Rebellious offspring of war children: parental exposure to the Korean War and risk aversion

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Abstract

This paper investigates the parental exposure to the Korean War at a sensitive development age and its impact on the risk aversion. Using the 7th wave of Korea Labor & Income Panel Study, we find that respondents whose parents spent sensitive age during the war are as risk averse as or less risk averse, while their parents are more risk averse themselves. Sons are more risk loving when the mother is in the sensitive age group. We use structural estimation method and the results are robust to reduced form analysis. Assortative matching is still prevalent among the parents who were exposed to the war. Parents who were exposed to the war during the sensitive age group are more likely to search for more risk averse spouse. The mother-son dyad shows the most significant negative intergenerational transfer.

Keywords: Intergenerational transfer, Risk aversion, Childhood experience, Sensitive period, Korean War.

JEL Classification: D74, D81.

1. Introduction

In economics there has been growing interest in parental influence as an important determinant of preference. These literatures examine intergenerational persistence in preference related factors including risk preference, time preference, altruism, values, ethics, religious traits and generosity (Alan et al. 2017; Arrondel 2013; Bisin and Verdier 2000; and Wilhelm et al. 2008). The intergenerational transfer of values leads to the transfer of important economic outcomes such as socioeconomic status, female labor force participation and human capital and saving propensities (Charles and Hurst 2003; Deckers et al. 2015; and Fernandez et al. 2004). More broadly, culture – values and beliefs transmitted across generation through ethnic, religious and social groups – affects preferences, labor market participation and fertility behavior (Fernandez and Fogli 2009; Guiso et al. 2006). Genetics is one clear reason for intergenerational persistence of risk and time preferences and economic decision making (Carpenter et al. 2011; and Cesarini et al. 2010). On top of the genetic factors, economic models suggest that there is extra channel for the transmission through the correlations in exogenous determinants of preference of parents and children, parental effort and emulation of attitudes of parents by children (Becker and Mulligan 1997; Bisin et al. 2004; and Doepke and Zilibotti 2008).

We study intergenerational transmission of risk attitudes for war victims by utilizing the Korean War, as it provides an ideal setting to examine the impact of trauma (See section 2.1). The treatment group is the children whose either parent experienced the Korean War during the sensitive development period and were residing in 'risky' provinces, defined by the provinces with civilian injuries and casualties per capita higher than the national average. We find that the transmission is negative for the treatment group and they are as risk averse as or more risk loving than the control group, while the parents were more risk averse themselves. Subgroup analysis reveals that only maternal effect is statistically significant and has greater coefficient than paternal effect. Parent-child dyad analysis shows that only the impact of mother-son dyad is statistically significant.

In this paper, we study the intergenerational transfer of risk preference for the agents exposed to a conflict during the sensitive development period. The main contributions of this paper are threefold. First, we show that the experience of a traumatic events during the sensitive development period not only has a long run impact on risk preferences of the exposed individuals but also has an intergenerational impact on their offspring. It is related with the literatures on the impact of traumatic event on risk aversion. Exposure to traumatic events such as natural disasters alter risk preferences of adult subjects in several experimental studies (Cassar et al., 2011; Eckel et al., 2009; Li et al., 2011; Sacco et al., 2003). The exposure to traumatic events such as war violence and financial distress affects risk preferences of individuals may alter the risk attitudes in the long run (Malmendier and Nigel 2011; and Callen et al. 2014). Kim and Lee (2014) find that the respondents who experienced a major civil war, the Korean War, during childhood are more risk averse after approximately five decades. They identify critical age range that leaves a lasting influence on risk aversion, related with the sensitive development period of risk preference formation. The finding may also have implications on the recovery process from a civil war because key economic behaviors related with economic growth such as the adaptation of new technology (Liu 2012) and entrepreneurial behaviors (De Paola 2013; Hryshko et al. 2011; and Kim and Lee 2012) are related with risk aversion.

Second, we test if the intergenerational transfer of risk aversion is negative. We examine whether the parents who are more risk averse because of the exposure to a trauma during sensitive development period has as risk averse as or more risk loving children than the control group. It adds to the literatures that study the intergenerational transfer of risk preferences. There are literatures that establish a significant impact on risk attitudes of children by father's occupation (De Paola 2013; and Leuermann and Necker 2011), mother's risk aversion (Alan et al. 2017) and parental risk aversion (Brown and van der Pol 2015; and Hryshko et al. 2011). Dohmen et al. (2012) show the transmission of risk preferences from parents to children and identify positive assortative mating and prevailing social attitude as the potential mechanism. The finding may provide a strong evidence for the economic theories of intergenerational transmission of preferences that suggest non-genetic behavioral factors as a significant determinant of the transmission mechanism.

Third, we attempt to identify the mechanism of the negative transmission by separately identifying the impact of mothers versus fathers. This contribution adds to psychology literatures of intergenerational transfers of parental distress. Literatures examine how traumatic experience by parents are passed to the next generation. Studies of the Holocaust survivors and refugees show that parental trauma affects parent-child interaction through insecure emotional attachment and reduced emotional availability, resulting in trauma transmission to the children (Dalgaard 2015; Enlow 2014; Horesh 2014; Schwerdtfeger 2007 and van Ee 2016). Kawabata et al. (2011) investigate the effect of parenting style on relational aggression using meta-analysis and show that more uninvolved parenting from mothers affect the behavior of children. Hoeve et al. (2011) find that delinquency increased by neglectful parenting for males while it increased by permissive parenting for females. As such, emotional detachment by a civil war may affect males to rebel against their parents. Also, since childrearing was mainly maternal obligation in Korean society during the 1950s – 1980s, the analysis of parent-child gender dyads may highlight the mechanism of negative transmission of risk aversion.

