Uncertainty and Fertility Decisions: Evidence from German Micro Data*

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Abstract

How does household fertility relate to labor income uncertainty? A large literature shows how household saving reacts to income uncertainty but only few studies recognize how fertility decisions are affected. We aim to shed some light on this relationship using data from the socio-economic panel from Germany. Our preliminary results indicate that our quantitative measure of income uncertainty is positively related to the number of children on average. A possible explanation for this pattern is specialization within the household.

Keywords fertility; uncertainty; life cycle decisions

JEL Classification J13 · D91 · D19

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1 How does fertility relate to income uncertainty?

In many developed countries, the demographic change will put severe pressure on the sustainability of the welfare state. Persistently low fertility rates in the last couple of decades will almost mechanically lead to an ever older society, in which a shrinking work force needs to sustain an unprecedented number of pensioners. In Germany for instance, the old-age dependency ratio, i.e. the number of inhabitants older than 65 per 100 people aged 15-64 is projected to increase from 31.6 in 2010 to 57.1 thirty years later. In the Southern European Countries these developments are expected to be similar. On the contrary, countries such as France, Sweden or the USA will be able to stabilize their old-age dependency ratios around 40 in 2040; still, also these countries will experience profound aging of their societies (United Nations, 2013).

In many of these countries the propensity to get children is negatively related to the mothers' educational attainment. It is often argued that especially highly educated women delay fertility, because of an on average longer time spent in education and longer time required to establish themselves in a secure position on the labor market. This transition from education to work life nowadays coincides with the usual time for family formation, leading to a *rush hour of life*, as it is coined in the sociological literature. Despite a lack of thorough empirical evidence, deferring fertility decisions at young ages is often cited as a response to income uncertainty.

However, economic research on the nexus between uncertainty and fertility decisions is rather scarce. In this research project, we want to scrutinize whether such a link exists and - if we find evidence for it - whether it is economically meaningful. Empirical explorations into the relationship between uncertainty and (economic) decision-making are in itself interesting and valuable; however, our insights could also change the way we think about the efficiency of pro-natalist policy instruments. If economic uncertainty seems to have a negative impact on fertility, policy makers might focus for instance on general labor market institutions to bring up fertility rates.

An important aspect of this research project is the kind of economic risk we want to focus on. The birth of the first child leads to a substantial change in the way households are constrained in their choices and will have effects for at least 18 years. Thus, it is natural to consider a forward looking fertility decision, taking into account future earnings, but also how sure households can be about their income expectations. Thus, we want to investigate and quantify the effect of the households' earnings risk on childbearing decisions. In turn, this leads us the the question how we can estimate these life-cycle earnings profiles and the corresponding uncertainty, facing the challenge that we want to obtain measures which are not mechanically related to the presence of children in the household.

We will perform our analysis based on German panel data, namely the GSOEP. In our opinion,the German case is particularly interesting, because of the severe demographic transition and the increase in academic and public awareness of raising income uncertainty. Germany has one of the lowest fertility rate across all OECD countries, even though it spends than 200 € billion on 156 marriage and family related policies per year (in 2010, (BMFSFJ, 2012)). Thus, it might function as a case of a country which tries to stimulate attractiveness of founding a family but turns a blind eye on their real underlying causes.

The rest of the paper is structured as follows: Section 2 will present some stylized facts about the development of fertility rates and childbearing in Germany. Afterwards, we will describe the way we obtain our measures for the parents' income potential and earnings uncertainty. Then we will present results from models of completed fertility and a multi-state hazard model. Section 6 concludes.

2 Background

2.1 Stylized Facts about fertility in Germany

The following section will present some stylized facts about fertility developments in Germany in the last five decades in order to give an impression of the German fertility transition. The developments we sketch here are similar to those in other developed countries, especially the Southern-European states, even though there might be some slight differences with respect to the timing of events. For consistency, all these graphs are based on women living in West Germany, since the developments in the former GDR and after the *Wende* seem to have their own dynamics[1], which are likely to confound our exploratory analysis.

