Do siblings' fertility histories influence each other?

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Abstract

Individuals' fertility decisions are most likely shaped not only by their own characteristics and life course paths, but also by social interaction with others through social networks. However, in practice it is often difficult to disentangle the role of social interaction from other factors like individual and family background variables. We propose to measure social interaction through the cross-sibling effects on fertility. Continuous-time hazard models are estimated separately for the women's first and second birth intensities. In addition to individual socioeconomic and demographic variables and a sibship-specific unobserved factor, siblings' birth events and their timing enter as time-varying covariates. We use data from longitudinal population-wide Norwegian administrative registers. The data set covers more than $110,000$ sibships, and includes the siblings' fertility, education, income and marital histories. Our results indicate that cross-sibling effects are relatively strong for the respondent's first births, but weak for the second parity transition. (148 words)

Introduction

Studies on fertility timing in developed countries contribute a strong explanatory role to individual life course transitions. These include educational, occupational, partnership and geographical mobility histories. The postponement and increasing variability in these processes has often been associated with the observed delay in childbearing. To account for fertility preferences in general, family background variables or more generally early life experiences, constitute key indicators (Axinn et al. 1994).

Individuals' fertility behaviour does not only depend on family background variables, and life course paths, but also on the behaviour and characteristics of other individuals through social networks. Several authors have emphasized the importance of social interactions for fertility choices (Bongaarts and Watkins 1996; Montgomery and Casterline 1996; Bernardi 2003). As Bongaarts and Watkins (1996) argue, social interactions have at least three aspects: the exchange of information, the joint evaluation of its meaning and social influence that constrains or encourages action. A comprehensive survey on fertility and social interactions is documented in the book by Kohler (2001). To understand the divergence in the demographic behaviour of different populations with relatively similar environmental conditions he argues for a combination of economic fertility theory (based on individual optimal and rational decision rules) and theories on social interaction (which incorporates the behaviour of other members of the community/society). Another contribution which emphasizes the relevance of social interactions in the context of low fertility is Kohler, Billari and Ortega (2002). They find that all lowest low fertility countries, i.e, all countries with TFR less that 1.3 have experienced a sharp increase of the age of first birth and argue that this observation cannot be explained by changing socioeconomic incentives alone: Social interactions (either impersonal through e.g. the labour market or personal ones through e.g. peer groups) must have induced multiplier effects or multiple equilibria. A further interesting demonstration how social interaction affect demographic behaviour is given by Åberg (2003) who examined how the high-school peers of young Swedes influenced their propensity to marry. She found positive effects of the proportion of peers' married on the marriage rate, indicating that social interaction is in part driving individuals' marital decisions.

In practice it is often difficult to disentangle the role of social interaction from other factors like individual and family background variables, as well as macrolevel indicators that also may shape fertility decisions. Often, the variables set up to capture social interaction effects are endogenous variables that are correlated with the unobserved factors of importance for the individual outcome (Kravdal 2003). Including variables that are correlated with the error term may produce severe bias in the estimation results. As summarized in Manski (1995), generally it is not possible to identify social interactions based on data of outcomes only. Exclusion criteria have to be added in order to achieve the identification of social effects.

In this paper we take a different approach and concentrate on “intra-family” social interaction mechanisms as opposed to external personal or impersonal social interactions. We argue that siblings’ fertility behaviour is related to the respondent’s own fertility. Referring to the theory of social comparison (Festinger 1954) that argues that ”individuals tend to alter their behaviour or attitude to conform to those of others the perceive as similar in social-structural positions or who share some characteristics that is relevant to the behaviour in question ”, siblings ”may serve as role models” (Haurin and Mott 1990). A key assumption to identify cross-siblings effects on fertility behavior is to control for observed and unobserved background variables that influence both siblings. We control for those factors through inclusion of a family specific unobserved factor in our econometric set up.

Siblings data have been mainly used to either study or to control for the effects of genes and shared environment on behavioural traits. Recent studies have started to investigate those data with a focus on ”intra-family” interaction effects through siblings behaviour. We follow this literature in our paper and estimate the cross-sibling effects on birth intensities for parities one and two, net of unobserved characteristics at the family level.

Siblings effects on other social and demographic phenomena have been demonstrated in several studies. Hogan and Kitagawa (1985) studied teenage fertility across siblings, Haurin and Mott (1991) investigated the cross-siblings effect of sexual initiation, and more recently Powers (2001) showed that there are similar effects on the risk of a premarital birth across siblings. In fact, Rodgers and Rowe (1988) argue that in case of adolescent sexuality siblings influence is greater than the influence by other peer groups. In a recent study Conley and Glauber (2005) focus on sibling similarity and difference in socioeconomic status as it may be related to life course versus family resource effects.

