Risk preference of mothers and investment in children

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1 Introduction

Investment in human capital has been considered risky since the works of Becker (1962); Levhari and Weiss (1974) and Schultz (1971). Returns to investment in human capital, ability, probability of getting a good job are few of the various accounts of risk. The traditional approach on the topic examines how an individual's risk preference affects her investment decision. Earlier theoretical works consider the investment choice in various contexts including migration (David, 1974), job mobility (Johnson, 1978), hazardous job (Thaler and Rosen, 1976), and between physical and human capital (Levhari and Weiss, 1974).

This line of inquiry is, however, valid insofar as the decision maker is the individual under study. Occupational choice, tertiary education, specific skills training, to name a few, fall under the domain of individual choice wherein an individual is the decision maker and she exercises scrutiny before making her choice. For children and teenagers, the choice are, more often than not, not theirs to make as they lack the appropriate capacity to make an informed choice while various factors such as pecuniary issues are beyond their control. At the same time, a vast literature on early childhood intervention has deemed these early investments substantially beneficial for future outcomes of children.[1] Furthermore, as highlighted by Jacob and Ludwig (2008) and Duflo and Banerjee (2011), early childhood interventions are most effective in levelling the playground for disadvantaged children. Thus, parents' investment during early childhood plays a pivotal role in shaping the children's future paths. If investment in human capital is risky, the importance of understanding the effect of parental risk preference on children investment naturally follows.

Mother's risk preference has been shown to affect a number of factors that have direct linkage to investment in children or even life outcomes

Most works that focus on parental risk attitudes study how various educational outcomes are influenced by risk preference of parents. The majority reported negative effects of risk aversion on educational outcomes including test scores in the US (Brown et al., 2012), college enrollment in Italy (Checchi et al., 2014), cognitive outcomes in Indonesia (Hartarto et al., 2023). Furthermore, Frempong and Stadelmann (2021) found a positive association between risk aversion and child labour. This, coupled with evidence found by Heady (2003) and Bezerra et al. (2009) suggesting child labour impedes learning, also points to a negative relationship between parental risk aversion and educational outcomes. With regards to various school tracks which offer different curriculums, Wölfel and Heineck (2012) confirmed the negative effects of maternal risk aversion

[1] See Currie (2001) and Nores and Barnett (2010) for a comprehensive review on a large number of childhood intervention programs. Prenatal and postnatal investments have also been found to affect later life outcomes (Almond and Currie, 2011a,b; Currie and Vogl, 2013).

on daughters for a sample of German students such that daughters of more risk-averse mothers are more likely to pursue lower secondary track. On the other hand, Leonardi (2007) found no effect of risk aversion on secondary school track choice for a sample of Italian students.[2]

In general, the literature on parental risk aversion is scarce whilst results are inconclusive. In direct relation to our study, Sovero (2018) uses height-for-age, and BMI-for-age along with other several spending categories to measure investment of Mexican parents. Risk attitudes of parents are elicited using a series of questions with multiple price list structure. Her results indicate a positive linkage between risk averse mothers and their investment on sons, i.e., risk averse mothers invest more on sons than daughters. Using data on Uganda households, Tabetando (2019) confirms the positive relation between risk aversion and investment, measured by level of educational expenditure and its share of household budget. Although wealthier households tend to be more risk averse, the relationship is reversed for poor households. That is, risk aversion depresses investment in credit constrained households.

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2 Data

I use data of National Longitudinal Survey of Youth 1979 (NLSY79) and NLSY79 Child and Young Adults (CYA) to study the effects of parental risk aversion on children investment. The NLSY79 is a longitudinal project that follows the lives of a sample of American youth born between 1957 and 1964 with the first round of data collection in 1979. The original cohort included 12,686 respondents ages 14-22 when first interviewed but later dropped to 9,964 respondents after the scaling down of the military subsample and the exclusion of a portion of the economically disadvantaged, non-Black and non-Hispanic sample. Data are collected annually from 1979 to 1994 and biannually thereafter. Beginning in 1986, additional information was collected biannually about children born to female NLSY79 respondents, constituting the NLSY79 CYA dataset. The Child and Young Adult contains information on a rich set of assessments on cognitive ability, temperament, motor and social development, behaviour problems, self-competence of the children as well as the quality of their home environment. By linking investment, as measured by The HOME (Home Observation Measurement of the Environment) indices along with its subsection indices in the NLSY79 CYA, and an indicator of risk attitudes generated from a series of questions in the NLSY79, it is possible to study the effect of maternal risk aversion on investment in children.

2.1 Mothers' risk preference

To measure attitudes towards risk of mothers,[3] Participants of NLSY79 were asked a series of hypothetical questions on occupational choice. The first question of the series reads:

[2]German and Italy secondary schools mainly separate curriculums based on later-life goals which can be broadly categorized into vocational-oriented education or traditional pathway to university. Schools in Germany also adopt a recommendation system based on the child's ability and which greatly affects track choice.

[3]Since NLSY79 and NLSY79 CYA are linked by identifying unique pairs of mother-child.

"...Suppose that you are the only income earner in the family, and you have a good job guaranteed to give you your current (family) income every year for life. You are given the opportunity to take a new and equally good job, with a 50-50 chance that it will double your (family) income and a 50-50 chance that it will cut your (family) income by a third. Would you take the new job?"

Questionnaire Public Report, National Longitudinal Survey of Youth 1979 (NLSY79), 1993.

Depending on respondents' answers to this question, survey participants were asked a similar question holding the first choice constant while the income cut in the second choice is modified. If participants choose "Yes" in the first question, the income cut in the second question is lowered to 20%. If "No" is chosen in the first question, the income cut is increased to 1/2 in the second question. The first series of questions on risk attitudes were asked in four rounds in 1993, 2002, 2004 and 2006. The new series of questions on lifetime income gamble were asked in 2010. Those who did not participate in 2010 were followed in either 2012 or 2014.[4] The new series begins with the following question:

"Suppose that you are the only income earner in the family, and that you have to choose between two new jobs. The first job would guarantee your current total family income for life. The second job is possibly better paying, but the income is also less certain. There is a 50-50 chance the second job would increase your total lifetime income by 20 percent and a 50-50 change that is would cut it by 10 percent. Which job would you take: the first job or the second job?"