Figure 1 pictures the age-specific fertility rate for 6 selected cohorts. If we compare these age-profiles of fertility, we see that especially for the immediate post-war cohorts,

[1]For instance, Buttner and Lutz (1990) show that the drop in GDR fertility rates after the liberalization of abortion in 1972 was successfully accommodated by a number of maternal leave and benefit policies. Note that the GDR was characterized by universal child-care provision and the virtual *absence* of labor market uncertainties, due to the centrally planned economy, which both might explain this unusual responsiveness of fertility decisions to those kind of policies. There are also several studies scrutinizing East Germany after unification ((Conrad et al., 1996; Witte and Wagner, 1995; Bonon and Euwals, 2002), discussing to what extend East German women adapted to the fertility and labor force behavior of their Western peers. Similarly, Goldstein et al. (2009) argue that the low fertility rates in Eastern European countries after the fall of the iron curtain merely reflect a rapid shift to childbearing later in life (as in Western European countries), which might leave the completed fertility rate unaffected, highlighting the importance of the distinction between period and cohort fertility rates.

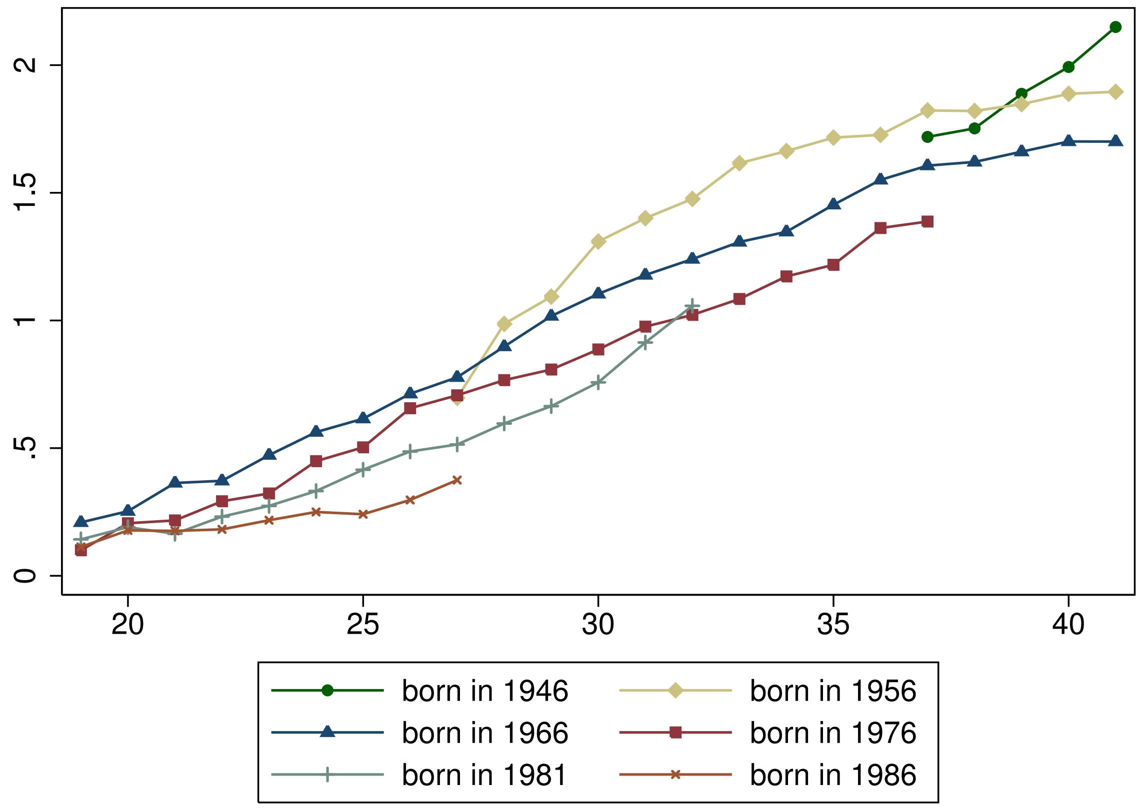

Figure 1: Children per women across cohorts

overall fertility decreases. The cohort of women born in 1946 still had more than two children on average and also for those born ten years later it was the rule to have on average already 1.5 children in your early 30s; however, the cohorts born in 1966 and 1976 have both a lower and lower age-specific fertility profiles, which indicates both, less children in total and children later in the life-cycle. Only the future will tell us, whether this trend will continue from generation to generation, or whether it stabilizes. Those born in 1981 compared to the cohort five years earlier seem to have had children generally at higher ages (lower age-specif profile between 23 and 30); however, in the last year of observation (at age 32) it seems that they caught up. On the contrary, those born in 1986 have an even lower fertility profile up to age 27, so it might well be that both, the trend towards children later in the life-cycle and also towards less children still continues.

