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Risk tolerance and fertility: Evidence from a lottery question in Italy

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Abstract

Objective: This article offers a contribution to the fertility literature by considering the role of risk tolerance in the fertility decision-making process.

Background: Despite a long tradition in fertility research emphasizing the great uncertainty underlying the decision to have children, the role of risk tolerance has been overlooked. Elaborating on previous theoretical approaches including those that have considered children as a "security" or as a "risky investment," whether and how risk tolerance is related to fertility outcomes has been analyzed.

Method: The analyses are based on longitudinal data from the Survey of Household Income and Wealth carried out by the Bank of Italy and rely on a lottery question to measure risk tolerance. Probit models for the probability of having the first and second child are estimated.

Results: Results indicate that the most risk-tolerant individuals have the lowest probability to have a (an additional) child. This is consistent with the theoretical approaches that conceptualize children as an insurance and an immanent value. These results are particularly evident for low-income individuals.

Implications: The findings point to the importance of considering risk tolerance in fertility research to gain a more complete understanding of heterogeneities in fertility behaviors.

KEYWORDS

demography, fertility, gender, quantitative methodology, transitions

INTRODUCTION

Theories of fertility decision-making have since long time explicitly incorporated the notion that fertility decisions are subject to uncertainty (Cain, 1983; Johnson-Hanks, 2004; Trinitapoli & Yeatman, 2011, 2018). Many studies have, for example, focused on economic uncertainty measured by objective (e.g., unemployment status, low income, precarious occupations) or subjective indicators (e.g., negative expectations on future economic conditions; Hofmann & Hohmeyer, 2013; Kreyenfeld, 2010; Schneider, 2015). However, a likely key factor has been overlooked. In this paper, we argue that among the preferences that may contribute to explaining heterogeneity in fertility choices over and beyond standard socioeconomic characteristics, an important role may be played by risk preferences, that is, preferences about the extent one is willing to accept risk—the so-called risk tolerance (the reciprocal of risk aversion). The reason behind this intuition is that individuals may feel threatened or, on the contrary, encouraged in their fertility choices by the stochastic dimension that characterizes childbearing consequences. Uncertainty, in fact, can be experienced by some individuals as anxiety and by others as excitement (Greco & Roger, 2001). Indeed, risk tolerance significantly affects the expected utility of decisions characterized by uncertain outcomes, regardless of individual's socioeconomic background (e.g., Schmidt, 2008).

Our study makes different contributions to the fertility literature. Going beyond classical theories of fertility (e.g., based on the theory of planned behavior; Ajzen, 1991), we incorporate risk tolerance as a crucial factor embedded in the fertility decision-making process and provide new insights on the connections between risk tolerance and fertility outcomes. Additionally, our study offers an empirical contribution by testing whether risk tolerance influences transitions to first and second births and whether the effect of risk tolerance varies by income levels. To the best of our knowledge, the only study that focused on risk tolerance found that it influences the timing of first births in the United States (Schmidt, 2008). Although this study is relevant, it overlooks crucial aspects of fertility behaviors such as parity transitions and socioeconomic heterogeneity. Inspired by this isolated work, our contribution aims to provide an original avenue to better understand the link between risk tolerance and fertility. Our analyses are based on data from the Survey of Household Income and Wealth (SHIW) conducted by the Bank of Italy which includes a question related to a hypothetical lottery to elicit respondents' risk tolerance.

RISK TOLERANCE AND THE DECISION-MAKING PROCESS

Risk tolerance has been conceptualized as "a descriptive label of the degree to which an individual appears to avoid or seek out risky options or behaviors" (Weber et al., 2002, p. 267). More formally, the level of risk aversion determines the preference for a bargain with a certain payoff over a bargain with an uncertain but possibly higher payoff (Arrow, 1971). As the risk preference theory and the sensation-seeking literature suggest (e.g., Tversky & Kahneman, 1974), the level of risk tolerance represents a specific marker of the subjective perceived costs and returns from a given action that also includes the excitement generated by its randomness (Zuckerman, 1994). In this sense, individuals choose according to personal assessments on the way to assign a value to perceived material and immaterial rewards and maximize expected utility, given also their risk preferences (Goode, 1997). There is a broad agreement that risk tolerance is a trait formed early in life (e.g., Andersen et al., 2008) and that during adulthood it is largely a time-invariant trait rather than a changing preference. For example, Guiso et al. (2018), using the same data we employ, found that risk tolerance did not vary with age. Similar results were obtained in other studies (e.g., Brunnermeier & Nagel, 2008).

Part of the literature has treated risk and uncertainty as different concepts. In economics, uncertainty has been defined as a lack of any quantifiable knowledge about the likelihood of some outcomes of a decision, as opposed to risk, characterized by a known probability distribution of the consequences of a decision (Knight, 1921). While the distinction is clear in some settings (e.g., investments in financial markets), it is more blurred in decision-making in other life domains (Guseva & Rona-Tas, 2001). Recent sociological studies question the notion of a tight distinction between uncertainty and risk (e.g., Trinitapoli & Yeatman, 2011). As noticed by De Groot & Thurik (2018, p. 5): "Looking even closer at how decision-making in real life is accomplished, it appears that the distinction between uncertainty and risk is continuous rather than binary."

Adopting implicitly or explicitly the view that individuals subjectively form expectations about the probability of occurrence of uncertain outcomes, the role of risk tolerance has been examined in different domains, including health behaviors (Dohmen et al., 2011), education (Checchi et al., 2014), occupation (Ekelund et al., 2005), and income (Guiso & Paiella, 2008). Instead, the role of risk preferences in demographic choices has been largely overlooked.