Questionnaire Public Report, National Longitudinal Survey of Youth 1979 (NLSY79), 2010.

Choosing "First job" would lead respondents to a second question with income cut increased to 15% as opposed to 5% for "Second job". Based on answers to the either series of questions, respondents can be categorized into four groups numbered 1-4 where individuals in group 1 choose "Yes" in both questions of the old series or "The first job" in both questions of the new series; while individuals in group 4 opt for "No" in both questions of the old series or "The second job" in both questions of the new series. This means that it is possible for an individual to be placed into different groups in different years, e.g., group 1 in 1993, group 2 in 2002, and group 1 in 2004. By contrast, it is also possible for any individual to stay in one category throughout all the years in which the responses are collected, for instance, she stays in group 1 in all the years she participated in the survey, including 1993, 2006, and 2010. Specifics of groups categorization are presented in Table 1.

It is noteworthy to point out the difference both in the stakes individuals face in two versions of the questions as well as the way in which the questions are phrased. In the first series, individuals face much higher stakes

Table 1: Category of risk attitudes

Response category	**Question / Risk aversion**	**Original**	**Increased income cut**	**Reduced income cut**
1	High risk aversion	First job	-	First job
2	Moderate risk aversion	First job	-	Second job
3	Low risk aversion	Second job	First job	-
4	Lowest risk aversion	Second job	Second job	-

The table describes response categorisation based on answers provided by participants. This applies to both versions of the questions and year-on-year categorisations are independent of one another.

[4] Unlike in the previous series where multiple answers across time are available for most individuals, responses to the new series are only recorded once per individuals.

with the lowest being 20% of income loss while the highest percentage of income loss in the second series is 15%. Further, as noted by Kimball et al. (2008, 2009), the original series presuppose that individuals already have the stable job, i.e., a job without any change to income. This supposition is absent in the newer version wherein individuals are present with two jobs, one stable and one risky. The difference in situations faced by individuals, albeit subtle, may induce the status quo bias. That is, individuals may be more inclined to choose the stable job in the first series not because they are more risk averse but due to their reluctance to change (Samuelson and Zeckhauser, 1988; Tversky and Kahneman, 1991). Consequently, having responses from individuals who answered both type of questions aids in the separation of the status quo bias from the true risk preference.

2.2 Investment data

Traditionally, investment is often associated with monetary expenditures or goods investment (Heckman and Mosso, 2014). Only in recent studies such as Carneiro and Ginja (2016), Bono et al. (2016) and Del Boca et al. (2016) has time input received more attention as a component of parental input. Since more educated parents spend more quality time with their children despite the higher opportunity cost, time inputs plays a pivotal role in shaping children's future (Guryan et al., 2008). Aside time input, a nurturing home environment has also been proven conducive to early cognitive development (Altman and Werner, 2013; Iverson and Walberg, 1982).

Following Carneiro and Ginja (2016), parental inputs are captured by various elements of HOME (Home Observation Measurement of the Environment). HOME (Short Form) comprises primary measures of the quality of a child's home environment included in the NLSY79 Child survey. Various components of the HOME evaluate the cognitive stimulation and emotional support children below 15 years old receive from the home environment. Items that made up the HOME score are grouped into goods input and time input. These are reported in Table 2. Apart from measures of HOME section, several items included in the self-administered questions indicating parent-child interaction for children between 10-14 are also present and have the (NH) prefix. These extra items are also used when constructing HOME index and Time index for children within said age-group.

For each age group, to generate the generic investment index (HOME index), indicators of all items in Table 2 for the corresponding age are totalled then normalised to have a mean zero and unit standard deviation.[5] A similar procedure is also applied to items denoting goods related investment and time related investment to generate indices representing the respective type of parental inputs. Other assessments of cognitive stimulation and emotional support are aggregated into percentile score for the respective quality of home. Unlike previous indices, the percentile scores for cognitive stimulation and emotional support are taken from the NLSY79 CYA dataset.

Now we discuss the timing of investment. Unlike the questions on lifetime gamble which, to some extent, captures an individual's risk preference at the time of survey, the HOME section of the Child & Young Adult survey contains a number of items that are measured at different time-interval as can be seen from the Time panel in Table 2. The time-interval can range from daily basis, to weekly or monthly bases. Two items even measure the frequency of occurrence in the previous year. The incongruence of time diary makes

[5] The recoding of items follows the procedure used by Bureau of Labor Statistics (BLS) when constructing HOME score (See Center for Human Resource Research (2004))

Table 2: Components of HOME index

Items \ Age group	0-2	3-5	6-9	10-14
Goods				
Child has 10 or more soft toys at home	x			
Child has 10 or more push/pull toys at home	x			
Child has more than 10 books at home	x	x	x	x
Family gets at least three magazines regularly		x		
Child has a CD player		x		
Family subscribes to daily newspaper			x	x
Child has a musical instrument			x	x
Time				
Child taken to grocery at least once a week	x			
Child goes on outings more than three times per month	x	x		
Child east at least one meal per day with both parents	x	x	x	x
Child sees father(-figure) daily	x	x	x	x
Mother reads to child at least once a week	x	x	x	
Child goes to museum more than twice in past year		x	x	x
Child spends time with father(-figure) at least four times a week			x	x
Family gets together with friends/relatives at least twice a month			x	x
Child spends time with father(-figure) outdoor once a week			x	x
Mother discusses TV programmes with child			x	x
Child goes to theatre/performance more than twice in past year			x	x
Activities last month[a]:				
(NH) Child went shopping with parents				x
(NH) Child went on an outing with parents				x
(NH) Child went with parents to movies				x
(NH) Child went with parents to dinner				x
Activities last week[a]:				
(NH) Child worked with parents on schoolwork				x
(NH) Child did things together with parents				x
(NH) Child play game or sports together with parents				x

The table reports items that are used to construct indices of investment for four different age groups: 0-2, 3-5, 6-9, and 10-14. Items under panel Goods are used to construct Goods index for all present children while items under Time are used to construct Time index only for children under 10. Extra items gathered under the last two panels are also used to construct the generic HOME index and Time index for children between 10-14.
[a] Items prefixed by (NH) are not from HOME but from self-administered survey of children.

comparison and aggregation of items difficult. To allow a more coherent interpretation of index collecting time-related items, we will assume that there are no stark changes in items that are recorded on bases spanning shorter than a year within the year when data is collected.