Figure 2 follows the same structure as the previous figure; however, instead of the fertility rate of all fertile women it focuses on those women who already have a child. Hence, these profiles start at one and can also slope downwards, for instance if at a certain age, more women get their first child compared to mother getting their second or third child. The figure

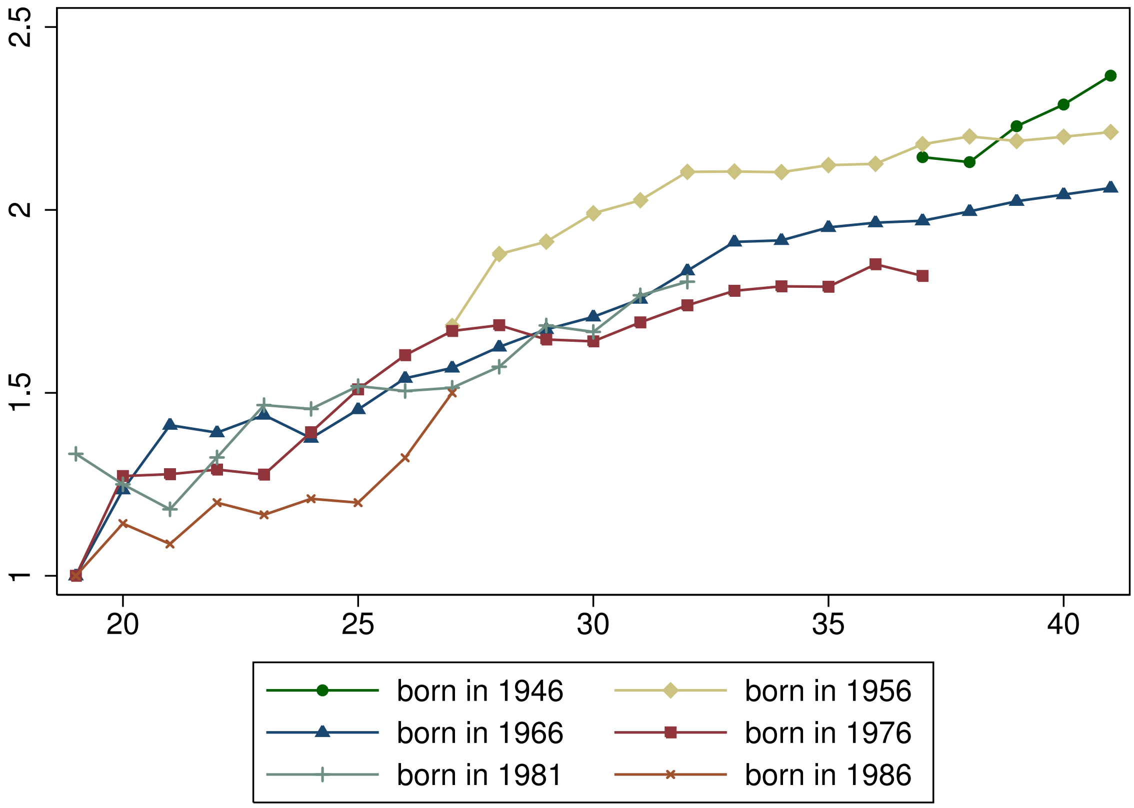

Figure 2: Children per mother across cohorts

tells us that there was a pronounced adjustment between the cohort born in 1956 and 1966; however, afterwards the difference across cohorts are more subtle. The cohort born in 1986 is again a noteworthy exception for the early years of the fertile cycle, indicating that it is less and less common to have more than two children in your early twenties. To sum up, it seems that there was a substantial adjustment in the number of children per mother (the *intensive margin* of fertility, so to say) from the generation born in the 1950s to those born in the 1960s; however, the adjustments at the *intensive margin* seems to be less important for later cohorts.