The rest of paper is organized as follows. The next section provides background about Korean War and dataset used. Then section 3 discusses methodology. Section 4 presents and discusses the results. Sections 5 concludes the paper.

2. Data

2.1 The Korean War

The Korean War was a civil war that started on 25th of June 1950 by the invasion of North Korea to the Southern part of Korean peninsula. The war lasted until the 27th of July 1953 and ended by a ceasefire following the Korean Armistice Agreement, leaving the two countries divided near the original pre-war border. The two Koreas remain divided until this day. It was a devastating civil war to Koreans. Total casualty was over 2 million and the troops from 20 countries fought in the battlefield. The unique feature of the war that makes it ideal for sensitive age analysis is that the civilian casualty of the war is heavily isolated in the year 1950. The North almost entirely occupied South Korea by September 1950. Following the arrival of the US and UN troops from 16 countries for South Korea, the allied forces successfully retaliated and by November 1950, almost entire North Korea was occupied by the allied forces. Then, following the Chinese intervention, the front of the war was pushed back to near the original border and the stalemate, where most casualties were military personnel, continued until the end of the war. Therefore, most civilian damage was in the year 1950 and we define the age at war by the age in the year 1950.

There are more key features of the Korean War that makes it a natural experiment, an ideal setup to examine the causal impact of the war. Our treatment group contains respondents whose mother or father or both were between 4-8 – the sensitive age for risk attitude as identified by Kim and Lee (2014) – at the peak of the war in 1950. These parents were children at the breakout of the war, and it would have been difficult for them to select into different provinces to potentially avoid the war. Also, the pace in the early stages was rapid and the breakout of the war was unanticipated, as shown by unpreparedness of South Korea that they almost lost control over the entire country within the first two months. Additionally, war intensity seemed random and substantially different across provinces (See figure 1). The varying intensity by region was a result of contemporaneous battle strategies that may have been impossible to predict. Finally, due to its geographic characteristic, there were very few refugees. South Korea is at the tip of a peninsula that it was very difficult for anyone to flee to a foreign country. As such, it would have been very difficult for respondents in the sample who experience the war to select into different provinces by risk attitudes before the breakout of the war. This allows us to make causal inferences, excluding cohort effect, exploiting within-cohort variation in treatment intensity.

2.2 Data

We use the 7th wave of Korean Labor and Income Panel Study (KLIPS), a longitudinal survey of approximately 5,000 households. The 7th wave of the survey was conducted in 2004 and it includes a set of five hypothetical lottery questions. Estimated risk aversion from the responses to the hypothetical lottery questions predict economic behaviors that are related with risk aversion, such as stock market participation and self-employment (Kim and Lee 2012). The survey is conducted 51 years after the end of the war hence it is suitable for the analysis of the intergenerational transmission of risk attitudes.

KLIPS also includes birthplace and residence at 14 information and this is crucial for our analysis as we exploit regional variation in war intensity by province within cohort. We determine the province of residence during the war based on this information. The dataset also provides detailed information about relationships among each member within each household. This enables us to identify the treatment group, respondents with either or both parents at a specific age group in the year 1950 and with the residency in specific provinces at the time. The seventh wave includes 11,661 individuals from 4,762 households. For our analysis, we include adult respondents (18 or older) who were less than 50 years old – those who were born after the end of the war and exclude samples with missing variables such as parental characteristics. The final sample contains 3,607 respondents. For the robustness check: 1) we include the respondents without parental information in the control group (7,396); 2) we include the respondents who experienced the war in the control group (3,783); and 3) we only include the respondents whose mother's or father's place of resident at age 14 and its birthplace are identical (2,748).

Table 1 presents descriptive statistics for the entire sample, treatment group and the control group. The treatment group includes the individuals whose mother and/or father were between 4 and 8 at the peak of the war and were residing in provinces with civilian injuries/casualties greater than the national average of 0.051. Individual characteristics controlled in the analysis show that the treatment group is older than the control group due to parental age restrictions. This may explain the discrepancies in education level, marriage rate and household income.

3. Methodology

The 7th wave of KLIPS includes a set of five hypothetical lottery choice questions. Table 2 summarizes the choices given by each question. Respondents are asked to choose between the two options as a payoff for a day's work. Option A provides a certain payoff of 100,000 Korean won (KRW) and option B provides a lottery, instead of the certainty payment. For example, for question 1, the respondents choose between getting paid KRW 100,000 or a lottery that pays KRW 150,000 with probability of 0.5 and KRW 50,000 with probability of 0.5. Choice A is summarized in the second column of table 2 and choice B is summarized in the third column of table 2. Using the information on the five choices by each respondent, we estimate the risk aversion parameter using structural estimation.

First, we estimate risk aversion parameter γ assuming a constant relative risk aversion (CRRA) utility function[1]:

$$\mathrm{U}(x) = \frac{x^{1-\gamma}}{1-\gamma} \tag{1}$$

Then, we include a structural noise parameter μ, as in Luce (1959) and Holt and Laury (2002). Expected utility of option *j* is denoted as *A* (risk-free cash) or *B* (lottery). The noise parameter μ captures the insensitivity of choice probabilities to payoffs, in the following probabilistic choice index in the form of a cumulative probability distribution function (Andersen et al., 2008):

$$\nabla \mathrm{EU} = \frac{EU_B^{1/\mu}}{EU_A^{1/\mu} + EU_B^{1/\mu}} \tag{2}$$

The noise parameter captures randomness in choices made by respondents. The choice probability approaches 0.5 (fully random) as μ increases and the choice become increasingly inconsistent with the expected utility theory. As μ approaches infinite, the choice becomes completely random (choice probability of 0.5). On the other hand, probability of choosing the option with greater expected utility approaches one as μ approaches zero.