In developed countries, a number of theories have argued that fertility decisions are based on predicted (economic and noneconomic) rewards/costs of having a child and on expected sacrifice of other individual goals (Hoffman & Hoffman, 1973; Kravdal, 2014). Following the exchange theory framework (e.g., Nye, 1979), one could assume that fertility is the outcome of decisions that are based on a comparison of alternatives. In this sense, the weights assigned to the rewards/costs and to the sacrifices associated with childbearing are differently estimated by individuals. The decision to have a child is, in fact, influenced by the individual's processing of information guiding the formation of expectations around the outcomes of childbearing (Vignoli et al., 2020). People may weigh differently the potential impact of childbearing on various social spheres such as leisure time, working career, and quality of relationship with the partner (e.g., Friedman et al., 1994). Parents-to-be probably expect an increase in their subjective well-being from having kids, but its predicted amount may be heterogeneous between individuals (Balbo & Arpino, 2016; Kravdal, 2014). We argue that risk tolerance represents a relevant determinant of the heterogeneity in these expectations that, in turn, influences reproductive choices. Risk tolerance can either increase or decrease the utility that an individual ascribes to certain choices (Fox & Tversky, 1995), among which we include childbearing. Thus, different risk preferences are likely to yield to different fertility behaviors. This perspective is even more compelling in recent decades, given that couples are more likely to be aware of their genetic inheritance and the genetic risks they potentially carry to newborns (e.g., Khoury et al., 2009).

RISK TOLERANCE AND FERTILITY

The value of children (VoC) theory addresses the value (or utility) of children (Friedman et al., 1994). According to VoC theory, childbearing is seen as an immanent good that increases both the individual's and couple's utility. The family, as other forms of association, may provide members with mutual insurance (Appelbaum & Katz, 1991). People may invest in the family as a way of being protected from negative events and as a source of help and well-being. Having children may then be a strategy for increasing the insurance benefits provided by the family club. Moreover, childbearing may also serve as a manner of increasing social integration into the community (e.g., Nomaguchi & Milkie, 2003) and reinforcing marital solidarity. In fact, such a long-term obligation, by bringing predictability and order to the parental life course (e.g., Burton & Tucker, 2009), generates a higher marital capital (in the form of marital solidarity) that should decrease the likelihood of couple instability (Friedman et al., 1994). Previous studies have found that poor (perceived) partnership quality may increase fertility in order to reduce life uncertainty and to decrease the risk of union dissolution (e.g., Rijken &

Liefbroer, 2009). Following this reasoning, because risk-averse individuals are those who most need to establish predictability to daily life, it would be especially for risk-averse individuals that having a child offers an immanent value.

Another strand of the literature also leads to the idea that children increase utility under risk, the children as an "old-age security" perspective. According to this framework, the value of offspring is originated by the belief that children, in the long run, will give back (monetary or in-kind) transfers to parents getting older (Burton & Tucker, 2009). Thus, "old-age security" may represent a core motivation for childbearing especially for risk-averse parents or parents-to-be. They might be likely to consider children, compared to other actors, as a more reliable source of emotional, instrumental, and economic support at older ages. Children as an old-age security is an argument used mostly for developing countries, but there is large evidence for its validity also in developed countries (e.g., Cigno & Rosati, 1992).

Previous arguments explain why high levels of risk aversion may favor fertility. In a specular way, we may bring several motivations for why high levels of risk tolerance may disfavor fertility. The literature on risk tolerance provides empirical evidence that a generalized orientation toward risky behaviors may exist for individuals who are (very) tolerant to risk. Risk lovers or risk-tolerant individuals are overrepresented among at-risk groups such as gamblers and drug users, high-risk sports players, and risky sexual performers (Zuckerman, 2007), all behaviors that give pleasure and are subject to risks which are more easily calculable than those implied by childbearing.

Along these lines, it has been found that risk-takers are more likely to unfollow normative behaviors and roles (Ferguson & Valenti, 1991) and to hold self-oriented attitudes (Güth et al., 2008). Thus, one of the reasons more risk-tolerant individuals may renounce to parenthood (or limit the number of children) is because they may anticipate that having children implies being intensely involved in parenting tasks, for example, child care (Poortman & Van Der Lippe, 2009)—which are incompatible, to a certain extent, with more rewarding and risky activities.

In sum, based on the previous arguments, one could expect that *the more risk-averse* (*tolerant*) *individuals are*, *the more* (*less*) *likely they are to have an additional child*.

Theoretical arguments, however, can be developed in favor of a competing expectation. Given the possibility of *ex post* negative shocks associated with children (i.e., in terms of well-being loss), theorists of "children as a risky investment" emphasize that childbearing represents an investment with uncertain "returns". Cain (1983, p. 695), for instance, stated that "children are neither costless nor risk-free investments. They may die or become disabled; and they may refuse to honor their obligations to parents."

In the same line of reasoning, the intergenerational wealth flows theory (Caldwell, 1982) supports the thesis according to which children are "unproductive goods". This perspective posits that in modern societies, contrary to traditional ones, the wealth flows transfers go from parents to children and not vice versa. Accordingly, the parental investment in economic and temporal resources for their offspring (e.g., for their education) is not expected to be recompensed via reciprocal altruism (Coleman, 1990). Transfers to children might be seen as non-reciprocal either because benefits might not be received in the future or because the expected gratification might be substantially smaller than the efforts put in parenting. Parents could conceive that child will reduce time for own leisure activities. Moreover, children could be considered as a trigger of economic or psychological distress such as short-term sleep problems (Dørheim et al., 2009), parental worries about newborn well-being (Bittman & Wajcman, 2000), and a decrease in the quality of the intimate relationship (Twenge et al., 2003). Given the recent ease of access to detailed information on genetic inheritance on a variety of diseases, children could be considered as a source of uncertainty also in terms of their future health, amplifying the perception of parental responsibility for managing genetic risks (e.g., Heyman et al., 2006). In parallel, childbirth could produce economic losses—such as

lower income, also possibly due to reduced working hours, higher consumption expenditures, and limited work opportunities (e.g., Boushey, 2008). Given that returns are considered to be highly unsure, children might be perceived as a "risky investment", which is decreasingly attractive as the individual level of risk aversion increases. Thus, high levels of risk aversion would deter from investing in childbearing.