Figure 3 again has the same structure as the previous figures; however, in order to scrutinize changes at the *extensive margin* of fertility, we look at the age-specific share of childless women for the usual six cohorts. The figure provides evidence that starting from the cohort born in 1966 age-specific childlessness increases from cohort to cohort. Again, only the future will tell whether these developments represent a development towards founding a family later in the life-cycle or towards permanent childlessness. Figure 3 also shows that the catching-up of generation 1981 spotted in figure 1 seems to be driven by delaying the begin

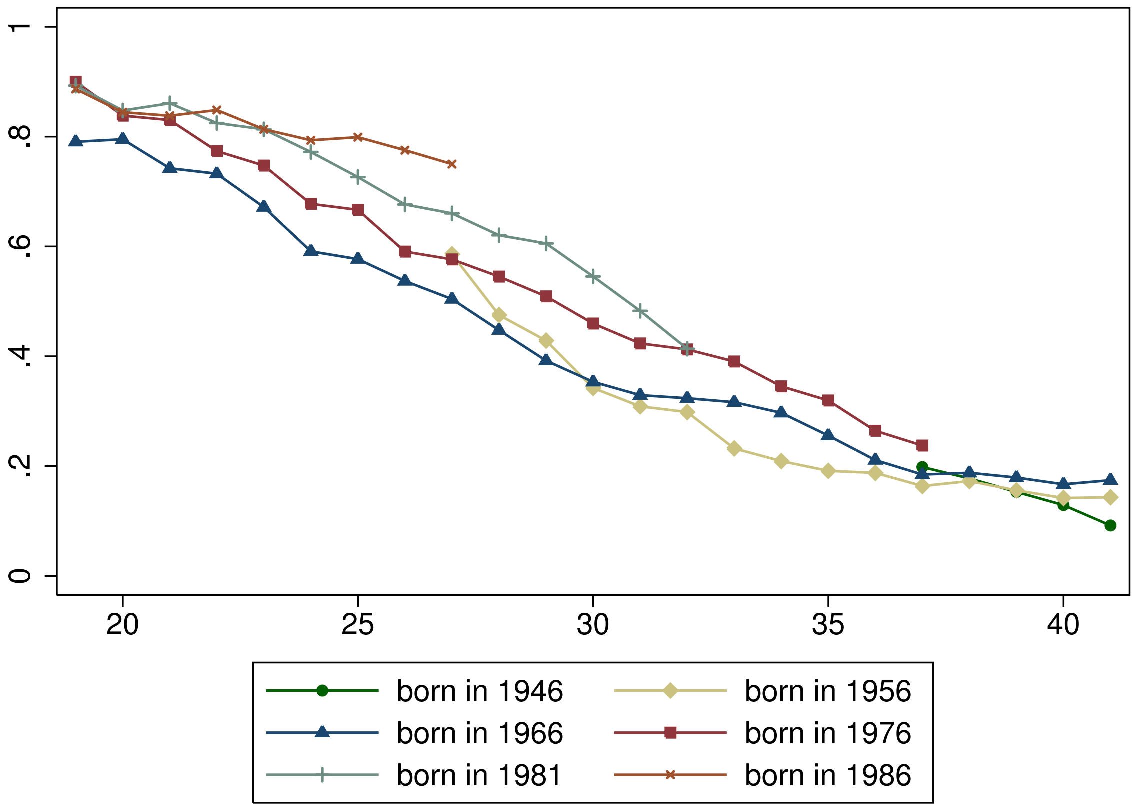

Figure 3: Share of childless women across cohorts

of childbearing and also the low age-specific profile of the generation born in 1986 seems to be primarily caused by changes at this extensive margin.

Another way to look at these adjustments at the extensive margins is to plot the mothers' age at birth for different parities, as it is done in figure 4. Since we can only generate meaningful graphs for those with completed fertile cycles, we can only plot until those born in 1972, which were 40 in the last year of our sample. In order to ease readability we predicted a quadratic trend. All three curves are sloping upwards, indicating that all parities are from generation to generation later in the fertile cylce; however, the largest change can be detected for the average age at the first child, which increased from slightly below 24 to 27 for those born in 1972. The change for the average age at the second child seems to be a parallel shift, going from a little bit above 26 to almost 30 in 1972. Thus, the average spacing between the first and the second child did not change much in the time period under scrutiny. The curve for the average age at the third child, however, displays a rather modest slope: Those mothers who will have at least three children in total also start early and do not to seem to delay the childbearing strongly. Thus, the biological constraints become apparent.