Then, utilizing the five responses to the set of hypothetical lottery questions, we construct following conditional log-likelihood.:

$$\ln L(\gamma, \mu; y, \mathbf{X}) = \sum_i^N \sum_j^5 \left[\left(\ln(\nabla \mathrm{EU}) \, \middle| y_i^j = 1 \right) + \left(\ln(1 - \nabla \mathrm{EU}) \, \middle| y_i^j = -1 \right) \right] \tag{3}$$

where *i* represents individuals and *j* represents the lottery questions. $y_i^j = 1$ (or -1) means that individual *i* chose option *A* (or *B*) for the j^{th} lottery question. The risk aversion parameter γ and structural noise parameter μ are estimated while allowing heterogeneity of the parameters, linearly depending on

[1] The power-expo utility function is more flexible (Saha, 1993), $\mathrm{U(x)} = (1 - \exp(-\alpha x^{1-\gamma}))/\alpha$. This function reduces to CRRA when $\alpha = 0$ and to CARA when $\gamma = 0$. Using power-expo utility function for the KLIPS data, Kim and Lee (2012) show that the parameter α is statistically insignificant. The result is consistent with intuition, as α measures the responses to the modification in payoff amount. However, the hypothetical lottery questions from KLIPS do not seem to display sufficient variations in the payoff amount (See Table 2).

individual characteristics (**X**). X includes parental exposure to the Korean War, gender, age, education, marital status, annual household income, and the first child indicator.[2]

The individual heterogeneity of interest is parental exposure to the Korean War. The sensitive age of risk attitude by war exposure was identified as 4-8, using the same dataset (Kim and Lee 2014). The treatment group therefore includes the respondents whose mothers and/or fathers were exposed to the war during that sensitive age. We validate this assumption by estimating equation (3) but using different age groups.

The estimated impact of specific age group is likely to be interpreted as the impact of war exposure. However, there is a small possibility that the impact may represent the parental cohort effect. The 4-8 age group was between 58 and 62 at the time of the survey and the differences in risk attitude of the children may be caused by the parental age cohort effect. Therefore, we exploit regional war intensity variation by province as presented in figure 1. Injuries and casualties from the Korean War per population by province varies between 0.01 in *Jejudo* to 0.115 in *Gangwondo*. We define an indicator variable "*risky area*" that denotes parental residency in a province with higher than average (0.051) injuries and casualties from the war. The estimated coefficient on the interaction term between the "*risky area*" and the indicator of the sensitive age at the peak of the war would then represent the difference-in-differences (DID) estimate of the impact of parental sensitive age exposure to war on risk aversion. As such, we include maternal and paternal interaction terms, sensitive age exposure indicators and "*risky area*". For the robustness check, we also use the provincial injuries and casualties as a continuous variable (See figure 1) instead of the indicator variable, "*risky area*".

As a corroborative analysis, we perform three robustness checks. First, we include the respondents whose parental information is missing in the control group. This would estimate partial impact of the war, as some of the parents whose data is missing may have to be included in the treatment group. This would more than double the total sample size. External validity would be improved if the estimated partial impact, including 3,789 individuals who are missing parental information, is qualitatively identical with the main analysis.

Second, we include respondents who were alive during the war, as we only include respondents who were born after the end of the war in our main analysis. However, including the ones who were alive during the war in the control group, reasonably assuming their parents were older than 8 years old at the time of the war, may be useful in age extrapolation. Therefore, we relax the age restriction and include anyone over 18 for the robustness check. For example, anyone aged over 50 who were excluded from our main analysis

[2] Maximum likelihood estimation was performed using Stata's **ml** command. The standard errors are clustered at parental province-by-cohort level.

would be included in the robustness check as the control group, as their parents were clearly older than 8 at the peak of the war.

Third, we exclude all the "movers" from the sample. The dataset provides birthplace and the residence at age 14 at provincial level. In the main analysis, we use the parental birthplace information to determine the treatment group. For example, if a respondent's father or mother were age 6 in 1950 and they resided in one of the provinces defined as risky area, the respondent is in the treatment group. However, for the parents whose birthplace and the residence at age 14 are different, the place of residence during the war may not be accurate. Therefore, we define the "movers" as the ones whose birthplace and the residence at age 14 are different and exclude all the respondents whose parents were movers for the robustness check.

As the supplementary analysis, we run the analogous reduced form analysis:

$$Safe\ \ choice_i = \alpha_1 faage_i^{4-8} + \alpha_2 Risky\ \ area_i^{fa} + \alpha_3 faage_i^{4-8} \times Risky\ \ area_i^{fa}$$
$$+\alpha_4 moage_i^{4-8} + \alpha_5 Risky\ \ area_i^{mo} + \alpha_6 moage_i^{4-8} \times Risky\ \ area_i^{mo}$$
$$+\mathbf{X}_i'\gamma + \delta_{province} + \varepsilon_i \qquad (4)$$

where *i* denotes individual, $faage_i^{4-8}$ is the indicator for the paternal age of 4-8 at the peak of the war, $Risky\ \ area_i^{fa}$ is the indicator for father's residency in the risky area during the war. Similarly, $moage_i^{4-8}$ and $Risky\ \ area_i^{mo}$ are the similar indicator variables for the mother. $\delta_{province}$ represents the province fixed effect. The dependent variable is the number of certainty option A, out of 5 hypothetical lottery questions, normalized to 1. For example, if the respondent selected 4 option A's and 1 option B, the dependent variable takes the value of 0.8. The coefficient of the interaction terms, α_3 and α_6, would represent causal impact of paternal and maternal war exposure during sensitive age on risk attitudes. We also perform the identical analysis but replace the indicator variables "*risky area*" with the continuous provincial injuries and casualties:

$$Safe\ \ choice_i = \delta_1 faage_i^{4-8} + \delta_2 Intensity_i^{fa} + \delta_3 faage_i^{4-8} \times Intensity_i^{fa}$$
$$+\delta_4 moage_i^{4-8} + \delta_5 Intensity_i^{mo} + \delta_6 moage_i^{4-8} \times Intensity_i^{mo}$$
$$+\mathbf{X}_i'\gamma + \delta_{province} + \varepsilon_i \qquad (5)$$

where $Intensity_i^{fa}$ represents the civilian injuries and casualty for the father's province of birth and $Intensity_i^{mo}$ is the same variable for the mother's province of birth.

Another reduced-form analysis is performed to directly examine the risk attitude transmission between generations. The correlation between the number of safe choices between the parents and the children for the treatment group versus the control group is estimated:

$$Safe\ \ choice_i^{offspring} = \beta Safe\ \ choice_i^{parents} + \mathbf{X}_i'\gamma + \delta_{province} + \varepsilon_i \qquad (6)$$

where i denotes individual, $Safe\ \ choice$ represent the number of certainty option as in equation (4), and superscripts $offspring$ and $parents$ indicate that the number of certainty options is of the respondent and of its parent, respectively.[3] Statistically significant and positive β would show a positive and significant correlation between the number of certainty option A between the parents and the children.

Next, we investigate the mechanism of negative intergenerational transfer of risk attitudes. Dohmen et al. (2011) identifies assortative matching as the key mechanism behind positive intergenerational transmission of risk attitudes. We investigate if the negative transmission of risk attitudes for war exposed parents are driven by identical channel. The reduced form analysis examines if assortative matching still occurs for the war exposed individuals:

$$Safe\ \ choice_i^{Spouse} = \beta_1 age_i^{4-8} + \beta_2 Risky\ \ area_i + \beta_3 age_i^{4-8} \times Risky\ \ area_i + \mathbf{X}_i'\gamma + \delta_{province} + \varepsilon_i \qquad (7)$$

where i denotes individual, age_i^{4-8} is the indicator for the age of 4-8 at the peak of the war, $Risky\ \ area_i$ represents the indicator for residency in the risky area during the war. $\delta_{province}$ denotes the province fixed effect. The dependent variable is identically defined as in equation (4), the number of certainty option chosen by the respondents out of five hypothetical lottery questions, normalized to 1. As the parents in the treatment group are more risk averse, we expect the coefficient β_3 to be positive if these parents also follow assortative matching in risk attitudes. We run a similar analysis but replacing the indicator variable $Risky\ \ area_i$ with $Casualty_i$, the continuous measure of injuries and casualties by province for the respondents who were residing in risky area.

Parents-offspring dyad analysis may be effective to identify potential mechanism because the lack of emotional attachment and neglecting parenting style may be a channel of negative transmission of risk

[3] We use the number of certainty options of either parent as it is available. If the number is available for both parents, we use the average between the two.

attitudes as identified in psychological literatures (Kawabata et al. 2011 and Hoeve et al. 2011). Therefore, we estimate the parameters and coefficients for the structural equation (3) and the reduced form equation (4) for each of the four paternal and maternal by male and female child dyad. For example, in equation (4), the father's exposure to war variables would be further split into son and daughter interaction terms.

4. Results and Discussions

4.1 Main Analysis: Structural Estimation of Risk Parameters

Table 3 presents the structural estimation of CRRA risk parameter γ and the structural noise parameter μ as a function of individual characteristics. Column (1) reports the result of baseline model with no control variables. Column (2) includes gender and age only and column (3) includes education, marriage and household income and the indicator variable for the first child. All columns show that respondents whose parents experienced the war during the sensitive development period experienced negative transmission of risk aversion. Their parents are more risk averse, but the children are more risk loving. The coefficients are statistically significant for all maternal exposure. The risk parameter γ decreases approximately by 0.1 for paternal exposure and by 0.2 for maternal exposure. Results presented in column (3) show that the baseline risk parameter is 0.839 and richer individuals are more risk loving.[4]

The results suggest that parents who experience the war during childhood and therefore who are more risk averse *reduces* risk aversion for their offspring. The impact is not statistically significant, and the estimated parameter is smaller for the fathers while the mothers who experience civil war at an early age are more risk averse than the individuals who do not, and the offspring of those mothers seem to be more risk loving than the individuals whose mothers are not exposed to the trauma during the sensitive age. It implies that trauma during the sensitive development period does not only affect risk aversion of the affected individuals in the long run, but it may also affect the risk attitudes of the next generation. Also, the results suggest that the positive transmission of risk attitudes found in general population operates in different direction for the trauma victims. Offspring's risk attitude is not more risk averse than the control group, suggesting negative transmission of the risk attitudes.