The discussion above illustrates why risk aversion may reduce fertility. Consistently, it may be argued that risk tolerance might favor fertility. Risk-tolerant individuals are more predisposed to seek novelty and excitement (Weber et al., 2002). Extending to fertility behaviors the concept of edgework, that emphasizes the positive value of risk (Lyng, 2008), risk-tolerant individuals might expect to obtain satisfaction from the risks associated with fertility. In this sense, having children provides the emotion of novelty and challenges that the newborn will give (Copping et al., 2013) and potentially increases self-esteem for the ability of managing the responsibilities and challenges of being a parent. Under these conditions, the benefits of having a (an additional) child are expected to outweigh the costs, given that the newborn is expected to increase individual pleasure. Therefore, risk tolerant are likely to have high fertility because they derive emotional pleasure from seeing a child growing up (Eibach & Mock, 2011; S. K. Nelson et al., 2014), thus considering children as "investments" with high expected gains.

All in all, the previous discussion implies that if children are essentially considered as "risky investments" with potentially high gains but also high and uncertain costs, it is risk tolerance rather than risk aversion to favor fertility. Thus, one could predict that *the more risk averse* (*tolerant*) *individuals are*, *the less* (*more*) *likely they are to have an additional child*.

Regarding parity transition, we expect that risk aversion will be more relevant for the transition to the first child than to the second one because marginal costs and benefits (objective and perceived) of the first child are higher compared to other parity transitions. Considering the costs of having a child from the perspective of risk-averse individuals, the entry into parenthood is expected to be more problematic because the opportunity costs, such as those related to one's working career, are higher (e.g., Liefbroer, 2005). Risk-averse individuals may expect the first birth to be more beneficial than higher order ones, too. In fact, partners may benefit from childbearing because it triggers a strengthening of the marital bond, but this effect is stronger for the first birth that gives to the partners the new role of parents. Moreover, having one child could be considered sufficient for receiving emotional support, as well as personal and instrumental care, during old age (Grundy & Read, 2012). Also, in the case of risk-tolerant individuals, it is reasonable to think that the objective and perceived costs are higher for the transition from childlessness to parenthood. In fact, it is such transition that makes incompatible, to a certain extent, those "risky" actions that increase the individual utility of risk-takers. In parallel, the benefits associated with the transition to parenthood might be more substantial than those for higher order births for risk-tolerant individuals who are more likely to experience a higher excitement when they become parents for the first time, given its higher degree of novelty.

Gender, risk tolerance, and fertility

The literature on gender differences in risk tolerance is vast, but the conclusions are rather ambiguous. Some studies point out the presence of a gender difference in risk tolerance (see Eckel & Grossman, 2008, for a review). For instance, Bernasek and Shwiff (2001) show that women tend to invest a lower percentage in stock of the contribution pension funds than men. According to the authors, this is because women, being more risk averse than men, are more likely to prefer lower risks associated with investments. A meta-analysis showed, however, that the effect of gender on risk tolerance is not significant in about 40% of the 322 effects considered (Byrnes et al., 1999). As such, a clear conclusion about the existence of a solid gender gap in risk aversion cannot be achieved.

Recent contributions have further questioned the existence of a clear gender difference in risk aversion. J. A. Nelson's (2015) review of the literature on gender and risk aversion shows that substantive gender differences in risk aversion found in previous studies are small and that the degree of overlap between women's and men's distributions of risk aversion is considerable. Similar conclusions are reached by other authors (e.g., Filippin & Crosetto, 2016).

Another important aspect to consider is whether gender similarity in risk aversion leads to gender similarity in responding to risks. The reasoning here is that women and men could respond differently to external risks, also in the case of similar risk preferences. Scholars have shown that this is not the case, and men and women with analogous levels of risk aversion seem to behave similarly (e.g., Bartczak et al., 2015; Fey et al., 2021). Given that no study has considered whether at similar levels of risk attitudes men and women embrace different reproductive behaviors, we will exploratively test this possibility.

Economic heterogeneity

In this section, we extend our theoretical considerations about the relationship between risk tolerance and fertility by considering economic status as a possibly relevant moderating factor (*economic heterogeneity*). The idea of a moderation effect of economic resources when analyzing risk tolerance recalls the view of Merton (1957) according to which preference for risk is seen as a transformative factor that contributes to the achievement of higher status. This theoretical perspective has been recently enriched by the relative risk aversion framework proposed by Breen and Goldthorpe (1997) in the field of sociology of education. Their intuition is that individuals from disadvantaged socioeconomic backgrounds invest in education especially in the case they (and/or their parents) are risk tolerant. Following this intuition, one may argue that risk tolerance could play a role in shaping the socioeconomic gradient of fertility. Take the case that risk aversion increases the awareness that having a child boosts uncertainty because of the perceived high variation of its costs. Under this circumstance, one would expect risk aversion to represent an antinatalist determinant for low-income individuals. We now explain more in depth this idea. In the previous section, we have put forward competing theoretical arguments about the relationship between risk tolerance and fertility. Consistently, the way the interaction between economic resources and risk tolerance works may vary depending on the considered mechanism at work.

Assuming that the mechanisms behind the expectation of a positive association between risk aversion and parity progression hold, one can expect that the VoC will be even higher for households at higher risk of economic instability. In fact, the VoC theory predicts that children bring order and predictability to parental lives. As thus, couples characterized by higher economic uncertainty, as those with lower income, are expected to be more likely to have children. The argument of children as an old-age security predicts the same, given that couples with precarious and/or lower status jobs are those with poorer pension prospects. Finally, as already explained, individuals with high level of risk tolerance may be inclined to self-fulfillment through the adoption of risky behaviors that compete with childbearing. Individuals with lower economic resources may find more challenging than their richer counterparts to combine responsive and intensive parenting that often imposes lifestyle constraints (Mills et al., 2011) and risky choices in other life spheres. Therefore, one may expect them to have a lower fertility especially if they have a low income, given that children may subtract economic resources that they would invest in sources of contingent gratification.