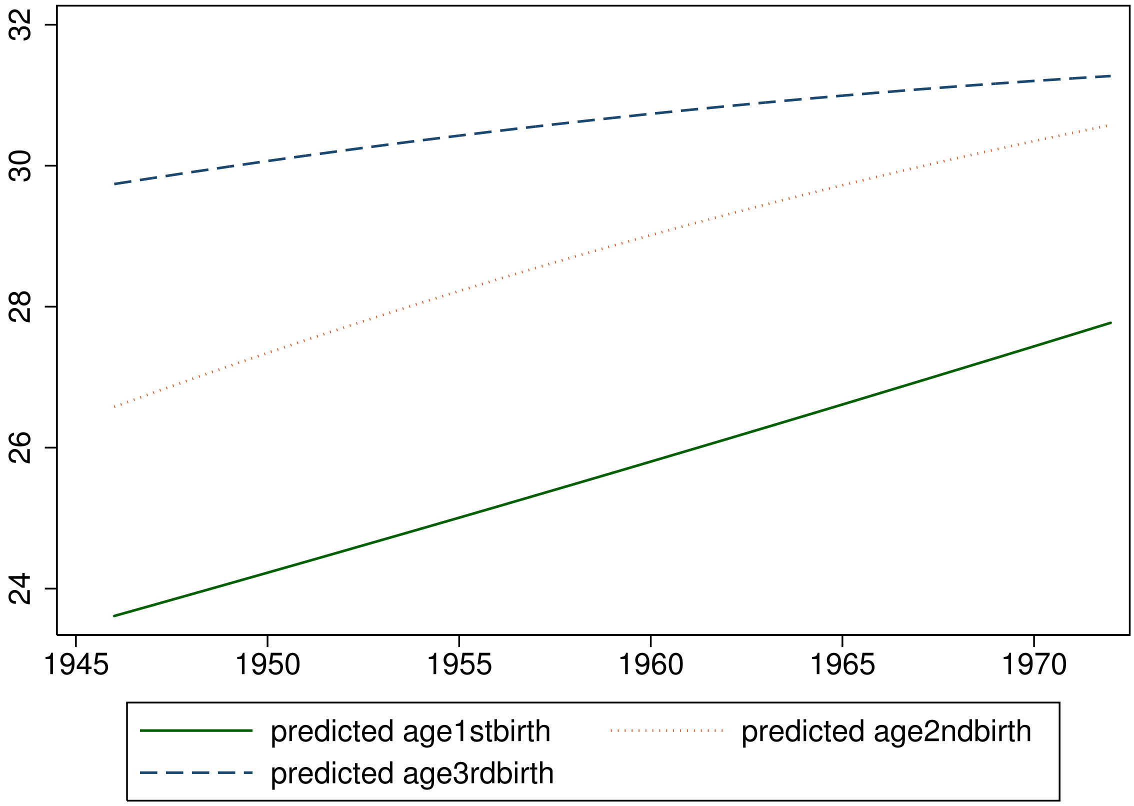

Figure 4: Age at 1st, 2nd and 3rd child across cohorts

Summing up, we see that there where decreases in overall age-specific fertility rates across cohorts. In general it seems that the changes between mothers born in the 1950s to those in the 1960s comes from a lower number of children per mother (the intensive margin), while later reductions in fertility can more likely be attributed to changes in the extensive margin. Also the average age at the first and second child increased substantially across cohorts, providing evidence for delaying fertility.

2.2 Rising Income Uncertainty

There are various ways to operationalize income profiles and their riskiness over the life-cycle and hence also various ways and answers to the question whether income risk increased in the last decades. Generally, these studies are based on annual earnings of men or on household income, in order to avoid complications coming from child-related interruptions of employment. Additionally, these approaches have in common that they decompose the observed earnings into a deterministic and a stochastic component. Changes in the latter represent changes in earnings risk, assuming that the deterministic part is known to the individual. The deterministic part, also referred to as the conditional mean, is usually predicted based on observable characteristics such as educational attainment and potential work experience. It is common that this estimated process varies with respect to education. Depending on the focus of the study, the estimation results can be used to predict aggregated deterministic earnings profiles, but also individual-specific permanent income proxies, as for instance in Lusardi (1998).