Cross-Siblings Effects on Fertility: Theoretical Considerations

In this section, we review the theoretical arguments for any cross- sibling effects on fertility with emphasis on factors related to social interaction.

In Axinn et al. (1994) the argument that there might exist cross-siblings effects on fertility preferences is three-fold: (1) a genetic component, (2) the fact that siblings share socioeconomic characteristics and (3) siblings share environmental factors such as schools, friends, and neighborhoods. In addition to these unmeasurable factors the authors argue that siblings may ”provide salient behavioral examples to their brothers and sisters”.

An obvious component of an individual's social network is the individual's siblings, as siblings are likely to have a close social relationship with each other. Moreover, such relationships may also become stronger throughout the lifecourse, as family relations are reinforced through transition rituals such as weddings, baptisms and funerals. Sibling interactions would therefore constitute a fairly important part of an individuals' social network. Siblings' experiences will be well known to the individual and by that an important source of information on life course transitions such as union formation and fertility (Bernardi 2003).

Thus, when an woman observes her sibling pass through the transition from childless to parenthood, through a higher parity transition, and possibly also an adoption process this might influence the individual's desire to have own children. Our first hypothesis is that *social interaction, as represented by the cross-sibling effects, has a measurable effect on first birth rates*.

Cross-siblings effects may be at their strongest for the first birth. Our reasoning behind this is as follows. Transition into motherhood constitutes a unique experience in anyone's life course. Social influence might play an important role to resolve the uncertainty associated with the consequences of motherhood. By learning from siblings how they cope with their ”new role” as mothers, and by experiencing the company of young children, a stronger desire for motherhood might be triggered. Once the woman and her partner have some experience with having and caring for a baby, she might be less prone to be influenced by social interaction with siblings and others. Thus, progression to a second child may constitute a rather ”stable” transition.

Another reason to expect a smaller impact of the sibling's fertility decisions for higher order births is what we will call ”life course bifurcation”. As both siblings progress through their life course experiencing various demographic and economic events that have implications for fertility-related decision making, such as union disruption or unemployment, the variance across siblings in the timing of same-order births will increase. For their first birth, the variance in siblings timing will be low, when all other relevant factors, such as their ages and age difference, are controlled for. Our second hypothesis is then that *cross-sibling effects are at their strongest for first birth, and weaker for subsequent births*.

Moreover, it is easily conceivable that these relations, if they exist, depend on the time passed since the siblings' births. For example it is likely that a birth to a sibling might have a positive effect on individuals' birth intensities in the short run, while having no effect or a negative effect in the longer run. The third hypothesis we put forward is thus that *the immediate experience of a siblings birth exert the strongest effect on ones own fertility decisions* while the effect in the long run is relatively small.

In addition to ”intra-family” mechanisms of social interaction, cross-siblings effects on fertility may be associated to parents' pressure and life course sequencing norms. A literature exists on the potential impact parents might have on their adult children's childbearing and family decisions (Barber 2000).

The first example of such pressure that comes to mind is usually parental pressure for grandchildren: Parents may exert pressure on their own children favoring entry into parenthood in order to give them grandchildren (Bernardi 2003). Once one of two siblings have had a child, their parents have gotten the desire for at least one grandchild fulfilled. This could lower the pressure on the sister that still is childless, but it is also conceivable that the pressure might be even *stronger* as her sister has given birth and she is 'lagging behind'.

Norms for sequencing of life course events among siblings represent another potential mechanism behind cross-sibling effects on fertility. In more traditional societies both kin and larger society expects that siblings marry and have children in the same order that they were born: First-borns marry and have families first, while later- borns marry and have families later. Of course, some of this sequenced structure appears due to the age schedules for union formation and fertility. For siblings with relatively small age differences, however, the "natural" ordering might easily be overturned. If, for example, a woman marries or has a child earlier than her older sister, the older sister could be subject to relatively stronger pressure to have children from her own kin and the local community.

Contemporary Norway is certainly not traditional with respect to family life, so it would be less likely that such social pressure could exist there than in less developed countris and countries less embracing of alternative family forms. But, if it does, it could have an effect on Norwegian women's fertility. As the potential stigma and sanctions originate from the woman's failure to meet expectations of role transitions, such an effect would most likely be found for the transition to parenthood (i.e. first birth), and less likely be found for second births. First birth is a more fundamental role transition than the transition from being a mother of one child to a mother of two children.