2.3 Summary statistics

Descriptive statistics of variables used in analysis are shown in Table 3. The sample is restricted to observations in the year 1994, 2002, 2004, 2006, 2010, 2012 and 2014 to include a measure of risk aversion and which have valid responses (non-missing and non-negative) to child's characteristics, mother's characteristics, and

Table 3: Summary statistics

Variable	Observations	Mean	Standard deviation
Imputed values of CRRA:			
Time-invariant γ_c	6905	1.37	0.87
Time-variant γ_v	6905	1.09	0.73
Parental inputs:			
HOME index	6905	0.39	0.82
Goods index	6897	0.39	0.89
Time index	6897	0.28	0.84
Cognitive Stimulation score (%)	6234	53.89	28.02
Emotional Support score (%)	5804	56.44	27.70
Child characteristics:			
Female	5167	0.49	
Black	5167	0.24	
Hispanic	5167	0.21	
Age of mother at child's birth	5167	27.80	5.63
Number of siblings	6905	1.71	1.25
Family size	6905	4.50	1.26
Mother characteristics:			
Mother lives with both biological parents at age 14	5167	0.74	
Age of mother at first birth	5167	23.79	5.42
Mother's AFQT score (2006)	5167	43.67	28.60
Mother's mother's years of schooling	5167	10.78	3.26
Mother's father's years of schooling	5167	10.68	4.11
High school	6905	0.51	
College	6905	0.32	
# weeks worked last year	6905	35.92	21.90
# weeks spouse worked last year	6905	49.22	8.48
Net household income ($)	6905	77 928.18	75 510.86

Mean and standard deviations are reported for all numerical variables. Only frequency is reported for indicator variables. The sample is restricted to observations with a full set of controls of child's characteristics and mother's characteristics.

parental inputs.[6] This leaves us with 6,905 observations for 5,167 children. The table reports the number of observations, mean, and standard deviations of numerical variables and only frequency for categorical variables. The table is organised into four panels: (1) Imputed values of CRRA coefficient γ which we will discuss in detail momentarily; (2) parental inputs which include various indices described above (HOME, Goods, Time, Cognitive Stimulation, and Emotional Support); (3) Child's characteristics which include sex, race, age of mother at birth of child, number of siblings and family size; and (3) Mother's characteristics which include an indicator variable showing whether mother lived with both biological parents at age 14, age of mother at first birth, mother's AFQT score (2006 revised edition), years of schooling of mother's parents, indicator variables indicating mother's educational level,[7] number of weeks mother and her partner worked in the previous calendar year, and net household income in the previous calendar year. Here we let number of siblings and family size vary with time as these crucially affect the amount of parent-child interaction as well as goods investment. For instance, a child might have receive more inputs in the period prior to her sibling(s) being born. It is also possible that parents anticipate the number of children they will have and thus know how their allocation of inputs will shift when all children have been born. In such a narrative, they can compensate the child or children born earlier in anticipation of diverted attention to other later-born sibling(s).

The average HOME score in our sample is 0.39 which is higher than the average HOME score for the nationally representative sample. A potential cause for this is the restriction on the years in which data chosen which are mostly after 2000 except for the first wave. By the mentioned years, mothers are typically older than the average age of mothers in NLSY79 CYA. This is apparent in the high mean age of mother at child's birth, which is close to 28 in our sample compared to around 25 in the whole sample as reported in Carneiro and Ginja (2016). Higher age also correlates with higher earnings and experience, thus affecting our measures of parental inputs.

The correlation matrix of Imputed values of CRRA and Parental inputs are presented in Table 4. The correlations between imputed values of CRRA and Goods index are found to be statistically significant under both assumptions whereas emotional support score is only robustly correlated with the time-variant version of imputed CRRA.

3 Methodology

3.1 The choice of proxy for risk

Several issues arise with the use of the series of questions on lifetime income gamble to capture risk preference of mothers when she make investment on her children, namely relevance, stability and temporal properties.

First, it is crucial to examine the suitability of this measure in capturing true risk attitudes as highlighted by Yilmazer and Lich (2015). To this end, note that the question wordings and structure of the questions on

[6] Risk preference in year 1993 will be recoded as 1994 to match the closest available investment data. 1994 is chosen instead of 1992 since various items in indices of parental inputs indicate frequency of occurrences in the previous year. Additionally, Hartog et al. (2002) remarked that risk aversion should be measured before individuals make actual decisions.

[7] Mother's education is broadly categorised into three groups: high school dropout, high school and college. Mothers who are in the college group received at least some college education but not necessarily completed college.

Table 4: Correlation matrix

	Time-variant γ_v	**Time-invariant** γ_c	**HOME index**	**Time index**	**Goods index**	**Emotional Support percentile score (%)**	**Cognitive Stimulation percentile score (%)**
Time-variant γ_v	1						
Time-invariant γ_c	0.891***	1					
HOME index	-0.0181	-0.000995	1				
Time index	0.00439	0.00458	0.886***	1			
Goods index	-0.0500***	-0.00682	0.664***	0.259***	1		
Emotional Support percentile score (%)	-0.0512***	-0.0384**	0.354***	0.358***	0.171***	1	
Cognitive Stimulation percentile score (%)	0.00227	0.0188	0.574***	0.413***	0.582***	0.254***	1

The table reports pairwise correlation of imputed values of CRRA and parental inputs for the restricted sample with a full set of control of mother and child' characteristics.
Significance level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

risk preference in the NLSY79 are the same as those in the Health and Retirement Study (HRS) as well as the Panel Study of Income Dynamics (PSID). While the method of eliciting risk preference using lifetime income is uncommon and most other methods fall into the category of self-evaluated risk willingness/tolerance employing Likert scale, gamble choice (Eckel and Grossman, 2002), or multiple price list (MPL),[8] Barsky et al. (1997) showed that this measure does predict an array of risky behaviours including drinking, smoking, and holding of risky assets. Furthermore, gamble on hypothetical choice in general has been shown to perform relatively well compared to its counterpart which offer real monetary rewards (Binswanger, 1981; Camerer and Hogarth, 1999; Dohmen et al., 2005). Given that these series of questions have predictive power over several risky behaviours as well as engagement in activities involving risks such as holding risky assets and participation in the financial market, the measure should be an appropriate proxy for true risk preference.

