

# Personality Traits and the Long-term Impact of Adolescent Adversity

Xuebo Wang,<sup>1</sup> Junsen Zhang<sup>2</sup>

## Abstract

This study posits that personality traits could be a crucial determinant of the long-term impact of adolescent adversity and provides the first empirical analysis of this hypothesis. With survey data on twins from urban China, we investigate the effect of the “send-down” experience during China’s Cultural Revolution on children’s later social success. Our findings indicate that children with desirable personality traits, who are likely to respond positively to adversity, benefit from the send-down experience. In contrast, children with undesirable personality traits, who tend to respond negatively to the sufferings, are harmed by the rustication experience. Additionally, significant gender differences emerge, with females generally exhibiting greater resilience to adversity than males. Further investigation into the determinants of such personality traits suggests that both genes and family background play crucial roles in shaping these traits during childhood.

**Keywords:** Personality traits, resilience, adolescent adversity, send-down experience

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<sup>1</sup> School of Economics, Shanghai University of Finance and Economics. E-mail: wang.xuebo@mail.shufe.edu.cn.

<sup>2</sup> School of Economics, Zhejiang University. E-mail: jszhang@cuhk.edu.hk.

Suffering, for the weak, is the tomb of death; for the strong, it is the soil from which ambition springs.

—— Jean Jacques Rousseau (*The Dream of a Lonely Walker*)

When heaven is about to confer a great office on any man, it first exercises his mind with suffering, and his sinews and bones with toil. It exposes his body to hunger, and subjects him to extreme poverty. It confounds his undertakings. By all these methods it stimulates his mind, hardens his nature, and supplies his incompetencies.

—— Mencius<sup>1</sup> (*The Works of Mencius, Gao Zi, Part 2*)

## 1. Introduction

A large body of literature has studied the effect of early negative shocks (e.g., diseases and malnutrition) on child development. These studies generally conclude that such shocks have a long-lasting negative impact on children's human capital accumulation and later achievements (e.g., Case et al., 2005; Strauss and Thomas, 2007; Smith, 2009; Currie et al., 2010; Almond and Currie, 2011; Currie and Vogl, 2013). However, this perspective may only tell part of the story. Conventional wisdom, as illustrated by the opening quotations, suggests that early life hardships could also strengthen individuals.

This study posits that children's personality traits can mitigate or even reverse the impact of early negative shocks and provides the first empirical analysis of this hypothesis. We use the survey data on twins in urban China to investigate the long-term impact of adolescent adversity on social success and examine the role of the personality traits in this process.

Many of these urban twins were affected by the forced mass rustication movement during the Chinese Cultural Revolution, in which youth were sent down to the countryside to "be educated from living in rural poverty" (Lu, 2007). This experience was extremely challenging, as youth were relocated to remote, impoverished villages and subjected to harsh physical labor and a lack of

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<sup>1</sup>Mencius or Mengzi (371–289 BC) was a Chinese philosopher who has often been described as the "Second Sage" in China, only after the most influential Confucius.

material supplies. In our survey data, many twin pairs were affected by the “send-down” movement: in some cases, only one twin was sent down; in others, both were sent down, but for different durations. This scenario provides a unique opportunity to study the effect of this experience on the affected youth.

To examine the role that personality traits play in the long-term impact of the send-down experience, we first need to measure these traits in the twins. In psychological literature, personality traits are often conceptualized within the framework of the Big Five personality traits, which include Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (McCrae and Costa, 2008). Among these, Neuroticism—associated with emotional instability, anxiety, and a tendency to experience negative emotions—is closely related to resilience to adversity. As established in the literature, high levels of Neuroticism are associated with lower resilience due to emotional instability and a tendency to experience negative emotions (Mroczek and Kolarz, 1998; Campbell-Sills and Stein, 2007).

Our survey includes questions about whether respondents frequently experience negative emotions such as sadness and anger, which reflect their levels of Neuroticism and resilience. Based on the responses, we identify within-twin stable personality traits and estimate the effect of rustication on children with different traits. Since monozygotic (MZ) twins are genetically identical at birth, if they still share specific traits several decades later, we define these traits as within-twin stable. Our data shows that twins’ answers to these questions are largely similar, indicating that their personality traits, as reflected in these answers, are stable within each twin pair over time.

We categorize the sample into subsamples based on twins’ stable personality traits—specifically “positive,” “neutral,” and “passive”. We find that for the “positive” subsample, where both twins are likely resilient to adversity, the send-down experience significantly increases the send-down twin’s later wage. Conversely, for the “passive” subsample, where both twins are less likely to be resilient, the rustication experience has a considerable negative effect on the send-down twin’s later wage. Additionally, we observe a significant gender gap: “positive” males and females both benefit significantly from the send-down experiences, while “passive” males suffer significantly

from these experiences, with the negative effect being negligible for “passive” females. This suggests that females are more resilient to adversity than males.