We attempt to verify that the intergenerational impact of risk attitudes is limited to the parents who experienced the war during the specific age group, as identified in the literature. Table 4 shows the

[4] The two groups are not mutually exclusive. There are 29 respondents (0.76% of the total sample) whose parents both experienced the war during the sensitive development age in a risky province. We run the analysis where the treatment group is divided into three mutually exclusive set – paternal exposure only, maternal exposure only, and parental exposure by both parents – despite the small number for the last group. The results are qualitatively similar and intuitive. The magnitude was much greater for the last group at approximately 0.6 (See Appendix Table A).

interaction term risk parameter γ for different age groups. We estimated the parameter using a fully specified model as in column (3) of table 3 and defined the 'sensitive age' differently in each column. Estimated parameters reported in columns (1), (2) and (4) represents the risk attitudes of respondents whose parents were in utero – age 0, age 1–3, and age 9–13 at the peak of the war, respectively. The results suggest that risk attitudes of those respondents were not different from the respective control groups, as the parents' risk aversions were not different from respective control groups. However, the coefficient in column (3) are not positive and significant for 4–8 age group, while the parents are more risk averse than the control group (Kim and Lee 2014). This implies that the sensitive age group during the war has negative intergenerational impact on risk attitudes of their offspring.

4.2 Robustness Checks and Analysis of Potential Mechanism

In the main analysis, we restrict the sample to the respondents whose parental information is available, who were born after the end of the war and include the respondents whose mother's or father's place of birth is different from the residence at age 14. Table 5 reports the structural risk parameter γ for the interaction term between the sensitive age group and risky area, while relaxing these assumptions. Top two rows use the indicator variable, "*risky area*" to control for the geographic variation in war intensity while the bottom two rows use the continuous variable, the provincial injuries and casualties out of total population. The columns (1) and (2) are the baseline model and column (1) is as reported in column (3) of table 3. Columns (3) and (4) includes respondents whose parental data is missing and extra 3,789 respondents are included in the sample, hence the increase in the total number of observations by 18,945, or five times 3,789. In columns (5) and (6), the age restriction is relaxed and extra 176 respondents are included in the sample. In columns (7) and (8) we exclude 859 respondents whose mother or father's place of birth is different from the residence at age 14 because they clearly have moved to a different province during the childhood and using the birthplace as the place of residence during the war may be inaccurate. The results reported in table 5 shows that the estimation is robust to the use of continuous war intensity variable, relaxing sample restrictions and exclusion of movers. As in column (1) and (2), parameters shown in columns (3) – (8) show that risk attitude transmission is negative for the treatment group, and the impact is stronger for maternal exposure than paternal exposure.

Table 6 presents the results of reduced form equation (4). The odd-numbered columns report the key coefficients α_3 and α_6 and the even-numbered columns report δ_3 and δ_6 for the baseline, no age restriction, and no-mover specifications, respectively. The results are qualitatively comparable to the results from main structural analysis. While the parents are more risk averse, the offspring is not more risk averse than the control groups. The magnitudes are greater for maternal exposure and the coefficients are statistically significant in columns (1), (5), (7) and (8). The number of certainty option A chosen by respondents decreases by 0.323 questions (6.45 percentage points/20 percent per question) in column (1) and by 0.417 questions (8.33 percentage points/20 percent per question) in column (7), if the respondent's mother experienced the war during the sensitive age group. According to the results in column (8), respondents whose mothers were in *Gangwondo* with civilian casualty measure of 0.115 would select 0.537 (94.14 percentage point/20 percent per question X 0.114) less safe option A than respondents whose mothers were in *Jejudo* with civilian casualy measure of 0.001.

The positive transmission of risk attitudes – where more risk averse parents would have more risk averse children – for the general population is explained by assortative matching. More risk averse individuals tend to match with more risk averse partners to produce children. In turn, having more risk averse parents increases the risk aversion for these children through genetic and environmental factors. We investigate if the negative transmission of risk attitudes for the individuals with trauma exposure at young age is driven by, perhaps a disassortative matching. In other words, more risk averse individuals due to the war exposure may select a partner who is more risk loving and this in turn could contribute to the negative transmission of risk attitude.

The correlation between the number of safe choices by parents and children, the key coefficient β from the reduced form equation (6), is reported in table 7. It shows that the coefficient is positive and statistically significant for the control group. One unit increase in parents' number of safe choices are correlated with the increase in 0.33 safe choices for the children, suggesting positive correlation between the risk attitudes for the control group. For treatment group, however, the correlation is smaller and it is not statistically significant.

Table 8 shows the DID β_3 parameter from equation (7). Columns (1) and (3) utilizes the indicator variable for risky area while columns (2) and (4) utilizes the continuous measure of civilian casualty measure, used to define the risky area indicator variable. The first column two columns report the results for the wife. Column (1) shows that the number of safe option A out of five hypothetical lottery questions for the husband increases by 0.218 questions, if the woman experienced the trauma during sensitive age of risk attitude formation. Results in column (2) suggest that a woman who experienced the war in *Gangwondo* with civilian casualty measure of 0.115, would meet a husband who would select 0.255 more safe options ((0.4539 $\times$ 0.114)/0.2) than a woman who experienced the war in *jejudo* with civilian casualty measure of 0.001. The results are qualitatively comparable for men, as reported in columns (3) and (4). Men who experience the war during the sensitive age in risky area are more likely to seek for a wife who are more likely to choose more safe options. The results imply assortative matching for both men and women who experience the war. Therefore, disassortative matching may not be a plausible mechanism for the negative intergenerational risk attitude transmission.

There are a number of literatures that report emotional detachment and neglecting parenting style of trauma survivors (Dalgaard 2015; Enlow 2014; Horesh 2014; Schwerdtfeger 2007 and van Ee 2016). The war survivors may have a similar parenting style, and this may engender rebellious behavior for the children. Instead of emulating their parents' values and attitudes, these children may be disaffected and strive for the opposite values and attitudes. Kawabata et al. (2011) finds that the uninvolved parenting was associated with relational aggression – a type of rebellious behavior – only for mothers. Studying adolescent delinquency, Hoeve et al. (2011) show that neglectful parenting was associated with higher levels of delinquency in males only. This implies that for the parents who experienced war trauma during the sensitive age, emotional detachment may affect attitude formation of sons for mothers only.