The second concern is whether the two versions of the questions on lifetime income gamble provide a consistent proxy for risk preference. More elaborately, it begs the question "Besides the status quo bias stemming from different phrasing of the questions, do mothers change their risk preference due to different stakes involved?" This problem is usually referred to in the literature as the stability or consistency of risk preference across contexts. At large, this literature explores how revealed preference changes with different elicitation methods, phrasing of questions, the amount of stakes, and the domains in which risks manifest. In our case, respondents are administered two hypothetical gambles on lifetime income with different stakes. As shown by Holt and Laury (2002), there are shifts in risk preference when participants consider gambles with varying magnitude of stakes when they involve real monetary payoffs. However, no such change in risk preference is found when the stakes are hypothetical. Consequently, responses to hypothetical lifetime income gamble can provide a consistent proxy for risk preference.

The third issue that we will address is the temporal properties of risk preference. We pay close attention to this on the following grounds. On the one hand, if risk preference is static and time-invariant, changes in investment in children across time are independent of risk preference. On the other hand, if risk preference varies over time, to distinguish the impact of risk preference from potential confounders, we need not only account for potential endogeneity and confounding factors, but also capture the dynamic linkage between risk attitudes and investment in children. Sahm (2012) found that systematic differences in risk preference across individuals and over time mostly stem from time-constant characteristics such as gender and ethnicity. To a lesser extent, aging and fluctuations in macroeconomic conditions also contribute to these discrepancies while the effects of the latter is short-lived. Surprisingly, individual circumstances such as job loss, divorce or serious health events do not alter risk preference. Görlitz and Tamm (2020) further found that while parenthood considerably affects risk aversion, that is risk aversion increases as early as 2 years prior to becoming a parent, risky labour market behaviour remains unaffected by parenthood. As our measure of risk is tightly-knit to labour market behaviour, it can capture risk preference without being affected by parenthood. To further separate true risk preference from underlying systemic factors, we will use 2-steps imputation methods by Kimball et al. (2008, 2009) further explained below.

This is to say, are risk attitudes mother adopts when faced with lifetime income gamble equivalent to those when she makes investment decision for her children. Stability across different domains of risk is our second point of contention. Barseghyan et al. (2011) rejects the null of stable risk preference for insurance on automobiles and homes. Similarly, Einav et al. (2012) found that only 30% of their sample make consistent choices when presented with a diverse set of options for insurance coverage and 401(k) portfolios. They

[8] For a comprehensive review on methods of elicitation of risk preference, see Charness et al. (2013)

further note that preference are less consistent for domains that are too disparate whereas choices in closer domains do exhibit some consistency. Then our question reduces to how "close" are risks of the lifetime income gamble and risks of child investment.

3.2 Identification of risk preference

Using the series of questions on risk attitudes, following Kimball et al. (2008, 2009), under the assumption that respondents have constant relative risk aversion (CRRA) and risk tolerance are log-normally distributed, we calculated and imputed values of CRRA coefficient for each respondent. Assuming that CRRA well approximates an individual's utility over lifetime income,

$$U(W) = \frac{W^{1-1/\theta}}{1-1/\theta}$$

where θ is the coefficient of relative risk tolerance and its reciprocal, $\gamma = 1/\theta$, coefficient of relative risk aversion, bounds on θ are calculated and reported in Table 5 for each category.

To derive the main imputations of HRS, Kimball et al. (2008) adopts the structural assumption that risk preference is time-invariant. Differences in responses of an individual across waves to the same type of questions are then attributed to response errors which are further decomposed into transitory error and persistent error, both normally distributed with zero mean. However, according to Dohmen et al. (2011) and Dohmen et al. (2017), willingness to take risks varies over the course of life-cycle and trends downward as individuals age. These evidences are consistent with Sahm (2012). To test for potential dynamic relationship between maternal risk preference and investment in children, we estimate the models with imputations under the assumptions of constant risk preference as well as floating risk preference. The former assumption impose a stringent constraint on risk preference such that risk preference can only depend on survey responses to the lifetime income gamble. The latter assumption is more flexible as it allows for risk preference to, conditioned on survey responses, not only fluctuate with time but also with other observable characteristics of an individuals.

The procedure entails 2 steps. First, for each wave that collects responses to risk preference questions, the

Table 5: Risk tolerance response category

Response category	**Downside risk of risky jobs**		**Bounds on risk tolerance**	
	Accepted	Rejected	Lower	Upper
1	None	20%	0	0.27
2	20%	1/3	0.27	0.5
3	1/3	1/2	0.5	1
4	1/2	None	1	∞

The table reports the implied downside risks accepted or rejected based on response category of NLSY79 respondents. Under the assumption of CRRA, the bounds on coefficient of risk tolerance θ based on the response category are calculated and present on columns 4 and 5.

Table 6: Summary statistics of imputed CRRA

	1993	2002	2004	2006	2010	2012	2014	Total
Panel A: Full NLSY79 dataset								
Time-invariant γ	1.55	1.53	1.52	1.53	1.53	1.70	1.55	1.53
	(1.02)	(1.05)	(1.07)	(1.08)	(1.06)	(1.04)	(0.90)	(1.05)
Time-variant γ	1.68	1.08	1.12	1.09	1.57	1.15	1.03	1.32
	(1.17)	(0.78)	(0.80)	(0.78)	(1.11)	(0.69)	(0.61)	(0.99)
Observations	8964	7569	7331	7339	7386	235	115	38999
Panel B: Restricted sample of mothers								
Time-invariant γ	1.34	1.39	1.38	1.43	1.40	1.27	-	1.37
	(0.83)	(0.93)	(0.88)	(0.89)	(0.85)	(0.49)	-	(0.87)
Time-variant γ	1.28	0.95	0.92	0.93	1.30	0.84	-	1.09
	(0.80)	(0.64)	(0.58)	(0.60)	(0.84)	(0.40)	-	(0.73)
Observations	2758	1608	1225	923	388	3	0	6905