Available Data

We use data from Norwegian administrative registers. The registers cover all who at some point have resided in Norway since 1963. A system of personal ID numbers uniquely identifies each individual, and links exist between an individual and his/her parents. This facilitates proper identification of siblings and their parents in the population register.

In this paper, we will only consider sibships of size 2 (i.e. persons with only one sister or brother). The reason for this restriction is that including sibships size three or higher would make data construction and modelling uneccessarily complex. A further restriction is that both siblings must be born during the time from 1955 to 1975. Their age difference is thus also restricted to a maximum of

19 years.

Once sibships and siblings are identified we link, again using the personal ID number system, further information from various registers to the data set. This information includes, but is not limited to, the siblings' fertility histories, time series of their income, education, enrolment, marital status. The information on marital status does not distinguish between singles and individuals that are currently cohabiting. Cohabitation is very popular in Norway, and a majority of first births are born out of wedlock. However, there are no reasons to believe that this problem represents a threat to the validity of our results.

Selected descriptive statistics of the data are given in table 1. Our final data set contains records of 111582 sibships, with information on both siblings in each record. Of these, one third are all-female sibship. Most siblings are quite close in age, as about half have an age difference of 2-3 years.

In total 144120 first birth spells are included in the estimation of our first birth model. The corresponding number for second births is 108647. During their exposure to both birth events, 70% or more of the women experience that their sibling had a first birth, 50% or more of the women experience that their sibling had a second birth and 17% or more of the women experience that their sibling had a third birth.

Note that, apart from the logarithm of the woman's income, the distributions of control variables are calculated on the basis of all person-months of exposure. As we follow each individual woman from age 15 and onwards, there will be quite a long period for almost every woman spent in the single state with low education and low income.

Table 1. Data overview and descriptive statistics

Number of sibships in estimation		111582
Age gap between siblings		
More than 10 years		1.6%
9 years		1.0%
8 years		1.7%
7 years		3.0%
6 years		5.4%
5 years		9.9%
4 years		17.5%
3 years		24.5%
2 years		23.8%
1 year		10.5%
0 years		1.1%
	First birth	**Second birth**
Number of spells	144120	108647
Sibling's birth outcomes		
Sibling had 1st birth?	70%	73%
Sibling had 2nd birth?	51%	55%
Sibling had 3rd birth?	17%	18%
Distributions of control variables		
Log income (mean w/s.d.)	2.87 (1.64)	3.59 (1.35)
Cohort - 55-59	14,3%	22.3%
Cohort - 60-64	23,6%	27.8%
Cohort - 65-69	33,2%	31.2%
Cohort - 70-74	28,8%	18.2%
Education level - primary	15.3%	8.7%
Education level - secondary	60.3%	61.3%
Education level - college	21.7%	26.3%
Education level - graduate	2.7%	3.7%
Enrolment: No	72.6%	91.6%
Enrolment: Yes	27.4%	8.4%
Marital status - single	93.3%	51.5%
Marital status - married	5.5%	40.0%
Marital status - prev.married	1.2%	8.7%

Statistical approach

Our strategy is to model each parity transition as a continuous-time piece-wise linear hazard, or intensity, with the timing of the sibling's births, if any, included on the equation right-hand side as spline functions. Mathematically, our model can be described as follows:

$$\ln h_{ij}^{p}(t) \;\; = \;\; \mathbf{D}(d, \mathbf{v_1}) + \mathbf{C}(t, \mathbf{v_2}) + \beta X(t) + \sum_{k=1}^{3} S^k(t) + \epsilon_j \qquad (1)$$

where h_{ij}^{p} denotes the monthly rate of *conceiving* a child of parity p for woman i in family j. $\mathbf{D}(d, \mathbf{v_1})$ denotes a duration spline (which is age for first birth, and time since last birth for higher parity transitions), and $\mathbf{C}(t, \mathbf{v_2})$ is a piece-wise linear transformation of calendar time. $X(t)$ are (potentially time-varying) individual background variables (see below). For the model of the second birth rate, the duration variable is the time passed since last birth, but we also include a spline with one node which captures effects of the woman's age.

Sibling's fertility outcomes are captured by piece-wise linear splines, denoted by $\sum_{k=1}^{3} S^k(t)$, where k is the number of children the sibling already have given birth to. Each spline corresponds to a sibling's birth of a specific parity (1, 2, or 3). The spline enters the equation once the sibling has experienced a birth of that parity. All splines have two nodes, and thus three slopes, at 12 and 36 months respectively which allow for time-dependencies in the effect of siblings' births on the woman's fertility rate.