Let us consider now as valid the expectation that children are risky investments. Childbearing should be perceived as an even more risky choice by low-income households. The negative balance between expected costs and rewards from childbearing should be relatively more salient for individuals with lower income who are less able to cope with potential income losses or

expenses associated with children. Therefore, risk-averse individuals in low-income households would be even less likely to have children. Similarly, the excitement to experience childbearing (Frejka et al., 2008) may trigger an underestimation of the potential direct costs of childbearing. Given that costs of having a child matter more for lower income individuals, risk-tolerant individuals may be even more likely to have children in case they have limited economic resources.

Thus, while the arguments at the beginning of this section bring us to expect that the relationship between risk tolerance and fertility per se may be either negative or positive, the association is expected to be stronger for low-income individuals. As previously discussed, expected economic costs and benefits of children are more likely to influence the decision to have the first child. Given that lower income households, at least marginally, are more sensitive to economic aspects of parenthood, one should expect the strength of the interaction between economic condition and risk aversion to be greater for the transition from childlessness to parenthood.

THE ITALIAN CASE

Our analyses rely on data from Italy, a country that, despite being characterized by familistic orientations (Dalla Zuanna, 2004), belongs to the group of the "lowest-low fertility" countries (Kohler et al., 2002). Italy is an interesting country where to investigate the effect of risk aversion on fertility.

On the one hand, the institutional and cultural context makes having children a risky choice, given uncertain consequences on its costs and parents' lifestyle. Formal childcare services are scarce and costly (Knijn & Saraceno, 2010), and childcare is largely delegated to mothers, making childbearing a risky choice for the working career of women and for the household's income (Matysiak & Vignoli, 2013). Additionally, in Italy, children tend to leave the parental home very late (Dalla Zuanna, 2004). This potentially creates a further perception of risk for long-term economic sustainability of the household. These considerations suggest that childbearing in Italy could represent a risky choice.

On the other hand, considering a number of ideational and structural characteristics of the Italian context, children could represent an insurance for parents. First, given the lack of a minimum income provision regulated at the national level, the family represents the safest institution to bear the burden of income support in case of need of its members (Saraceno, 2016). Indeed, according to the Italian law, adult children have financial responsibility toward a parent in need. Second, given the characteristics of the welfare state and of family ties, having children in Italy may be also related to parents' expectations about care that children would provide at older ages (Alesina & Giuliano, 2007). Even if Italy is a country characterized by strong family ties (Dalla Zuanna, 2004; Giuliano, 2007; Reher, 1998), where also childless older people can generally count on the support of the extended family (Kalmijn & Saraceno, 2008), lack of help might be experienced, especially related to intense care tasks (Deindl & Brandt, 2017). This is mainly because public welfare, given its low social service provision, is not able to compensate fully for informal support deficits (Albertini & Mencarini, 2014). As such, even if the intergenerational exchange of resources in Italy tends to be less frequent than in other European countries, it is more intense, and more connected to individual needs (Albertini & Kohli, 2013). Not being a parent, in other words, has adverse consequences on individuals where the family is the most important provider of welfare (Saraceno & Keck, 2010).

Such expected benefits become even more relevant in a context where, due to the continued increase of life expectancy, the pension system has undergone several reforms generating expectations of reduced future pension benefits. Several socioeconomic contributions support the idea that having children represents a form of social security that is complementary to pension insurance (e.g., Cigno, 1993). Studies find that changes in husbands' prospected income (pensions

benefits) significantly influence women's fertility (e.g., Fenge & Scheubel, 2017), also in contexts with strong family ties (Billari & Galasso, 2009).

Given the multifaceted nature of childbearing in Italy, risk preferences of individuals are likely to play an important role in determining the fertility choices in this country, but it is not obvious in which direction risk preferences may operate.

DATA AND METHODS

We use data from the SHIW carried out by the Bank of Italy every 2 years since mid-60s. The sample used in the most recent waves comprises about 8000 households resident in Italy (20,000 individuals; for more details, see www.bancaditalia.it). SHIW collects information on consumption, income, and labor marker participation in addition to several other household characteristics for a representative sample of Italian households drawn in two stages from population registers. From the 1989 wave, a rotating panel component has been introduced. The share of panel households on the total has been around 45%–50% in total since 1993.

Risk tolerance measure (explanatory variable)

A question designed to elicit risk tolerance has been included in the 1995 and 2000 waves. The question posed to each head of household asks the maximum price he/she would be willing to pay to participate in a hypothetical lottery. Specifically, the question was asked as follows: "We would now like to ask you a hypothetical question that we would like you to answer as if the situation was a real one. You are offered the opportunity of participating in a lottery permitting you, with the same probability, either to gain a net amount of Italian Liras (Lit.) 10 million (corresponding to about 5,164 Euros) or to lose all the capital invested. What is the most you are prepared to pay to participate in this lottery?" To help the respondent understand the question, the interviewers showed an illustrative card and were ready to provide explanations. We convert the original values in Lit. to Euros using the official conversion rate (Lit. 1936.27 = €1). Note that the net payout is fixed (€5164). The question is aimed at measuring the maximum price (bet) the respondent is willing to pay to participate in the lottery (with known payout and probability of winning). Thus, the expected gain (G) from participating in the lottery is given by: $E(G) = 0.5 \times (5164 - \text{bet})$. This implies that risk-averse individuals are those who declare a bet <€5164 (and the degree of risk aversion increases as the amount of bet decreases).

We use all observations from households who participated in at least one of the 1995 or 2000 waves of SHIW. In this way, our data include observations covering the period 1989–2008. In the year 2000, the question was asked to half of the sampled households, that is, to around 4000 households heads. As a convention, the SHIW considers the household head as the main earner. Thus, the number of female household heads is low (about 15.1%).

