	Father	Source
	β^{DK}	β	$\beta^{DK} - \beta$			
Finland	0.06	0.13	-0.07	Log 3-yr. mean annual earnings; ages 30-40 yrs.	Log 2-yr. mean annual earnings	Österbacka (2001)
Canada	0.09	0.23	-0.14	Log annual earnings in 1995; ages 29-32 yrs.	Log 5-yr. mean earnings	Corak & Heisz (1999)
Canada	0.13	0.26	-0.13	Log annual earnings in 1998; ages 32-35 yrs.	Log 5-yr. mean annual earnings	Corak (2001)
Canada	0.09	0.19	-0.10	Log annual earnings in 1998; age 30 yrs.	Log 5-yr. mean annual earnings	Blanden (2005)
Germany	0.09	0.30	-0.21	Log monthly earning in 2000; age 30 yrs.	Log 5-yr. average monthly earnings	Blanden (2005)
UK	0.05	0.45	-0.40	Log 2-yr. annual earnings in 1991 and 1991, ages 33 and 41 yrs.	Log annual earnings	Bratberg et al. (2007)
USA	0.09	0.33	-0.24	Log annual earnings in 2000; age 30 yrs.	Log 5-year average monthly earnings	Blanden (2005)
USA	0.11	0.39	-0.28	Log annual earnings in 1987; ages 28-36 yrs.	Log 5-year mean annual earnings	Björklund & Jäntti (1997)
USA	0.05	0.41	-0.36	Log annual earnings in 1984; age 25-33 yrs.	Log 5-year mean annual earnings	Solon (1992)
USA	0.11	0.37	-0.26	Log annual earnings in 1980; ages 28-38 yrs.	Log 4-year mean annual earnings	Couch & Lillard (1998)

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	Elasticity for DK applying the same characteristics as in the comparative source	Elasticity applying national data	Elasticity differentials between DK and the country under comparison	Son	Father	Source
	β^{DK}	β	$\beta^{DK} - \beta$			
USA	0.05	0.54	-0.49	Log annual earnings in 1981; ages 25-33 yrs.	Log 5-year mean earnings	Zimmerman (1992)

β^{DK}: Own calculations based on Danish data, but with son's age and son/father incomes defined as in the studies mentioned in the 'Source' column.

Note: Some newer estimates in Bratsberg et al. (2007) for Finland and the USA were not included because they were based on sons who were "too" old (Finland) and used family income (USA).

If intergenerational earnings mobility for Denmark is calculated using the same measures used for various other countries – income concepts, age brackets, and earning periods – (β^{DK} in Table 3, Column 1), we find nearly the same level of intergenerational earnings mobility in Denmark as in Finland and Norway but a higher level in Denmark than in Sweden for one of the calculations (see Column 3 of Table 3, Björklund and Jäntti, 1997; and Jäntti, Røed, Naylor, Björklund, Bratsberg, Raaum, Österbacka, and Eriksson, 2006). This demonstrates that there is only small variation in intergenerational earnings mobility between the Nordic countries. The intergenerational earnings mobility in the Nordic countries is, however, found to be higher than in Canada and higher still than in Germany, the United Kingdom, and the United States, where very low intergenerational earnings mobility is found. The earnings elasticity in the United States studies is between 0.24 and 0.49 higher than for Denmark, when the same ages and earnings periods are used.

The smaller degree of social inheritance observed for the Nordic countries is usually explained by their compressed earnings distributions (Danish Economic Council, 2001; Bonke and Munk, 2002; Danish Economic Council, 2006; and OECD, 2008). Another commonality among the Nordic countries is that the earnings mobility is nonlinear, as opposed to the linearity found to exist in the United Kingdom and the United States (see e.g., Bratsberg, Röed, and Raaum (2007)). This factor has not, however, been incorporated into the regressions of Table 3. Linear specification is the most commonly used in the mobility studies referred to in this article, and the focus here is on the sensitivity issue regardless of the intergenerational specification used.

The sensitivity of the calculations with respect to the use of different age groups and earnings periods is shown in Column 1 of Table 3, where we compare international findings. As an example, we find that calculations referring to quite

young adult second-generation individuals, as is the case for some Canadian, German, and American studies (Corak and Heisz, 1999; Blanden, Gregg, and Machin, 2005; Solon, 1992; and Zimmerman, 1992), produce somewhat smaller elasticities, i.e., 0.05, 0.09, 0.09, than calculations in other studies for Canada and United States, i.e., 0.11, 0.11, 0.13, where older second-generation individuals are included (Corak, 2001; Björklund and Jäntti, 1997; and Couch and Lillard, 1998). Another example is the effect of applying different earning periods (e.g., Blanden, Gregg, and Machin, 2005; and Österbacka, 2001). Since this shows that earnings elasticities are sensitive to the age-groups and the earning periods used, these factors have to be taken into consideration when comparing different mobility studies.

Conclusion

This article has shown that intergenerational earnings mobility calculations are sensitive to the delimitation of earnings measures and earnings periods as well as to age groups. Consequently, we estimated intergenerational earnings mobility on the basis of different measures, including hourly wage rates, and annual earnings inclusive or exclusive of unemployment and sickness benefits. We showed that the wage rate taken as a productivity proxy suggests smaller intergenerational earnings mobility than the yearly earnings measures, which also depend on the number of hours spent on the labour market. These results were obtained using Danish Register information, which makes it possible to replicate intergenerational earnings mobility for a range of countries. Moreover, we found that the Danish intergenerational earnings elasticity is relatively small, indicating high mobility between Danish generations. This is the case when using both yearly earnings and hourly earnings based on information for the period 1984-2002.

As the different international estimations apply different delimitation criteria concerning sons' ages and earnings periods, corrections were made in this study to take this into consideration, which has not been the case in most other comparative work. We found that the Danish intergenerational earnings mobility is at nearly the same level as that of Sweden, Norway, and Finland, while comparable mobility estimates for Canada are smaller than for Denmark. For all these countries, however, the level was considerably lower than for Germany and especially for the United Kingdom and the United States.

Our findings indicate that the Nordic welfare model, and probably also the Canadian one, ensure relatively more equitable opportunities compared to other welfare models, no matter whether one comes from a privileged or less privileged background. This confirms the findings by Mayer and Lopoo (2008) for the United States showing greater intergenerational mobility in states where governmental spending on children is higher than in states where it is lower. This conclusion only makes sense, however, if mobility studies are based on the same

earnings concepts, age groups, and earning periods. The recommendation for future intergenerational earnings mobility studies is therefore that some minimum standards in terms of methodology and settings be observed if the results are to be used for policy purposes. In other words, our advice to mobility researchers is as a minimum to use among themselves the same earnings concepts, age groups, and distances between the generations.

Notes

[1] The concepts are used interchangeably in this article.

[2] Controlling for women's income and child-rearing ability, and their husband's ability and schooling produces a marginally negative coefficient for mother's schooling and her child's schooling attainment, while the father's level of attainment remains significantly positive.

[3] To look at the functional form of the intergenerational relationship we have also used the less constrained rank based measure – mobility matrices. The results can be obtained from the authors upon request.

[4] The estimated elasticities are smaller and the standard errors higher, i.e., 0.11 (0.06) for Germany and 0.13 (0.06) for the United States, than those found in other studies for these two countries. The explanation might be that because of the sons' very young age, 23 and 25 years old respectively for the two countries, these sons do not yet all have a permanent position in the labour market and thus no permanent income yet.

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