The last term, ϵ_j, denotes a family-specific unobserved factor which is shared by the individual and her sibling(s). This term is included as the siblings share a common family background. It will capture any time-constant unobserved factor that the siblings share due to their similar socialization, childhood experience, and other characteristics either socially and biologically (genetically) transmitted from their parents. This random effect is assumed to be drawn from a normal distribution, with a variance to be estimated. To be able to estimate this variance of ϵ_j, it is required to have at least two observations for some sibships (that is, some of the j's).

Currently, we estimate the models with data on female siblings only. This means that for mixed-sex sibships (brother and sister), we only have one of the siblings (the woman) included in the estimation. The other (male) sibling will not contribute to the estimation apart from the effects of his fertility outcomes on his sister's birth intensities. All-male sibships are then, of course, excluded from the analysis. The women included in the estimation are all followed from age 15 and censored when they reach age 45.

We include a number of control variables that appear regularly in fertility models such as educational attainment, current enrolment, dummy variables for being married or previously married, and logged income. All these variables are time-varying, and updated annually after 1980 (income and marital status from 1970). In addition, we also include dummy variables for five-year cohort groups, the siblings' birth order, the sibship sex mix, and for the age difference between the two siblings.

Finally, there are some other concerns related to identify cross-siblings effects. For example, period conditions affect all individuals' fertility rates at the same time. We therefore make sure our control for shifts in fertility rates between periods are adequately captured by letting our piece-wise linear transformation of calendar time have five nodes.

Results and Discussion

We estimate our model separately for the first and second birth rates. Table 2 shows our main results, while the complete regression results for both models are listed in Table 3, in the appendix..

Table 2. Effects of sibling's birth events on two birth rates.

	First birth		Second birth	
Up to 12 months	0.070	***	0.004	***
12-36 months	-0.025	***	0.000	
36 months and onwards	-0.001	***	0.000	*

Cross-sibling effects on birth rates

We estimated the effects as a piece-wise linear spline, that enter the model only after the conception of the sibling's child. As the spline has nodes at 12 and 36 months after the conception the effect, if any, is allowed to vary with time letting us uncover any time-dependencies in the influence of sibling's fertility outcomes.

As can be seen from Table 2, We find positive effects of the sibling's fertility on women's first birth rate. Figure 1 shows the time-dependency in this effect over the first 8 years after a sibling's conception. The slope for the first year after the sibling's conception is positive, and leads to a cumulative increase in the log- hazard of first birth by 0.07 per month. One year after the conception of the sibling's child, the risk starts to decline. The next two years, the woman's super risk of conceiving her birth that is due to the sibling's fertility decreases with 0.025 for every month passed. After three years, the risk is much closer to the risk for women who are in similar circumstances, but still have a childless sibling. It continues to decline the following years. These results suggests that there are important cross-sibling effects on the transition to motherhood, as our first hypothesis stated.

A comparison between the results for first and second birth rates supports our second hypothesis, which expected cross-sibling effects to be at their strongest for the transition to motherhood, i.e. the first birth rate, compared to the transition to parity 2. The differences between the effects are best demonstrated visually. Figure 1 shows the temporal pattern in the cross-sibling effect for both birth rates. In the figure, the effect on the second birth rate is hardly visible on the graph. If we consider the effects of sibling's fertility when they are at their strongest, the relative risk of a first birth is more than double while the relative risk of a second birth is only 5% higher than for those with childless siblings.

Interestingly, our results also lend support to our third hypothesis. The sibling effects for first birth declines steeply 12 months after the conception. We thus conclude that the cross-sibling impact on fertility is an immediate one, that is to say that a sister or brother having children affects a womans fertility in the short run while being unimportant in the long run,