The table reports the means, standard deviations and number of observations of the imputed CRRA by year, under assumptions of time-constant or time-varying, and in the full NLSY79 dataset or the restricted sample of mothers with available data on investment in children and a full set of control described in Table 3.

status quo bias, mean and variance of log risk tolerance, and variance of transitory and persistent response error are estimated using maximum likelihood.[9] Having obtained estimates of the mean and log risk tolerance in the first stage, we impute the coefficient of risk aversion, γ, via conditional expectation that an individual belongs to a certain risk category j. Depending on the assumptions imposed, two patterns can be observed. Under the assumption of time-constant risk preference, the imputations are constant for an individual for a risk category across years. If an individual are grouped into different categories in different years, she can still be assigned different values of imputed γ but for years in which she belong to the same category, the assigned CRRA values must be the same. If risk preference is time-varying, an individual can have varying degree of risk aversion across waves even if she belongs to the same category.[10] Table 6 reports the means and standard deviations of the imputed CRRA values under the two assumptions within the NLSY79 dataset and the restricted sample of mothers used for linking with investment in children.

It is readily apparent that the imputed values for the whole dataset is higher than the restricted sample. A potential source of this salient difference is the well-established findings in the literature that females are more risk averse than males (See, for instance, Croson and Gneezy (2009); Jianakoplos and Bernasek (1998); Powell and Ansic (1997)). Under the assumption of floating risk preference, gender difference in risk preference is captured by the observable characteristic sex and after separating this systemic difference,

[9] For clarity, only those who responded to both questions in the risk preference series are included. Individuals who only provide answer to the first question are excluded from the sample. To circumvent any biases potentially introduced by sample selection, for each wave, MLE is carried out on the entirety of the NLSY79 dataset. Likelihood functions and results of the first-stage MLE are reported in Appendix A.

[10] While there are evidences suggesting linear increase in risk aversion over the life-cycle (Dohmen et al., 2017), individuals do not necessarily have a priori increasing risk aversion over years as there are also supporting evidence on the increase in willingness to take risk when entrepreneurs accumulate more experience (Brachert et al., 2017; Cho and Orazem, 2021). We allow risk aversion to float freely with other observable factors further described in Appendix A.

women in our sample are found to be less risk-averse than men.[11] This is a debatable area in the literature studying risk preference since risk preference is context-dependent and no definitive results have been found to corroborate or negate the statement. If we assume that women and men are equivalent in terms of risk preference if not for their sex, a potential cause for the downward bias in the imputed values might be the upward bias of the effect of sex on risk preference. That is, differences in sex may have far-reaching impact on other aspects that are also relevant to risk preference and which feed into this upward bias. On the other hand, under the assumption of time-constant risk preference, a similar mechanism exaggerates the persistent response error of the female sample. That being the case, we do not investigate this issue further since it is not the main focus of our study.

Another striking point from Table 6 is the steady reduction in the number of observations across the year in the restricted sample of mothers with available data on investment in children. This is natural if we take into account the age of mothers in our sample in the corresponding years. In 1993, the first wave of question on risk preference, mothers were between the age of 28 and 36. In 2010, they were between 45 and 53. Since our sample only include children below 15, having data on investment in the year 2010 means that mothers were at least 30 at child's birth. This age is remarkably higher than the average age of mother at child's birth as presented in Table 3. Consequently, there are fewer mothers whose children were below 15 in 2010 compared to 1993.

3.3 Empirical strategy

To estimate the effect of risk preference on parental inputs, we follow the 2-step system GMM (Arellano and Bond, 1991; Blundell and Bond, 1998) with corrected-standard error (Windmeijer, 2005) and acknowledge the potential autocorrelation of parental inputs. That is, investment in children in a particular year might correlate with that of previous year(s), especially for investment in goods such as books or toys. Thus, failing to account for autocorrelation in the error term leads to biased estimates, also known as "dynamic panel bias" (Nickell, 1981). Since our dataset is unbalanced with gaps, taking first difference will exclude a large portion of the sample, i.e., the year 1994, 2010, 2012, and 2014 will be omitted from the estimation due to the absence of responses on risk preference.[12] To circumvent this issue, we adopt the *forward orthogonal deviations* approach introduced by Arellano and Bover (1995) which subtracts the average of all future available observations of a variable to deal with endogeneity in short panels and minimise data loss. Formally, we estimate a dynamic model with exogenous variables,

$$I_{ij,t} = \alpha I_{ij,t-2} + \delta\gamma_{j,t-2} + \beta_1' Z_{ij,t} + \beta_2' Z_{ij} + \eta_i + \lambda_t + \kappa + v_{ij,t} \tag{1}$$

where $I_{ij,t}$ denotes the parental input child i of mother j receives at time t. $\gamma_{j,t-2}$ is the imputed CRRA of mother j 2 years prior to the investment time since some investment are recorded with respect to past year and risk preference should be measured before an investment decision is made Hartog et al. (2002).[13] $Z_{ij,t}$ denote child i and mother j' time-variant characteristics number of siblings, family size, number of weeks mother and mother's spouse worked in previous year, and household net income in the previous calendar

[11] Although panel B of the table shows the mean and standard deviation for the restricted sample of mothers with a full set of controls, the statement still hold when we weaken the restriction to include all mothers with available investment data.

[12] Note that while 2010, 2012 and 2014 are considered continuous in our panel, each participants only responded to the risk preference questions once across all three years. The lack of repeated responses thus make said years unsuitable for estimation in difference.

[13] Since data is recorded biennially, we can only include 2-period lagged explanatory variables instead of 1-period lag variables.

year. Z_{ij} denote child i and mother j' time-invariant characteristics including child i's sex, mother's age at child's birth, mother's age at first birth, mother's AFQT score (2006 revised edition), educational level of mother, an indicator variable for mother's residence at age 14, mother's parents education. The specification also contains unobservable child-specific effect η_i, a year-specific effect common to all children at time t, λ_t, age-group specific effect κ, and an idiosyncratic shock $v_{ij,t}$ assumed to be purely stochastic.[14] Standard error are clustered at mother's level to allow correlation among siblings. All time-variant variables are assumed to be endogenous while time-invariant exogenous.