The SHIW data and risk-tolerance question we use have been previously employed, for instance, to study educational investments (Belzil & Leonardi, 2013; Checchi et al., 2014). Compared to self-reported measures of risk aversion, lottery-type questions as the one in SHIW offer a validated, theoretically grounded objective measure of attitudes toward risk (Guiso & Paiella, 2008; Hammitt & Haninger, 2010). On the contrary, the question can be more difficult to understand compared to a self-assessment of risk attitudes, leading to higher number of missing values. As in Belzil and Leonardi (2007), the declared value of the "bet" is our explanatory variable in the main analyses. Alternative operationalizations give very similar results (see the Supplementary Materials [SM]).

Control variables

Most of the control variables are individual characteristics measured on both partners. Thus, we control for woman's characteristics and measures of difference between the partners. Controlling, alternatively, for women's and men's characteristics, we obtain very similar results. Specifically, we control for woman's age and its square, age difference between the partners, woman's education (*low* = ISCED 0–2; *medium* = ISCED 3–4; *high* = ISCED 5–6), education homogamy (partners have the same education; woman's education is higher; woman's education is lower), woman's and man's employment status (employee; self-employed; not employed), logarithm of household income, respondent's gender, region of residence (North; Center; South or Islands), and year dummy variables.

Analytical approach

We estimated panel data probit models for the probability of having the first or second child within each wave. Time-varying control variables were lagged. Robust standard errors accounted for repeated observations. We did not consider higher order parities because of the extremely low number of these transitions during the observation period.

We tried different specifications for the explanatory variable of interest, that is, risk tolerance: linear, quadratic, logarithmic transformation, and categorization based on terciles. The quadratic specification was selected because it produced the best model fit, but results did not vary substantially for the other specifications. As an exemplification of this robustness check (see SM), we provided results for the logarithmic transformation (other results are available upon request).

We estimated two types of models that differ for the control variables included. The variables entered only in model M2 (woman's education, education homogamy, woman's and man's employment status, and logarithm of household income) potentially may be themselves affected by risk tolerance (e.g., Checchi et al., 2014; Guiso & Paiella, 2008). We included these variables separately to assess the robustness of our estimates to the inclusion of potential mediators.

Finally, we also implemented moderation analyses by introducing interactions between risk tolerance and gender or household income.

The initial sample includes 4709 individuals. The model for the transition to the first child is estimated on the subsample of individuals at risk of experiencing this event, that is, it excludes from the original sample 3247 individuals who already had children at the beginning of the relevant observation period. Similarly, we exclude from the original sample 3161 individuals with two or more children for the analysis of the transition to the second child. We select only individuals in a couple (married or cohabiting) where the man is aged 18–55 and the woman is aged 18–45, thus excluding 543 and 143 individuals for the first and second child sample, respectively. We also excluded individuals with missing information on control variables (39 and 36) and, in the main analyses, also on the bet variable (128 and 202). After applying the abovementioned exclusion criterion, our working samples are reduced to 752 and 1167 individuals for models for the transition to the first and second child, respectively (amounting to 1272 and 2542 observations, respectively).

Robustness checks

First, we considered alternative operationalizations and specifications for risk tolerance. Second, we excluded respondents that declared a null value for the bet. Third, we used instrumental

variables to adjust for possible bias due to missing answers to the lottery question. Fourth, we considered only observations for which risk tolerance was measured before the fertility events. Fifth, we added additional control variables (household consumption and liquidity constraints). Finally, we used again an instrumental variable approach to adjust for measurement error in the risk tolerance measure.

On the whole, the robustness checks demonstrated that results were highly robust. Not only the statistical significance and sign were not altered but also the magnitude of the effects was stable (as shown by the predicted probabilities). Robustness checks are described in more detail in the SM where we also report all results.

RESULTS

Descriptives

Table 1 reports descriptive statistics on all independent variables separately for the two subsamples used in the multivariate analyses, that is, for the probability of first and second birth, respectively. It also reports the number of observations, individuals, and events. Table 1 shows that the answers to the lottery question were characterized by a high variability. For the first child sample, the average declared bet value (our risk tolerance measure) was €978.8 with a standard deviation of €1716.3. Similarly, for the second child sample, the declared bet value was on average equal to €799.2 with a standard deviation of €1926.8.

TABLE 1 Descriptive statistics separately for the two samples used in the multivariate analyses

Variables	First child % (mean/SD)	Second child % (mean/SD)	Variables	First child % (mean/SD)	Second child % (mean/SD)
Risk tolerance	978.8 (1716.3)	799.2 (1926.8)	Man's employment		
Age of woman	31.5 (6.2)	35.4 (6.0)	Employee	72.2	73.4
Age difference partners	3.2 (3.8)	3.4 (3.5)	Self-employed	23.8	22.3
Woman's education			Not employed	4.0	4.2
Low	37.0	51.6	Total income (log)	9.5 (1.5)	9.5 (1.4)
Medium	45.3	38	Gender (household head)		
High	17.7	10.4	Man	82.5	86.1
Education homogamy			Region of residence		
Same education	60.8	65.4	Northern Italy	53.5	51.1
Woman education: higher	22.7	19.6	Central Italy	17.5	21.0
Woman education: lower	16.4	15.0	Southern Italy	29.1	27.9
Woman's employment					
Employee	52.8	49.3	No. observations	1272	2542
Self-employed	11.9	9.4	No. individuals	752	1167
Not employed	35.3	41.4	No. childbearing events	428	499

Note: The table reports the percentage of each category for categorical variables, the mean and standard deviation (SD) of quantitative variables.

The effect of risk tolerance on first and second births

Because of the nonlinear nature of the probit model and the quadratic specification for the tolerance measure, to ease interpretation of results, we show results graphically reporting the predicted probability of first and second birth, separately, for different values of the declared bet (our risk tolerance measure). Full tables of regression estimates are reported in the SM.