The results of parent-offspring dyad analysis in table 9 is consistent with the intuition. Columns (1) and (2) reports the structural risk aversion parameters for the triple interaction terms for war exposure at sensitive age, risky area and the indicator variable for the gender of respondents. Similarly, columns (3) and (4) report the reduced form triple difference estimators from the reduced form equation. The results are quite consistent. Mother $\times$ son dyad has the strongest negative risk attitude transmission that only this dyad is statistically significant and negative. Sons with mothers who experienced the war during the sensitive age are *more risk loving*. For all other dyads, the intergenerational risk attitude transmission is still negative but not enough to make the children *more risk loving* than the control group. This may suggest that the mechanism behind negative transmission of risk attitudes is driven by the alteration in parenting style due to the war exposure during the sensitive age. As literature and the result imply, less emotionally attached mothers may instigate more rebellious behavior especially for sons, who may opt not to emulate values and attitudes displayed by their mothers.

5. Conclusion

Risk is pervasive in economic decision making. As such, risk attitudes have profound effect in economic and behavioral decision making. Existing literatures provide evidence that traumatic experience may have a profound impact on preference formation, including the risk attitude. This paper investigates whether the traumatic experience during sensitive development period, known to alter risk attitudes in the long run, may also affect risk attitudes of the subsequent generation. We find that the trauma may affect the risk attitudes of significant population for even longer term, by affecting the risk attitudes of the subsequent generation. We also find that the direction of transmission is negative for the trauma victims, unlike general population whose intergenerational transmission of risk attitude is positive through assortative matching and prevailing social norms. Analysis of the potential mechanism reveal that the respondents who experienced the war still show assortative matching behavior and the negative transmission of risk attitude may be driven by emotional detachment and the parenting style, based on parent-offspring dyad analysis.

The results of this paper may have a profound impact on the development of countries that experience major civil conflicts. As more risk averse population who experience the war firsthand may be more cautious – they may smoke less, participate in stock markets less, and perhaps start own enterprises less, which may have mixed impact on the recovery of the economy at a macro level. To complicate the matter even further, the subsequent generation who are born approximately one to two decades afterwards – offspring of the war children – may show exactly the opposite behaviors. The policymakers in those countries and international organizations may consider different priorities for different generations, to facilitate the recovery from devastating conflicts. Future studies may examine the trauma impact on other aspects related with profound individual preference such as time preference and attitudes, and the impact of war trauma during the sensitive age on behavioral outcomes such as smoking and entrepreneurships.

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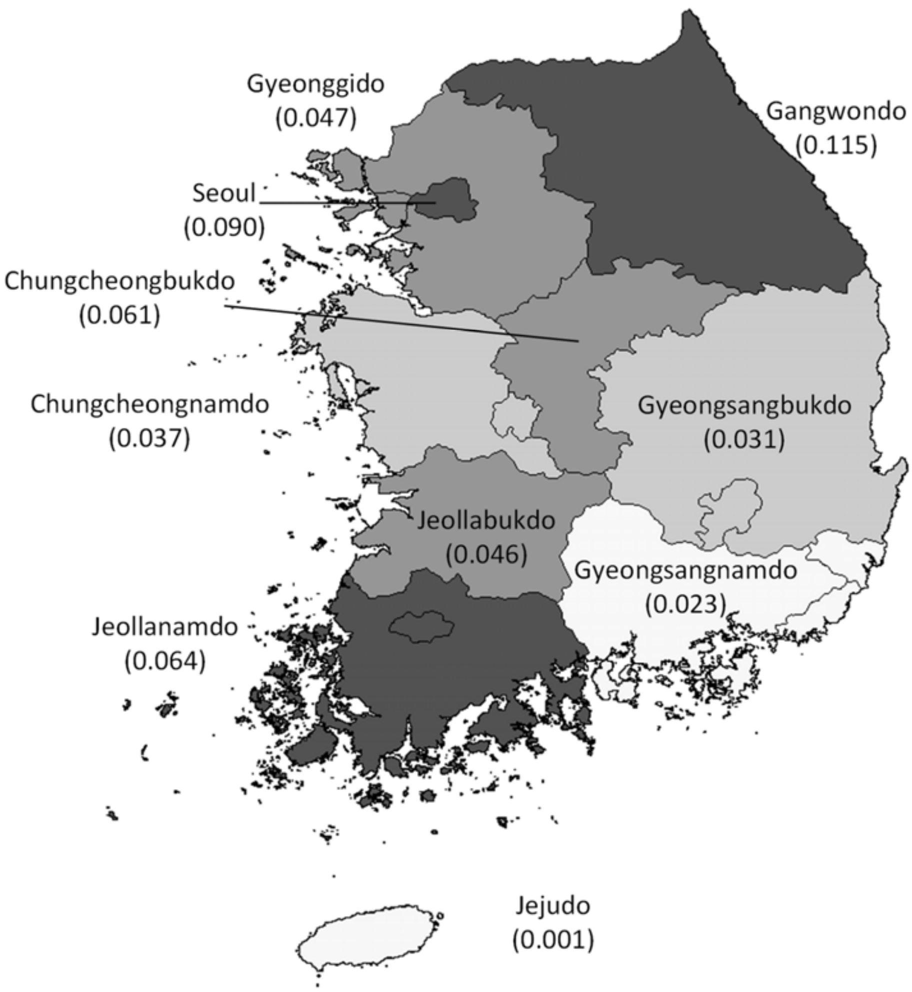
Figure 1: Injuries and Casualties from the Korean War per Population by Province



Source: Population data from the 1949 Census of South Korea. War damage data has been obtained from Kim (1996), p.85. Number of civilian injury/casualties per population ratios are shown in parenthesis.