However, studies differ with respect to the way the residuals are further treated. A considerable body of research evolved around the specification of the random part, with the aim to decompose the random shocks into idiosyncratic transitory opposed to a permanent part.[2] These studies have the advantage that they can obtain complex stochastic specifications of uncertainty; however, come at the cost that the uncertainty specification applies to either the whole population or for certain subgroups at most. Hence, these procedures are interesting for inquires about the nature of uncertainty and for macroeconomic questions, but are generally not convenient to generate individual-specific uncertainty measures.

According to the results of Meghir and Pistaferri (2004), earnings risk in the United states increases until the mid 1984 and declined afterwards, but showed a slight tendency to increase again around the end of their sample in 1993. Using similar methods as described above, Rostam-Afschar and Yao (Rostam-Afschar and Yao) show based on GSOEP data that idiosyncratic labor income risk increased in the recent decades. Based on German Social Security data, Giesecke et al. (2011) find evidence that overall earnings volatility increased over time, primarily driven by changes in the permanent earnings component. Blundell et al. (2014) also find for Norway that earnings risk increased for younger cohorts.

A different way to treat the residuals from the earnings regression is presented in Fossen and Rostam-Afschar (2013). Here the permanent income is obtained as the prediction of the the earnings regression, similar to Lusardi (1998). In order to obtain an individual-specific uncertainty measure the authors rely on the predicted values from a heteroscedasticity function , i.e. the prediction from a regression of the squared residuals from the earnings regression on the independent variables which generate the deterministic income profiles. Thus, their uncertainty measure consists on the expected variance of log income, conditional on observed characteristics. Also our approach will be based on these procedures.

[2]Noteworthy examples are (Meghir and Pistaferri, 2004) and (Carroll and Samwick, 1997).

3 Literature Review

Income and Uncertainty in Fertility Decisions

Economic theories of fertility, such as the so-called *new household economics* focused on the role of the male income, the female wage rate and the quantity-quality trade-off in family size (For extensive survey of this research, see for instance Bagozzi and Van Loo, 1978). Conventionally, the male income is usually considered only with respect to its income effect on fertility decisions. If children are a normal good, a higher (male) income should lead *ceteris paribus* to more children. However, as pointed out by Becker and Lewis (1973) that the "consumption" of children can also happen in the quality-domain, which implies that a higher income could lead not to more children, but to more investment into the existing offspring.

For the woman's wage however, there is not only the income effect but also a substitution effect, which is usually assumed to dominate. A higher wage rate increases the opportunity cost of child-rearing and thereby decreases the number of children, an idea first pointed out by Mincer (1963), who also first highlighted the importance of permanent instead of current income in fertility decisions.

Analogously, the theoretically conjectured impact of income uncertainty is also ambiguous. Concerning the male partners income, one would expect that a higher income risk might lead to postponed or abandoned family formation due to a precautionary motive. For the woman's income however, it is not clear, since a more uncertain female income might either lead to more pronounced specialization (c.p. higher fertility) or to precautionary delay. Presumably, the nature of this adjustment depends on both, the expected male income and on the male part's income risk. Thus, it is ex-ante not possible to give an expected sing of the female income risk; however, we expect that the due to the increased importance of the woman's income, the precautionary motive might have gained importance in recent decades. Thus, we will assume for the following discussion of potential biases that the income uncertainty for both partners might *ceteris paribus* lead to delayed childbirth and reduced family size.

Uncertainty and Fertility in the Previous Research

Children have a prominent role in the debate about the permanent income hypothesis, in order to explain the high correlation between income and consumption Tobin (1967) and are thus an alternative or accompaniment to other explanations such as income uncertainty induced precautionary savings. Browning and Ejrnæs (2009) show that if one allows for a rather flexible specification of how children enter the consumption function there is even no need for precautionary motives or liquidity in order to obtain flat consumption income profiles. However, these studies treat children as exogenous and there are only little studies explicitly linking children to income uncertainty.