As explained above, we considered two models that differ for the number of control variables included. Estimates (Table S1 in SM) show that adding potentially endogenous control variables (e.g., education) did not alter the magnitude and statistical significance of the risk-tolerance coefficients. This was also the case for predicted probabilities. Therefore, in the following, we focused on interpreting estimates from the complete models (M2). We also implemented formal mediation analyses that confirmed the substantively small and often statistically insignificant differences between estimates from models M1 and M2 of Table S1 (results available upon request).

The left-hand-side plot in Figure 1 shows that there was a negative relationship between risk tolerance and the probability to have the first child during the observation period: Individuals who were more risk tolerant (willing to pay more to participate in the lottery, that is, they declared a higher bet value) shown the lowest probability of having the first child as compared to remaining childless. The trend in the decline in the predicted probability of first birth as risk tolerance increased was almost perfectly linear as also confirmed by the small and not significant coefficient of risk tolerance squared (Table S1). The effect of risk tolerance was not only statistically significant but also substantive: The predicted probability of first birth ranged from about 35% for the least risk-tolerant (most risk-averse) individuals (bet = €0) to about 22% for the most risk-tolerant (least risk-averse) individuals in the considered range (bet of about €5000).

Similar results are found also for the transition to the second child as demonstrated in the right-hand-side plot in Figure 2. The main difference between the models for the first and second birth is that in the latter case, the predicted probabilities were, of course, lower for all values of risk tolerance. However, the relationship between risk tolerance and the probability of a second birth (as compared to remaining with one child) was again substantive: The predicted probabilities ranged between 21% (bet = €0) to about 12% (bet of about €5000). We can also notice that the squared term in the model for the second birth (Table S1) was statistically significant, and this was reflected in a mildly quadratic relationship in the second plot in Figure 2.

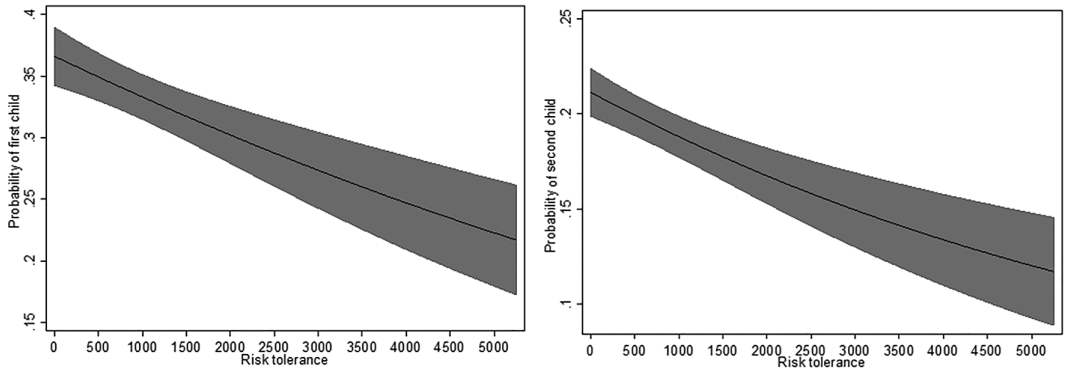

FIGURE 1 Predicted probability of first and second births by risk tolerance with confidence bands for 5%-level multiple comparisons. The figures represent predicted probabilities obtained from probit models "M2" (Table S1 in the SM)

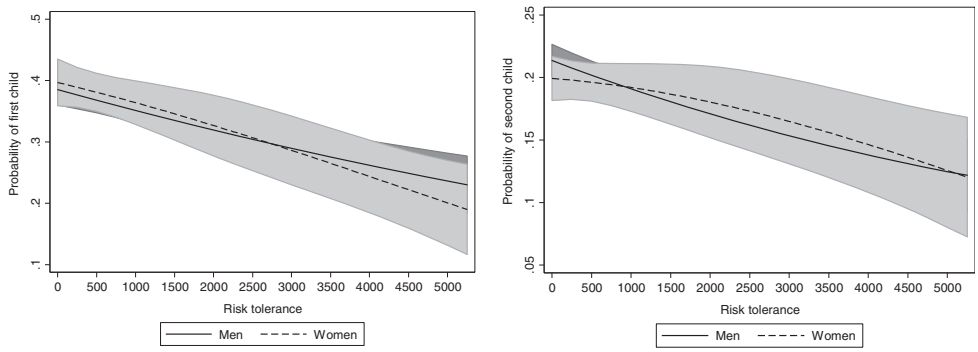

FIGURE 2 Predicted probability of first and second births by risk tolerance and gender with confidence bands for 5%-level multiple comparisons. The figures represent predicted probabilities obtained from probit models (Table S2 in SM)

Gender as a moderator of the effect of risk tolerance on fertility

Before testing whether the respondent's gender moderates the relationship between risk tolerance and fertility, we tested the gender difference in our measure of risk tolerance and found a small (€37.1) and statistically insignificant ($p = 0.4357$) effect of gender on risk tolerance. This is consistent with the results of Guiso and Paiella (2008) on the same data we used but on the whole sample.

Then, we estimated probit models including an interaction between risk tolerance (and its square) with gender. Results are presented graphically in Figure 2 for the first and second births separately (full regression estimates are reported in Table S2 of the SM). The results show that the effect of risk tolerance on fertility outcomes did not depend on the gender of the respondent on which risk tolerance was measured. In fact, the patterns of association between risk tolerance and both the probability of the first and second birth were very similar for women and men. Correspondingly, interactions were not statistically significant (Table S2 in SM).

Income as a moderator of the effect of risk tolerance on fertility

We estimated probit models including an interaction between risk tolerance (and its square) with the logarithm of the total household income. Results are presented graphically in Figure 3 for the first and second births separately (full regression estimates are reported in the Table S3 of the SM). Figure 3 shows the predicted probability of having the first child (first plot) or second child (second plot) at different values of risk tolerance (x-axis) and at two different percentiles of (log) income (10th and 90th percentiles), that we label as "low" and "high" income. This produces two curves, representing how the relationship between risk tolerance and fertility varied for the two income levels considered.