Table 1: Descriptive statistics

	(1)	(2)	(3)	(4)
	Entire Sample		Treatment Group	Control Group
	Mean	Std. Dev.		
Outcome variable				
Proportion of safe choices	0.850	0.300	0.803	0.853
Treatment variable				
Father's cohort exposed to the war	0.131	0.338	0.581	0.101
Mother's cohort exposed to the war	0.102	0.302	0.617	0.067
Father born in risky area	0.237	0.425	0.749	0.202
Mother born in risky area	0.307	0.461	0.841	0.271
Individual Characteristic				
Male	0.562	0.496	0.608	0.559
Age at survey year (2004)	25.81	7.74	29.78	25.54
High school graduates	0.762	0.426	0.960	0.749
College graduates	0.313	0.464	0.520	0.299
Married	0.203	0.403	0.396	0.191
Household income (in millions KRW)	35.19	39.26	41.30	34.78
First in birth order	0.422	0.494	0.256	0.433
Sample size	3,607		227	3,380

Notes: The treatment group are the ones whose mother or father were between the ages of 4 and 8 and were residing in “risky” provinces. "Risky" provinces are those whose war intensity, defined by civilian injuries and casualties per capita, is higher than the national average. The data on civilian injuries and casualties are obtained from Kim (1996, p.85).

Table 2: Hypothetical lottery questions

Question Number	Option A (Safe Choice)	Option B (Risky Choice)	Gap in Expected Payoff (Option A - Option B)
1	100,000	1/2 of 150,000, 1/2 of 50,000	0
2	100,000	1/2 of 200,000, 1/2 of 0	0
3	100,000	2/5 of 200,000, 3/5 of 0	20,000
4	100,000	3/5 of 200,000, 2/5 of 0	-20,000
5	100,000	1/5 of 500,000, 4/5 of 0	0

Source: Kim and Lee (2012)
Notes: All units are in KRW; KRW 100,000 is equivalent to USD 105.12, based on the average exchange rate in 2004, or equivalent to 0.6% of annual GDP per capita of South Korea in 2004. The questions were asked in the order of the question number. Each question was asked for the payment option for a day's work.

Table 3: Maximum likelihood estimations of risk parameter and noise parameter

	(1)	(2)	(3)
Risk preference parameter			
Paternal exposure to war at age 4-8 X risky area	-0.164*	-0.111	-0.101
	(0.095)	(0.114)	(0.124)
Maternal exposure to war at age 4-8 X risky area	-0.235**	-0.207**	-0.223**
	(0.093)	(0.089)	(0.095)
Paternal exposure to war at age 4-8	0.009	-0.026	-0.008
	(0.050)	(0.057)	(0.063)
Maternal exposure to war at age 4-8	-0.013	0.025	0.032
	(0.059)	(0.081)	(0.080)
Father born in risky area	0.119	0.077	0.072
	(0.101)	(0.103)	(0.101)
Mother born in risky area	-0.044	-0.056	-0.043
	(0.064)	(0.054)	(0.056)
Male		-0.048	-0.004
		(0.049)	(0.056)
Age at survey year (2004)		0.001	-0.005
		(0.004)	(0.004)
High school graduates			-0.044
			(0.045)
College graduates			-0.029
			(0.072)
Married			0.092
			(0.077)
Log of household income (in 0,000 KRW)			-0.001***
			(0.000)
First child indicator			0.063
			(0.056)
Constant	0.697***	0.682***	0.839***
	(0.036)	(0.092)	(0.070)
Noise parameter			
Male		0.170***	0.203***
		(0.036)	(0.035)
Age at survey year (2004)		0.002	-0.003
		(0.004)	(0.003)
High school graduates			0.071***
			(0.022)
College graduates			-0.016
			(0.046)

Married			0.002
			(0.038)
Log of household income (in millions KRW)			-0.000***
			(0.000)
First child indicator			0.024
			(0.032)
Constant	0.365***	0.216**	0.284***
	(0.023)	(0.100)	(0.075)
Number of observations	18,035	18,035	18,035

Note: This table presents the estimated risk aversion parameter γ and structural noise parameter μ from equation (3). Standard errors are clustered at the province by cohort level. Robust standard errors are reported in parentheses. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 4: Estimation of risk parameter using different age groups

	(1)	(2)	(3)	(4)
Risk preference parameter				
Paternal exposure to war in utero or at age 0 X risky area	-0.154			
	(0.164)			
Maternal exposure to war in utero or at age 0 X risky area	0.192			
	(0.204)			
Paternal exposure to war at age 1-3 X risky area		0.113		
		(0.144)		
Maternal exposure to war at age 1-3 X risky area		0.060		
		(0.121)		
Paternal exposure to war at age 4-8 X risky area			-0.112	
			(0.113)	
Maternal exposure to war at age 4-8 X risky area			-0.207**	
			(0.089)	
Paternal exposure to war at age 9-13 X risky area				-0.080
				(0.184)
Maternal exposure to war at age 9-13 X risky area				0.237
				(0.156)
Number of observations	18,035	18,035	18,035	18,035

Note: The table reports the estimated risk aversion parameter γ of interaction term between the indicator variable for the specified age group and risk area from the equation (3). Standard errors are clustered at the province by cohort level. Robust standard errors are reported in parentheses. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 5: Robustness check