Under the assumption of time-constant risk preference, $\gamma_{j,t-2}$ is strictly exogenous, such that $\mathbb{E}[\gamma_{j,t-2}v_{i,s}] = 0$ for all t, s. Thus, consistent estimate of δ in this case can be obtained through the inclusion of γ as an instrument for other endogenous variables alongside the exogenous variables. On the other hand, if risk-preference is time-invariant, $\gamma_{j,t-2}$ is predetermined, in the sense that $\mathbb{E}[\gamma_{j,t-2}v_{ij,s}] \neq 0$ for $s < t-2$ but zero otherwise. Then δ can be consistently estimated by also treating γ as an instrument for endogenous variables but the set valid instruments reduce to $\gamma_{j,1}, ..., \gamma_{j,t-3}$. In practice, however, due to gaps in responses to lifetime income gamble, we treat $\gamma_{j,t-2}$ purely as an endogenous variable.

4 Results

We present the estimates of the effect of maternal risk preference on parental input in Table 7 as the main result of the paper. For comparison, we also include OLS estimates with fixed effect model. Table 7 is organised into 5 panels of each measures of parental inputs, namely HOME index, Goods index, Time index, Cognitive stimulation score (%) and Emotional support score (%). For each panel, the second column reports the OLS estimates with fixed effect of (1). Since child fixed-effect would collinear with all time-invariant covariates, we instead interact these time-constant characteristics with year. The next two columns utilise the two-step system GMM with orthogonal deviation as described in section 3. The third and fourth column report point estimates and standard errors for δ under the assumption of time-invariant and time-variant risk preference respectively. All models include a full set of controls of child's characteristics (sex, race, age of mother at child's birth, number of siblings, family size) and mother's characteristics (age of mother at first birth, mother's AFQT score, education level of mother, an indicator of whether mother lived with both biological parents at age 14, education levels of mother's parents, number of weeks worked of mother and mother's partner in the previous year, log household income the previous calendar year) as described in Table 3.

I present the OLS estimates of γ in (1) Table 7 as the main results of the paper. Table 7 is organised into 5 panels of each measures of parental inputs, namely HOME index, Goods index, Time index, Cognitive stimulation score (%) and Emotional support score (%). For each panel, the first two lines report point estimates and standard deviation of α in (**??**) for the whole sample and three sub-sample characterised by mother's level of education including High school dropout (not rewarded High school diploma), High school (rewarded High school diploma but no further education) and College or above (attended college regardless of awards). The next two lines also report point estimates and standard deviation of α but when models are augmented with interaction terms between γ and year to account for year-specific changes in risk preference. All models include a full set of controls of child's characteristics (sex, race, age of mother at child's

[14] We include age-group fixed effect since parental inputs are normalised by age-group, namely 0-2, 3-5, 6-9, and 10-14.

birth, number of siblings, family size) and mother's characteristics (age of mother at first birth, mother's AFQT score, an indicator of whether mother lived with both biological parents at age 14, education levels of mother's parents, number of weeks worked and log of household income in the previous calendar year) as described in Table 3.

We observe an overall positive effect of risk aversion on parental inputs notwithstanding the substantial heterogeneity of effects size across groups. When considering sub-samples, the effects are found only for the sample of child whose mothers never attended high school or are high school dropouts. For these children, maternal risk aversion exhibits significant and positive effects throughout all panels of parental input except for cognitive stimulation. A unit increase in CRRA coefficient of mothers drives an increase of 0.038 which is slightly more than one third of the standard deviation of HOME index for this sub-sample. The effect size on goods and time inputs are similarly high, at 0.027 and 0.032 respectively, which correspond to about 25% and 1/3 of the standard deviations for these inputs. Lastly, for a unit increase in γ, emotional support percentile increases by 0.489 percentage points. For the whole sample, positive and significant effect size is found for generic HOME index, Time index and Emotional support score (%) when accounting for year-specific changes in risk preference of mothers. However, these positive results for the whole sample might be driven by results in the sample of mothers who are high school dropouts.

5 Robustness checks

In this section, various specifications are used to check for robustness of our model. These include re-estimating the model excluding the year 2004 (due to the discussed substantial change in variance of log risk tolerance), using a categorical variable of risk preference, using other measures of risk preference.

5.1 Large swing in risk preference

As mentioned in Section 2, in the year 2004, the distribution of responses to the series of questions on risk preference changed drastically. In particular, the second response category, which groups respondents who answered "First job" in the first question and "Second job" in the second question, expanded substantially compared to other years, accounting for almost 16% of responses compared to under 12% in other years. To put these figures into perspective, in 1994, the year with the second highest proportion of "Group 2" respondents, 1027 out of 8945 participants were classified into the second response category. For 2004, 1133 out of 7176 participants belong to the second category based on their responses. Taking the other three years as baseline (1994, 2002, and 2006), the year 2004 is characterised by a large movement of concentration in terms of mass towards the "least popular" second category even overtaking the third response category. Even though the drastic change in risk preference is puzzling, OLS estimates of (**??**) without observations in 2004, presented in Table 8, are almost identical to those in Table 7.

The exclusion of 2004 brings the total number of observations down to 7399 from 9134 for the HOME index, an omission of 1735 observations. Similarly, the restriction excludes 1679 observations on Goods and Time indices, 1552 observations on Cognitive Stimulation score, and 1387 observations on Emotional Support score. Nevertheless, most point estimates remain the same while there are a slight increases in the point estimates of the effect of γ on emotional support score. This shows that our original specification is robust