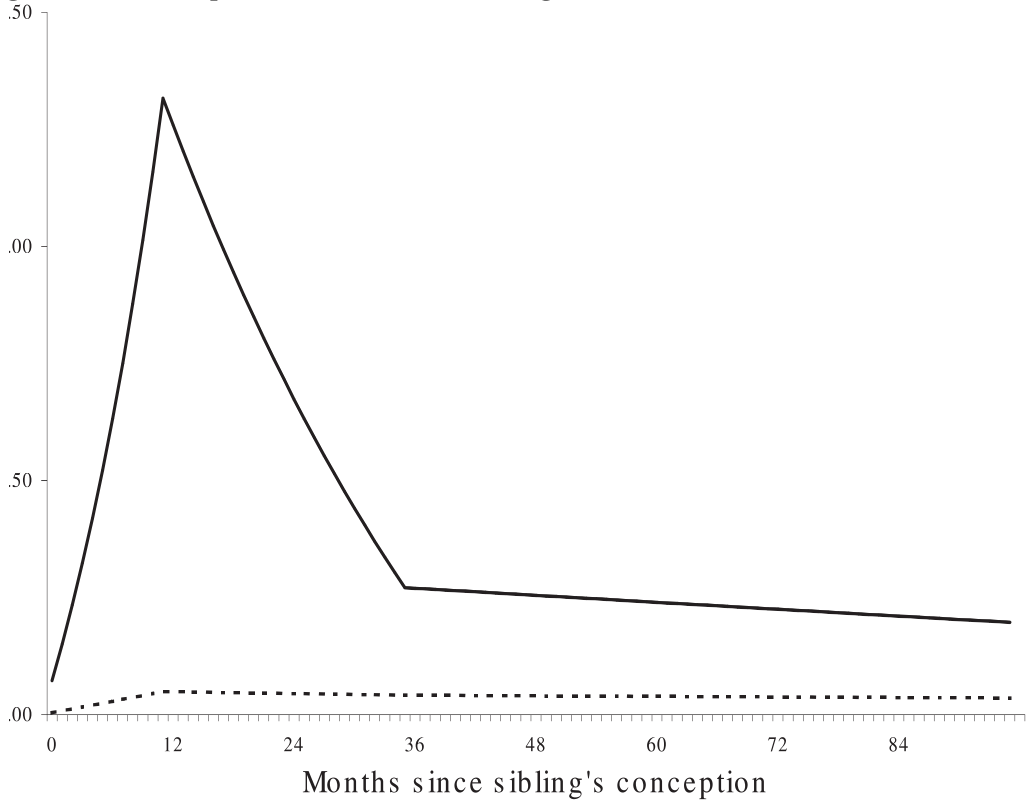
Results for control variables

Most of our control variables behave as expected. The duration patterns conform to what we have seen in other studies of first and second birth rates from Norway and comparable countries. Period effects show a decrease in first-birth rates until 1980. Any pattern beyond this is hard to identify from the results. The hazard of women at risk of a second birth is declining quickly after 35 years of age.

It is important to be aware of how our selection of sibships size 2 born within certain cohorts will affect our results. Being a child of a two-child mother when larger families was the norm could very well affect the woman's childbearing decisions. For example, it would be likely that the mothers of the siblings in our data set constitute a disproportionate number of working women and women with longer educations, as they have restricted their fertility to only two children.

Having a relatively young mother seems to increase the risk of a first birth substantially. This suggests the existence of an intergenerational transmission of fertility behaviour. Currently enrolled women have a substantially lower rate of first births than those who are not. Education effects are small for first birth, but notable is the 0.11 higher log-hazard of women with graduate or professional degrees. For second birth, we see an even stronger increase for the highly educated. This might be due to selection effects as demonstrated earlier by Kravdal (2001).

Figure 1: Time-dependent effects of a sibling's birth on 1st and 2nd birth rates.



Effects of never being married or divorced are, as expected, negative on both birth rates modelled.

Discussion and Conclusions

This paper provides an analysis of how a woman's fertility decisions are influenced by her sibling's fertility outcomes. Continuous-time hazard models were estimated for the first and second birth rate.

From our results, it is evident that there are cross-sibling effects on the Norwegian first birth rate. The corresponding effects are close to negligible for the second birth rate. These results indicate that the social interactions, in whatever way they operate, play their most important role at the onset of motherhood, and are less important for later births. Our finding also lends support to the idea that uncertainty around the process of entering parenthood can be reduced by observing siblings' experience with the same transition. The fertility experiences of a woman's sibling also seem mostly to have an immediate and a less permanent effect on the woman's fertility.

These results indicate that it might be fruitful in fertility and family research to consider ”intra-family” social interaction effects in addition to external personal or impersonal effects through social interactions. As discussed in Manski (1995) and demonstrated in Kohler et al. (2002) these ”endogenous” social interaction effects (i.e. effects wherein the propensity of an individual to behave in some way varies with the prevalence of that behaviour in the reference group) may lead to multiplier effects in fertility dynamics. Combined with the evidence that fertility depends positively on the family size where individuals grew up (put differently on the number of siblings), such cross-siblings effects could reinforce a negative trend towards low fertility. To study such cross-siblings effects register-based data are especially useful as compared to the smaller samples often used in siblings and twin related studies in demography.