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Risk preference parameter								
Paternal exposure to war at age 4-8 X risky area	-0.112		-0.111		-0.103		-0.041	
	(0.113)		(0.125)		(0.111)		(0.132)	
Maternal exposure to war at age 4-8 X risky area	-0.207**		-0.200**		-0.196**		-0.234**	
	(0.089)		(0.087)		(0.090)		(0.095)	
Paternal exposure to war at age 4-8 X provincial casualty		-0.945		-0.881		-0.743		-0.897
		(1.478)		(1.548)		(1.447)		(1.633)
Maternal exposure to war at age 4-8 X provincial casualty		-2.382**		-2.286**		-2.203*		-3.038***
		(1.166)		(1.080)		(1.179)		(1.154)
Note	Baseline		Missing parental information		No age restriction		No movers	
Number of observations	18,035	18,035	36,980	36,980	18,915	18,915	13,740	13,740

Note: Standard errors are clustered at the province by cohort level. Robust standard errors are reported in parentheses. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 6: Reduced form estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Paternal exposure to war at age 4-8 X risky area	-0.0290		-0.0219		-0.0287		0.0127	
	(0.0361)		(0.0365)		(0.0359)		(0.0254)	
Maternal exposure to war at age 4-8 X risky area	-0.0645*		-0.0611		-0.0630*		-0.0833**	
	(0.0354)		(0.0350)		(0.0349)		(0.0388)	
Paternal exposure to war at age 4-8 X provincial casualty		-0.1695		-0.1294		-0.1587		0.2114
		(0.4375)		(0.4686)		(0.4379)		(0.3396)
Maternal exposure to war at age 4-8 X provincial casualty		-0.6282		-0.6211		-0.5995		-0.9414*
		(0.4625)		(0.4560)		(0.4535)		(0.5135)
Note	Baseline		Missing parental information		No age restriction		No movers	
R^2	0.199	0.198	0.200	0.200	0.197	0.197	0.208	0.206
Number of observations	3,607	3,607	7,396	7,396	3,783	3,783	2,748	2,748

Note: This table reports α_3 and α_6 from reduced form equation (4), and δ_3 and δ_6 from reduced form equation (5). Standard errors are reported in parentheses. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 7: Correlation between the number of safe choices by parents and children

	(1)	(2)
Parents' number of safe choices	0.1932	0.3280***
	(0.1876)	(0.0408)
Note	Treatment group	Control group
R2	0.426	0.288
Number of observations	138	2806

Note: This table reports β from reduced form equation (6). Standard errors are reported in parentheses. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 8: Assortative matching analysis

	(1)	(2)	(3)	(4)
Wife exposed to war at age 4-8 X risky area	0.0436**			
	(0.0165)			
Wife risky area war intensity X casualty		0.4539**		
		(0.1963)		
Husband exposed to war at age 4-8 X risky area			0.0330***	
			(0.0090)	
Husband risky area war intensity X casualty				0.4069***
				(0.1102)
R^2	0.175	0.174	0.211	0.211
Number of observations	3,247	3,247	32,366	32,366

Note: This table reports β_3 from reduced form equation (7). Standard errors are reported in parentheses. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 8: Estimation of risk parameters and reduced form DID coefficients for parents-offspring dyads

	Structural estimate		Reduced form estimate	
	(1)	(2)	(3)	(4)
Paternal exposure to war at age 4-8x Male X risky area	-0.071	-0.012	-0.0127	0.0136
	(0.110)	(0.127)	(0.0239)	(0.0269)
Paternal exposure to war at age 4-8 x Female X risky area	-0.130	-0.087	-0.0537	0.0079
	(0.167)	(0.198)	(0.0758)	(0.0538)
Maternal exposure to war at age 4-8 x Male X risky area	-0.305***	-0.295**	-0.0949*	-0.1111*
	(0.112)	(0.119)	(0.0501)	(0.0557)
Maternal exposure to war at age 4-8 x Female X risky area	-0.122	-0.164	-0.0005	-0.0139
	(0.130)	(0.148)	(0.0373)	(0.0455)
Note	Baseline	No mover	Baseline	No mover
R2			0.200	0.208
Number of observations	18,035	13,740	3,607	2,748

Note: Columns (1) and (2) reports the estimated structural risk aversion parameter γ of triple interaction term of the indicator variable for each parent-offspring dyad. Columns (3) and (4) reports α_3 and α_6 from reduced form DID equation for each parent-offspring dyad. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

APPENDIX

APPENDIX TABLE A. MAXIMUM LIKELIHOOD ESTIMATIONS OF RISK PARAMETER AND NOISE PARAMETER WITH THREE MUTUALLY EXCLUSIVE TREATMENT GROUP

	(1)	(2)	(3)
Risk preference parameter			
Only paternal exposure to war at age 4-8 X risky area	-0.055	0.006	0.006
	(0.102)	(0.131)	(0.126)
Only maternal exposure to war at age 4-8 X risky area	-0.142	-0.098	-0.118
	(0.105)	(0.109)	(0.111)
Both parental exposure to war at age 4-8 X risky area	-0.629***	-0.563***	-0.564***
	(0.219)	(0.179)	(0.178)
Number of observations	18,035	18,035	18,035

Note: This table presents the estimated risk aversion parameter γ and structural noise parameter μ from equation (3), but with three mutually exclusive treatment groups, paternal, maternal and parental exposure groups. This table only reports key parameters. Standard errors are clustered at the province by cohort level. Robust standard errors are reported in parentheses. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.