Table 7: OLS estimates of risk aversion on Parental inputs

	All	High school dropout	High school	College & above
Panel A: HOME index				
γ	0.001	0.017**	-0.001	-0.005
	(0.003)	(0.007)	(0.004)	(0.005)
With Year $\times\gamma$ interaction	0.013***	0.038***	0.006	0.006
	(0.005)	(0.011)	(0.006)	(0.010)
Observations	9134	1671	4976	2487
Panel B: Goods index				
γ	0.003	0.013*	-0.001	0.002
	(0.003)	(0.007)	(0.004)	(0.004)
With Year $\times\gamma$ interaction	0.004	0.027**	-0.001	-0.011
	(0.005)	(0.011)	(0.006)	(0.009)
Observations	8902	1643	4851	2408
Panel C: Time index				
γ	0.002	0.014**	0.001	-0.003
	(0.003)	(0.007)	(0.004)	(0.005)
With Year $\times\gamma$ interaction	0.014***	0.032***	0.008	0.015
	(0.005)	(0.012)	(0.007)	(0.011)
Observations	8902	1643	4851	2408
Panel D: Cognitive stimulation score (%)				
γ	-0.057	0.293	-0.096	-0.225
	(0.089)	(0.221)	(0.123)	(0.148)
With Year $\times\gamma$ interaction	0.033	0.213	-0.085	0.078
	(0.151)	(0.381)	(0.195)	(0.298)
Observations	8227	1494	4514	2219
Panel E: Emotional support score (%)				
γ	0.189*	0.489**	0.094	0.128
	(0.098)	(0.230)	(0.133)	(0.186)
With Year $\times\gamma$ interaction	0.325*	0.513	0.294	0.114
	(0.168)	(0.412)	(0.210)	(0.360)
Observations	7641	1375	4215	2051

Note: The table present OLS estimates of risk aversion on parental inputs. For every panel, the first two lines report point estimates and standard errors of γ in models without interaction between risk aversion and year, whereas the next two lines report the same figures but for models with year interaction (year 1994 is treated as baseline). The set of controls included in the table but omitted here due to space constraints and ease of representation consist of child characteristics (sex, age of mother at child's birth, number of siblings, family size) and maternal characteristics (age of mother at first birth, AFQT score, indicator of whether mother lived with both biological parents at age 14, educational level of mother's parents, number of weeks worked last year and log of household income last year). All models are augmented with year and age-category fixed effect. Standard errors are clustered by mother and shown in parentheses.
Significant levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: OLS estimates with restricted sample

	All	**High school dropout**	**High school**	**College & above**
Panel A: HOME index				
γ	0.001	0.017**	-0.002	-0.005
	(0.003)	(0.007)	(0.004)	(0.005)
With Year $\times\gamma$ interaction	0.013***	0.038***	0.006	0.005
	(0.005)	(0.011)	(0.006)	(0.010)
Observations	7399	1368	4109	1922
Panel B: Goods index				
γ	0.003	0.013*	-0.001	0.001
	(0.003)	(0.007)	(0.004)	(0.004)
With Year $\times\gamma$ interaction	0.004	0.027**	-0.001	-0.011
	(0.005)	(0.011)	(0.006)	(0.009)
Observations	7223	1345	4012	1866
Panel C: Time index				
γ	0.002	0.013**	0.000	-0.003
	(0.003)	(0.007)	(0.004)	(0.005)
With Year $\times\gamma$ interaction	0.014***	0.032***	0.008	0.014
	(0.005)	(0.012)	(0.007)	(0.011)
Observations	7223	1345	4012	1866
Panel D: Cognitive stimulation score (%)				
γ	-0.059	0.253	-0.093	-0.210
	(0.089)	(0.219)	(0.123)	(0.150)
With Year $\times\gamma$ interaction	0.033	0.206	-0.085	0.082
	(0.152)	(0.384)	(0.194)	(0.297)
Observations	6675	1221	3735	1719
Panel E: Emotional support score (%)				
γ	0.207*	0.531**	0.097	0.160
	(0.098)	(0.230)	(0.232)	(0.186)
With Year $\times\gamma$ interaction	0.328*	0.518	0.293	0.134
	(0.169)	(0.411)	(0.210)	(0.358)
Observations	6254	1125	3529	1600

Note: The table present OLS estimates of risk aversion on parental inputs excluding observations in 2004. Other details are the same as Table 7.
Significant levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

to the shift in the risk preference of the population and point estimates along with standard error are very precisely estimated.

5.2 Risk as category

Now we focus on the treatment of the variable that acts as a surrogate for risk preference, i.e., how we incorporate responses to the sequence of risk preference in our model. As has been done thus far, one way is to impute and turn these responses into a single cardinal variable which aids in interpretation. In so doing, however, we impose several identifying restrictions crucial to the imputation process as noted in Section 2. Another approach which relaxes these restrictions is to group respondents into different categories depending on their answers. **??** present OLS estimates of (**??**) when the cardinal variable γ representing CRRA coefficient is replaced by a 4-level categorical variable segregating participants by their answers.

Table 9: OLS estimates with 4-level categorical variable of risk

	All		High school dropout		High school		College & above	
Year interaction	No	Yes	No	Yes	No	Yes	No	Yes
Panel A: HOME index								
Category 3	0.035	0.060	0.155*	0.326**	0.003	-0.050	-0.005	0.112
	(0.041)	(0.066)	(0.090)	(0.127)	(0.056)	(0.088)	(0.077)	(0.130)
Category 2	0.069*	0.109	0.087	0.106	0.082	0.087	-0.003	0.109
	(0.040)	(0.067)	(0.099)	(0.171)	(0.054)	(0.084)	(0.066)	(0.123)
Category 1	0.056	0.143***	0.243***	0.427***	0.025	0.047	-0.037	0.119
	(0.034)	(0.052)	(0.079)	(0.111)	(0.045)	(0.066)	(0.063)	(0.105)
Observations	9134	9134	1671	1671	4976	4976	2487	2487
Panel B: Goods index								
Category 3	0.025	0.057	0.061	0.195	-0.001	-0.027	0.066	0.136
	(0.041)	(0.062)	(0.094)	(0.122)	(0.055)	(0.081)	(0.069)	(0.125)
Category 2	0.061	0.078	-0.007	0.020	0.073	0.103	0.064	-0.013
	(0.042)	(0.067)	(0.113)	(0.216)	(0.058)	(0.083)	(0.068)	(0.122)
Category 1	0.054	0.066	0.150**	0.289***	0.010	0.003	0.054	-0.032
	(0.033)	(0.049)	(0.076)	(0.099)	(0.046)	(0.064)	(0.055)	(0.102)
Observations	8902	8902	1643	1643	4851	4851	2408	2408
Panel C: Time index								
Category 3	0.020	0.034	0.145	0.324**	0.002	-0.061	-0.046	0.055
	(0.043)	(0.069)	(0.097)	(0.144)	(0.058)	(0.093)	(0.078)	(0.132)
Category 2	0.048	0.094	0.106	0.143	0.053	0.048	-0.029	0.160
	(0.041)	(0.069)	(0.094)	(0.152)	(0.056)	(0.090)	(0.070)	(0.125)
Category 1	0.048	0.140**	0.227***	0.384***	0.034	0.052	-0.058	0.178
	(0.035)	(0.054)	(0.080)	(0.120)	(0.045)	(0.068)	(0.066)	(0.112)
Observations	8902	8902	1643	1643	4851	4851	2408	2408