One of the rare exceptions is Sommer (2012). After providing some motivating evidence that women whose husbands are in high-risk occupations indeed have lower age-specific fertility rates, she presents a life-cycle optimization model of savings, time allocation and fertility decisions. Following Becker and Tomes (1976), children enter the households' utility function in quantity and quality, where the latter is determined by parental investment in time and money into their children. Household labor income enters as an idiosyncratic stochastic earnings process as in the first strand of the income uncertainty literature. Labor supply is determined endogenously, given by the fraction of total time that is not spent on childrearing; there is no leisure and wages do not depend endogenously on past labor participation. In her calibration, young households postpone childbearing when income uncertainty is high, preferring to work and to accumulate more precautionary savings as a self-insurance before founding a family. In turn, facing an exogenous infertility risk, this postponement depresses the number of children per household. Thus, savings and wealth holdings might constitute a relevant factor in anaylsing fertility decisions.

Kreyenfeld (2010) analyses the effect of labor market uncertainties on transitions to motherhood in Germany and finds heterogeneous effects with respect to the womens' educational attainment: Using GSOEP data she finds that more highly educated women postpone parenthood when subject to employment uncertainties (She uses actual unemployment and subjectively stated worries about economic situation or career), while those with low levels of education often respond to these situations of uncertainty by becoming mothers. These findings indicate that the effect of uncertainty can be quit different with respect to the parents' socio-economic status.

By the same token, Bhaumik and Nugent (2005) show also based on GSOEP data that women whose employment situation is uncertainty (women with a job, but fearing to loose it and women without a job, hoping finding one) are less likely to get children compared to those who are are cofident to keep their job, or have a high certainty of remaining unemployed. However, their results indicate that this effect of uncertainty was not present in West-Germany before the *Wende*, when there was a negative correlation between maternal employment stability and the propensity to get children.

Schmitt (2012) compares the effects of occupational uncertainty on fertility in Germany and the United Kingdom with BHPS and GSOEP data, respectively. His operationalization is based on the womens' incomplete labor market integration, i.e. either a fixed-term contract, marginal employment, or an "inadequate" position, which does not correspond to a person's educational attainment. The evidence suggests that the occupational uncertainty hampers transitions to parenthood in Germany, while the results are inconclusive for the UK. In both countries, however, he finds delayed family formation for highly educated women.

There is further evidence that labor markets which enable easy exit and re-entry have a positive effect on fertility, as pointed out in a cross-country panel study by Adsera (2004, 2005). Interestingly, such conditions are given in highly flexible labor markets, such as in the US, but also in the Nordic countries with their extensive leave programs (Sweden, Norway) or flexicurity designs (Denmark). On the contrary, dual labor markets and high unemployment, notably in the Souther European countries, seems to depress fertility, especially for women under 30.

4 Operationalization

Our approach to generate profiles of permanent en earnings is similar to the one adopted by Fossen and Rostam-Afschar (2013). Generally, we will provide two different specifications, **Model (I)** based on the annual gross household income, and **Model (II)** based on the individual monthly gross earnings of both partners.

$$ln(y_{it}^j) = \beta^j x_{it}^j + \epsilon_{it}^j \; for \; j \; \in \{household, ♀, ♂\} \tag{1}$$

We obtain the permanent, i.e. the deterministic part of the earnings as the prediction of a gross earnings regression on various household or individual-specific variables as it is described in equation 1. Depending on the specification, x_{it}^j contains the years of education, potential work experience, occupational and regional dummies, as well as various interaction terms.[3] We argue that the residual captures the stochastic income component.

[3]Our preferred specification contains: years in education and its square, potential work experience and its square, cohort dummies, occupation dummies (blue collar, white collar, civil servant, self-employed, other), interactions of the occupation dummies with the quadratic experience specification, regional dummies, a quadratic specification of household size and a quadratic specification of time effects. In case of household income regressions, the specification contains additionally a dummy for cohabiting couples and interacted partner variables. In order to obtain scale-invariant residuals we regress log earnings and adjust by multiplying the exponent of the prediction with the coefficient of a simple bivariate regression without constant term of the exponent of the predicted value on the actually observed earnings.

Given our focus on fertility decisions there are two fundamental problems we need to address: First, how to obtain an income measure which is invariant to the presence of children in the household, and second, how to obtain a measure of the womens permanent income which is usually not estimated in the literate, due to child-related interruptions in employment. Both questions have in common that we want to obtain measures of the permanent income *potential*, rather than the actual permanent income as it is done in the surveyed literature.