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Table 3. Complete results from hazard models of first and second birth rates

Variable	Category/Slope	First birth model			Second birth model		
		Beta	S.E.		Beta	S.E.	
Intercept		-0.48	-1.41		16.67	-6.06	***
Duration spline		0.02	0.00	***	0.07	0.00	***
(age or time		0.01	0.00	***	-0.02	0.00	***
since 1st birth)		0.00	0.00	***	-0.01	0.00	***
		-0.01	0.00	***			
		-0.02	0.00	***			
Age spline	Up to 35				0.00	0.00	***
	35 and older				-0.03	0.00	***
Period spline	1970-75	-0.01	0.00	***	-0.02	-0.01	***
	1975-80	-0.02	0.00	***	0.00	0.00	
	1980-85	0.00	0.00	***	0.01	0.00	***
	1985-90	-0.01	0.00	***	-0.01	0.00	***
	1990-95	0.01	0.00	***	0.01	0.00	***
	1995-03	0.00	0.00	***	0.00	0.00	***
Mother's		-0.08	-0.02	***	0.05	-0.02	**
birth cohort		0.00			0.00		
		0.22	-0.01	***	-0.05	-0.01	***
		0.60	-0.02	***	-0.01	-0.03	
Marital status	Not married	-1.06	-0.01	***	-0.49	-0.01	***
	Married	0.00			0.00		
	Previously married	-0.69	-0.03	***	-0.54	-0.02	***
Educational	Primary	0.04	-0.01	***	-0.18	-0.01	***
attainment	Secondary	0.00			0.00		
	College	0.02	-0.01	***	0.33	-0.01	***
	Graduate	0.11	-0.02	***	0.47	-0.02	***
Enrolment	No	0.00			0.00		
	Yes	-0.49	-0.01	***	-0.42	-0.02	***
Log Income		0.28	0.00	***	0.07	0.00	***
Birth cohort	1955-59	0.00			0.00		
	1960-64	0.11	-0.01	***	0.10	-0.02	***
	1965-99	0.13	-0.02	***	0.15	-0.03	***
	1970-74	0.05	-0.03		0.10	-0.04	***
Sibship position	Has younger sister	0.00			0.00		
	Has older brother	0.07	-0.06		0.05	-0.07	
	Has younger brother	0.05	-0.01	***	0.01	-0.01	
	Has older sister	-0.02	-0.06		0.02	-0.07	
Sibling's	0-12	0.070	-0.01	***	0.004	-0.001	***
birth event	12-36	-0.025	0.00	***	0.000	-0.001	
	36+	-0.001	0.00	***	0.000	0.000	*

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Table 3. Complete results from hazard models of first and second birth rates

Variable	Category/Slope	Beta	S.E.		Beta	S.E.	
Age difference of siblings	-10 or more	0.36	-0.05	***	0.03	-0.06	
	-9	0.22	-0.06	***	-0.04	-0.07	
	-8	0.22	-0.06	***	-0.02	-0.07	
	-7	0.17	-0.05	***	0.06	-0.06	
	-6	0.19	-0.05	***	-0.01	-0.06	
	-5	0.19	-0.05	***	-0.01	-0.06	
	-4	0.18	-0.05	***	0.05	-0.05	
	-3	0.18	-0.05	***	0.08	-0.05	
	-2	0.16	-0.05	***	0.09	-0.05	*
	-1	0.18	-0.05	***	0.08	-0.06	
	0	0.00			0.00		
	1	0.16	-0.04	***	0.07	-0.05	
	2	0.10	-0.04	**	0.05	-0.05	
	3	0.07	-0.04	*	0.03	-0.05	
	4	0.07	-0.04		0.00	-0.05	
	5	0.06	-0.04		-0.01	-0.05	
	6	0.05	-0.05		-0.02	-0.05	
	7	0.01	-0.05		-0.06	-0.06	
	8	0.04	-0.05		-0.06	-0.06	
	9	-0.04	-0.06		-0.02	-0.07	
	10 or more	-0.07	-0.06		-0.14	-0.07	**
Std. error of unobserved factor		0.27	-0.02	***	0.30	-0.02	***
		-648651.55			-401573.81		

* = p ¡ 10%; ** = p ¡ 5%; *** = p ¡ 1%