The first plot in Figure 3 shows evidence of a moderation effect of income. The relationship between risk tolerance and the probability to have the first child was negative for both "low-" and "high"-income levels. However, consistent with our theoretical expectations, the effect of risk tolerance was much stronger at the low-income level. The moderation effect of income was also confirmed by the statistically significant interaction between income and risk tolerance (Table S3).

Instead, the relationship between risk tolerance and the probability to have the second child was not moderated by income. The interactions between income and the risk tolerance variables

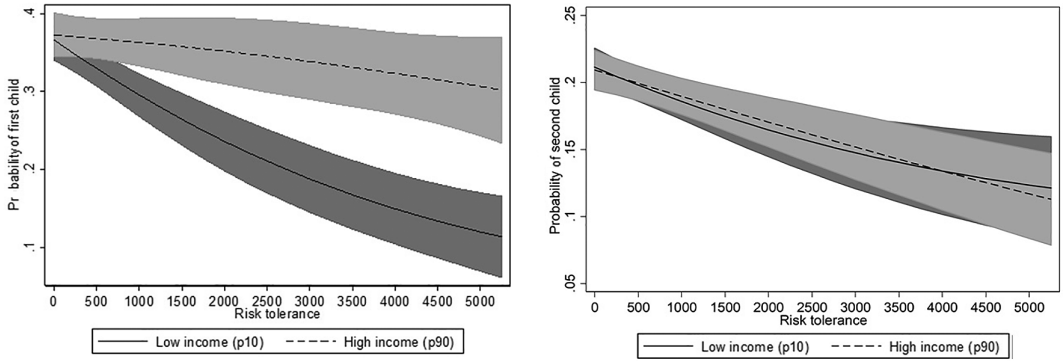

FIGURE 3 Predicted probability of first and second births by risk tolerance and two levels of total household income (log) with confidence bands for 5%-level multiple comparisons. The figures represent predicted probabilities obtained from probit models (Table S3 in SM). Two levels of income are considered: low and high, corresponding to the 10th and 90th percentile of the income distribution, respectively

were not significant in the second child model (Table S3). This is evident in the second plot of Figure 3 where we can clearly see that the predicted probability of having the second child varied with risk tolerance almost in the same exact way for low- and high-income levels.

DISCUSSION AND CONCLUSIONS

This study aimed at demonstrating the role of risk preferences in theorization and empirical research on fertility. By bringing together different theoretical perspectives, we discussed the role of risk tolerance in fertility behaviors. Inspired by Merton (1957) view of risk preferences as transformative factor that contributes to the achievement of higher status and by the relative risk aversion framework (Breen & Goldthorpe, 1997), we also extended our theoretical arguments on the relationship between risk tolerance and fertility by considering economic status as a moderating factor (*economic heterogeneity*). Our theoretical discussion consistently implied a stronger effect of risk tolerance (either positive or negative) for low-income individuals. We also explored gender differences in risk tolerance and the potential gendered effect of risk tolerance on fertility.

We provide an empirical test of the effect of risk tolerance on fertility in Italy. To the best of our knowledge, with the exception of the work by Schmidt (2008), there is no study focusing on the role of risk tolerance on fertility. Using data from the United States, Schmidt (2008) examined the timing of first births among women and found an effect of risk tolerance on the whole population only at young ages (among women younger than 20 years). This seems to provide evidence in favor of one of the predictions made by Schmidt (2008) that more risk-tolerant women are more willing to accept high risks of an unplanned pregnancy and therefore contracept less effectively. Unplanned pregnancies, especially among teens, have received quite a deal of attention in the United States for their consequences on subsequent life outcomes (e.g., Furstenberg Jr et al., 1987), but this phenomenon has a considerably marginal incidence in other developed countries, such as Italy (Robson & Berthoud, 2003). In fact, in our preliminary analyses, we did not find any evidence of moderation effects of age. In other words, the effect of risk tolerance did not seem to substantially vary with age. On the contrary, our results point to a negative effect of risk tolerance on the probability of having the first and second child—during the observation period.

Estimates from our probit models, confirmed by several robustness checks, showed that the most risk-averse individuals had the highest likelihood of having a (another) child, while the opposite was found for those individuals who are more risk tolerant. Additionally, we found that the effect of risk tolerance on fertility persisted (also in its magnitude) even after including other determinants of fertility, which may also be influenced by risk tolerance, such as education. This suggests that the effect of this individual preference on fertility is mostly direct, that is, due to the trait per se and it is not (substantially) mediated by other factors that are influenced by risk tolerance. Our results were also robust to the presence of missing data and measurement errors. The estimated effect of risk tolerance was not only statistically significant but also substantially relevant. The predicted probability of first birth ranged from about 35% for the least risk-tolerant individuals to about 22% for the most risk-tolerant individuals. For the second birth, the predicted probabilities ranged between 21% and about 12% for the least and most risk-tolerant individuals, respectively. We did not find any gender difference in the association of interest.

Our findings on higher fertility among the most risk-averse individuals are consistent with expectations from the VoC theory and the old-age security perspective. Based on the VoC theory (Friedman et al., 1994), childbearing can be considered as an immanent investment that increases both the individual's and couple's utility. Risk aversion may play a key role in influencing the expected utility of having a child. In fact, having a (another) child may aim at achieving higher stability and predictability in one's couple and individual life. Previous studies have supported the idea of parenthood as a reinforcer of the quality of relationship with the partner (Friedman et al., 1994; Rijken & Liefbroer, 2009; Wu, 1996) and of the social integration of the individual and the couple into the community (Knoester & Eggebeen, 2006). By bringing stability and predictability in one's life, fertility is particularly attractive for those individuals who wish to minimize risks, that is, the risk averse.