In order to address the first concern in model (I), the family size-invariance property, we replace the household size with the average household size before predicting the permanent income, i.e. $y_{it}^P \equiv \hat{y_{it}} = \hat{\beta}\tilde{x_{it}}$, where $\tilde{x_{it}}$ indicates that the household size variables have been transformed before the prediction. The residuals however which we will later use for our uncertainty measure are obtained without this adjustment and thus only contain variations beyond directly observable household characteristics, and therefore relate to the uncertain dimension of the people's income.

In model (II) the procedures are similar for the male partners' income; however, for the female income, we need to adjust our procedure in order to account for child- and family-related interruptions of employment. Thus we perform the well-known Heckman correction (Heckman, 1979), using the presence of young children in the household as an exclusionary restriction for labor market participation.

5 Models of Completed Fertility

In this section we apply our estimated permanent income potentials and income uncertainty measures to a model of *completed fertility*, i.e. the number of children a women has ever born at the end of her fertile cycle. we employ a Poisson regression model. We also tried out the more flexible negative binomial models,w hich are not constrained to the mean-variance equidispersion; however, the data seems to obey this property really well, thus we decided for the simpler poisson model.

We use mothers aged 40-44 in the years 2002, 2007 and 2012, resulting in 15 cohorts, born between 1958 and 1972. We focus on the sampling years 2002, 2007 and 2012 in order to use the wealth information, which are only surveyed in these years. The ages are chosen in order to maximize our range over birthyear cohorts. Biologically it is not impossible to conveive after 40; however, the vast majority of children are born at younger ages and we control for potentail differences between women aged 40 to those aged 44, by including age dummies.

A difficulty in this kind of modeling is to obtain a measure for the uncertainty and the income potential over the fertile cycle. We decided to exploit the Panel dimension in our data, by using the individual fixed effects as a proxy for the average individual income or risk, which explicitly takes out year and age effects. These fixed effects do not have an intuitive scale, but we are confident that they represent a proper cardinal measure of the underlying variables. In order to obtain meaningful results from these variables we thus normalize the estimated marginal effects with a standard variation of a varian

Table 1: Linear Specification

	HH	1w	1m	2w	2m
Mfx	0.0143	-104.7367	0.0085	-0.0543	0.0108
Z	5.5027	5.4833	3.2746	5.7878	2.8288
Effect	0.3149	-0.3060	0.1051	-0.2943	0.0940
Mfx	3.4475	6.7509	1.0750	5.8476	0.9815
Z	6.4089	2.3826	1.2751	2.5413	1.3424
Effect	0.1859	0.0915	0.0249	0.0916	0.0251
Mfx	-0.0612	-0.0024	-0.0024	-0.0077	-0.0077
Z	2.3977	0.0940	0.0940	0.3044	0.3044
Effect	-0.1256	-0.0049	-0.0049	-0.0158	-0.0158

Table 2: Quadratic Specification

	HH	1w	1m	2w	2m
Mfx	0.0241	-84.1244	0.0066	-0.0496	0.0088
Z	6.4669	3.9189	2.2899	4.7987	2.2090
Effect	0.5317	-0.2457	0.0814	-0.2684	0.0763
Mfx	8.3329	21.4900	-1.1973	17.0676	-1.2316
Z	6.5221	5.1888	0.9273	5.0618	1.0298
Effect	0.4492	0.2913	-0.0277	0.2673	-0.0315
Mfx	-0.0992	0.0351	0.0351	0.0369	0.0369
Z	3.3563	1.4327	1.4327	1.5311	1.5311
Effect	-0.2038	0.0721	0.0721	0.0758	0.0758

6 Conclusion

In our preliminary findings suggest that contrarily to common beliefs, uncertainty does not seem to have a negative impact on fertility. Contrarily, there seems to be mild evidence that labor income uncertainty might actually increase completed fertility, which could be rationalized by traditional spousal separation of tasks. Thes preliminary results however are based on so far only on women who already completed their fertile cycle. Thus, we cannot rule out that this relation is different for the currently fertile women.

Further analysis is needed and we plan to additionally apply hazard models for the impact of uncertainty on the timing and spacing of childbirths. Next to the advantage that this method also allows to focus on more recent cohorts, it also adds a temporal dimension to our results, since we could detect postponement effects and the degree of cathicng up later in the fertile cycle.

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