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continue

	All		High school dropout		High school		College & above	
Year interaction	No	Yes	No	Yes	No	Yes	No	Yes
Panel D: Cognitive stimulation score (%)								
Category 3	0.911	2.110	3.544	7.417*	-0.105	-1.806	0.158	5.675
	(1.349)	(1.944)	(3.093)	(4.324)	(1.854)	(2.592)	(2.500)	(4.167)
Category 2	0.627	1.696	1.026	0.486	0.581	2.875	-1.232	-1.251
	(1.445)	(2.140)	(3.637)	(6.362)	(1.957)	(2.622)	(2.634)	(4.419)
Category 1	0.103	1.307	4.560*	4.386	-0.771	-0.682	-2.276	2.511
	(1.143)	(1.601)	(2.456)	(3.608)	(1.535)	(2.024)	(2.205)	(3.854)
Observations	8227	8227	1494	1494	4514	4514	2219	2219
Panel E: Emotional support score (%)								
Category 3	-0.112	-0.480	4.529	8.268*	-0.175	-2.265	-4.343	-6.327
	(1.496)	(2.201)	(3.246)	(4.857)	(1.971)	(2.764)	(3.129)	(5.111)
Category 2	0.438	3.704	4.843	3.039	1.141	4.000	-4.741	-0.910
	(1.538)	(2.278)	(3.138)	(4.956)	(2.066)	(2.849)	(3.136)	(5.184)
Category 1	1.483	3.091*	5.774**	7.271*	1.119	2.340	-2.432	-2.060
	(1.258)	(1.867)	(2.667)	(4.203)	(1.586)	(2.246)	(2.801)	(4.619)
Observations	7641	7641	1375	1375	4215	4215	2051	2051

Note: The table present OLS estimates of risk aversion on parental inputs using a 4-level categorical variable segregating respondents by their answers to the sequence of questions on lifetime gamble. Category 4 (least risk averse) is treated as the baseline. Other details are the same as Table 7.
Significant levels are as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

With the baseline being category 4, which groups respondents answering "Second job" to both questions, estimates in **??** indicate how being more risk averse affects parental inputs. As before, significant results are only found for children whose mothers are high school dropouts. Results show that children tend to receive more investment in terms of parental inputs if their mothers are the most risk averse, i.e., they are in category 1. Effects are more sizeable than those found using the cardinal measure γ. Most notably, children with high school dropouts mothers in category 1 receives up to 7.271 % higher in emotional support percentile score compared to category 4. Additionally, positive effects are also found for category 3 but not for category 2, implying a possibility of a non-linear relationship between investment and maternal risk aversion.

5.3 Other measures of risk preference

Another concern over the use of answers to lifetime income gamble to capture risk attitudes towards investment in children is how relevant such a measure is to the process of investment in children. Put differently, are risk attitudes captured by lifetime income gamble equivalent to risk attitudes mothers take when they make their investment decisions.

Another concern is that since we only have one response from any individuals for the newer series, the identification problem of risk preference, especially with regards to the estimation of persistent error of the SQB-free questions, is under-identified.

6 Conclusion

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7 Appendix

7.1 First-stage MLE of risk preference

7.1.1 Time-invariant risk preference

Under the assumption of time-invariant risk preference, our estimates are most conservative in that the probability distribution functions, and hence derived conditional expectations, depend only on survey responses to the question on lifetime income gamble. The probability of being in category j for an individual who answered in only one wave is

$$P(c = j) = P(\log \underline{\theta}_j < x < \log \bar{\theta}_j) = \Phi\Big(\frac{\log(\bar{\theta}_j) - \mu - b}{\sqrt{\sigma_x^2 + \sigma_{eq}^2 + \sigma_{\kappa q}^2}}\Big) - \Phi\Big(\frac{\log(\underline{\theta}_j) - \mu - b}{\sqrt{\sigma_x^2 + \sigma_{eq}^2 + \sigma_{\kappa q}^2}}\Big) \tag{2}$$

μ and σ_x are respectively the mean and standard deviation of true log risk tolerance. σ_{eq}^2 is variance in an individual's transitory response error for a particular wave and question type q while $\sigma_{\kappa q}^2$ is variance in an individual's persistent response error for question type q. $\bar{\theta}_j$ and $\underline{\theta}_j$ are upper and lower bounds on the coefficient of risk tolerance. b denotes status quo bias (common bias across individuals to questions of type q) and σ_e standard deviation of transitory response error, assumed to be purely random and independent of an individual's true risk tolerance or any other attributes. If she participated in exactly two waves, the probability of her being in category j in wave w and category k in wave w' is

$$P(c_w = j, c_{w'} = k) = \vec{\Phi}(\bar{N}_{jq}, \bar{N}_{kq'}, \rho) + \vec{\Phi}(\underline{N}_{jq}, \underline{N}_{kq'}, \rho) - \vec{\Phi}(\underline{N}_{jq}, \bar{N}_{kq'}, \rho) - \vec{\Phi}(\underline{N}_{jq}, \bar{N}_{kq'}, \rho) \tag{3}$$

where $\vec{\Phi}$ is the bivariate normal cumulative distribution function, $\bar{N}_{jq} = (\log \bar{\theta}_j - \mu - b_q)/\sigma_q$, $\bar{N}_{kq'} = (\log \bar{\theta}_k - \mu - b_{q'})/\sigma_{q'}$, $\underline{N}_{jq} = (\log \underline{\theta}_j - \mu - b_q)/\sigma_q$, $\underline{N}_{kq'} = (\log \underline{\theta}_k - \mu - b_{q'})/\sigma_{q'}$, and ρ is the correlation between answers across the two waves. If respondents participated in more than two waves, the form of (3) alters accordingly to accommodate multivariate normal distribution.

7.1.2 Time-varying risk preference

7.1.3 MLE results