The fact that fertility level is higher among the most risk-averse individuals is also consistent with the old-age security perspective, which posits that fertility decisions are, in part, motivated by the expectation of receiving care and other forms of support from children in case of future need, especially at older ages (Burton & Tucker, 2009). Several studies provided evidence for the validity of the old-age security perspective also in developed countries, including Italy (Billari & Galasso, 2009; Cigno & Rosati, 1992; Galasso et al., 2009; Rendall & Bahchieva, 1998), where informal care is an important part of the care received by older individuals (Dykstra & Fokkema, 2011). If children are seen as an old-age security, childbearing is particularly attractive for risk-averse individuals who may want to "buy" this security in order to reduce future risks.

In sum, risk-averse individuals display a higher level of fertility likely because having children is seen as a decision that does not expose them to more risks. All of the contrary, fertility may act as an uncertainty-reducer strategy that counterbalances the risks that may be associated with other life events, as for example, health deterioration at older ages, or that may reduce the risks of potentially stressful life events, such as divorce.

In a specular way, our results point at low-fertility levels among individuals who are the most risk tolerant or the least risk averse. This is consistent with the idea that the most risk-tolerant individuals may consider childbearing as incompatible with other more rewarding risky behaviors. Studies found evidence of a generalized orientation toward risky behaviors for some risk-tolerant individuals, who are simultaneously attracted by different risky choices such as gambling, uses of drugs, risky sports, and sexual practices (Zuckerman, 2007). These individuals are likely to hold individualistic and self-oriented attitudes (Güth et al., 2008) and to deviate from normative behaviors and roles (Ferguson & Valenti, 1991). Thus, our findings are in line with the idea that the most risk-tolerant individuals have a lower fertility because investing in children may be perceived as an obstacle to their self-realization throughout a diversified source of excitement via risky life choices.

Our test of the economic heterogeneity hypothesis confirms the expectation of a stronger effect of risk tolerance (either positive or negative) for low-income individuals, but only for the first child. More specifically, we found that the relationship between risk tolerance and the probability to have the first child is negative for both "low-" and "high"-income levels but much stronger for the low-income individuals and rather weak for their richer counterpart. In other words, risk tolerance matters more for low-income individuals in influencing their transition to the first child. This was not the case for the second child. In fact, the relationship between risk tolerance and the probability to have the second child was not moderated by income. The extent to which the predicted probability of having the second child varied with risk tolerance was almost the same for low- and high-income levels. Looking at predicted probabilities of having the first child more closely, we observe that the likelihood of becoming a parent tends to be similar for low- and high-income levels among the most risk-averse individuals; they become increasingly different as risk tolerance increases. Therefore, these findings suggest that low-income risk-tolerant individuals face stronger constrains in choosing between having the first child and other decisions, as compared to those with a high income who may combine fertility and other choices more easily. However, this "income advantage" does not differentiate risk-tolerant individuals when facing the decision to progressing to a second child. Higher parity progression seems to be similarly incompatible with risky behaviors for high-income and low-income risk-tolerant individuals.

Our study is, of course, not without limitations. As mentioned in Section 2, we followed the subjective expected utility theory considering that fertility decisions are subject to uncertainty in the occurrence of negative and positive consequences and that the likelihood of these events may be subjectively estimated by individuals based on their own and others' experiences. For some subgroups of the population or in some countries, however, uncertainty may be "fundamental", meaning that the consequences of fertility may be completely impossible to be predicted. Johnson-Hanks (2004), for example, argues that in Africa, women face "radical" uncertainty in fertility decisions. Thus, uncertainty aversion may be more relevant than risk aversion in some contexts. Disentangling the effect of risk and uncertainty aversion is an interesting avenue for future theoretical and empirical work, possibly based on survey or laboratory experiments.

Despite the availability of an objective and validated measure of risk aversion, SHIW data present some limitations. First, we did not have a long panel data set, and it was not possible to implement an event-history analysis. Second, it would have been ideal to account for time discounting preferences (TDP), a related but very distinct concept from risk aversion. TDP indicate the extent to which individuals prefer immediate utility over delayed utility, and it has been found to be nonlinearly associated with fertility (Bellani et al., 2021). In SHIW, a measure of TDP was not included in the same waves in which risk tolerance was measured. Third, the SHIW data did not allow to directly test the theoretical mechanisms we discussed in the background of the paper. Alternative data, such as the German Family Panel (pairfam) which includes VoC items, could be used in future research. In addition, pairfam data would allow testing the role of risk tolerance in fertility behaviors in a country characterized by a different context than the Italian one, with respect to welfare state provision and family ties.

Notwithstanding these limitations, our study highlights the important role of risk tolerance in fertility behaviors and stimulates researchers to consider risk preferences more broadly as potential determinants of family dynamics.

Future studies should also consider the implications for the nexus between risk aversion and fertility of recent changes in the Italian context. The first is related to the legalization of several forms of gambling (e.g., Gandullia & Leporatti, 2019). As a number of authors have observed, the expansion of gambling exposes local cultures to more favorable attitudes toward sensation seeking (e.g., Horvath & Zuckerman, 1993). An increase in the normative acceptance of risk-tolerant attitudes could imply an expansion of risk-oriented behaviors in other domains of social life, such as in the reproductive sphere. The second change concerns the rising easiness of the acquisition of genetic information (e.g., Khoury et al., 2009). Studies have shown that the

provision of extremely detailed information about the risks of a wide variety of diseases might alter the reproductive decision-making process.

In conclusion, the upshot of this study is that finding solutions to the lowest-low level of fertility requires a better understanding of how individuals react in terms of reproductive choices to their risk preferences and to what extent economic heterogeneity can strengthen the role of risk aversion in fertility decision-making. This article provides a relevant contribution in this direction, but there is still a need for future research to unpack the black box of the link between risk tolerance and fertility.

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