We further investigate the determinants of these personality traits. Since the traits are essentially same for both MZ twins, we infer that they are determined by common factors such as genes or family background. By comparing the traits of MZ and dizygotic (DZ) twins, we assess the role of genes, and by examining the family backgrounds of MZ twins with different traits, we explore the role of family background. Our results suggest that both genes and family background seem to play important roles in shaping these traits.

We are able to address several concerns about our identification strategy. First, the personality traits used to predict resilience are assessed several decades after respondents’ send-down experience, raising concerns about the measure’s validity and reliability. These traits could have been affected by the send-down itself or subsequent experiences. In response, we provide compelling evidence that the relevant trait crucial for predicting resilience remains stable within twins over time. Our findings indicate that MZ twins exhibit only minimal differences in many personality traits at the time of the survey. Moreover, the divergent characteristics of MZ twins have a minimal or even negligible impact on these traits, including those most likely to be shaped by environmental factors and experiences. Notably, even for personality traits that usually undergo significant changes over time in the general population, MZ twins demonstrated remarkable similarity at the time of the survey. These results suggest that our assumption of within-twin stability of personality traits is considerably less stringent than the concepts of mean-level stability and rank-order stability commonly discussed in the psychology literature.

Second, MZ twins may not be exactly the same, and parents’ decision on which twin send down could be endogenous. In response, we examine the implications of potential differences within the MZ twins on our results. Specifically, we compare the within-MZ and within-DZ twin estimates to reveal the sign of the correlation between rustication and endowment. Our results indicate that, for the “positive” subsamples, parents generally chose the weaker twin to send down, implying that the estimates provide a lower bound on the returns to rustication for this group. In contrast, for the “passive” subsamples, parents exhibit no obvious favoritism toward the abler or less able child,

resulting in an unbiased estimate of the returns to rustication. This selection pattern guarantees that our estimates capture the lower bound of the gap in the effect of rustication experiences between the “positive” and “passive” subsamples.

Third, there may be spillover effects within families, where the stay-home twin might also be affected by their sibling’s send-down experience. However, these spillovers do not invalidate our results. In fact, we do not require the strong assumption that the stay-home twins were completely unaffected by their siblings’ send-down experience. We only anticipate that the send-down twins would be more affected by their rustication experience than their stay-home siblings. Our within-twin estimates aim to capture the differences in the effects of send-down exposure between twins who were and were not sent down.

This study contributes to the growing body of literature on personality traits and labor market outcomes, which has demonstrated that personality traits significantly shape career success, earnings, job performance, and other work-related outcomes (e.g., Nyhus and Pons, 2005; Heckman et al., 2006; Caliendo et al., 2015). Our findings enhance the understanding of how personality traits influence individuals’ socioeconomic status, particularly how those with desirable traits can use adversity as an impetus for self-improvement and success.

Additionally, this study contributes to the literature on the significance and determination of non-cognitive skills. Previous research has established that non-cognitive skills (e.g., personality and social and emotional traits) are as important as cognitive ability (e.g., IQ) in determining individuals’ social and economic success (e.g., Borghans et al., 2008; and Kniesner and Weel, 2008). However, the determinants of non-cognitive skills and the mechanisms through which these skills can be nurtured remain underexplored. Our findings shed light on these issues, particularly on the formation of non-cognitive skills such as resilience in children.

## **2. Historical Background: The Cultural Revolution and the Send-Down Movement**

On May 16, 1966, the Central Committee of the Chinese Communist Party chaired by Mao Zedong issued a circular that outlined Mao’s ideas on the cultural revolution. It marks the start of the 10-year long “great proletarian Cultural Revolution” in China.

The Cultural Revolution is a colossal catastrophe for China. During this period, human rights, democracy, the rule of law, and the Chinese civilization itself were unprecedentedly crushed (Yan and Gao, 1996). Many leading cadres of the government were persecuted, and numerous intellectuals and ordinary people were also attacked and maltreated. Song (2011) estimates that during this period, several million people were persecuted to death and hundreds of millions received cruel and inhumane treatment. The economy was also on the verge of collapse, and large segments of the Chinese population, particularly residents of rural areas, lived in extreme poverty. The literature has documented the traumatic impact of this period, such as the disruption of social stability, breakdown of social norms, economic stagnation, unnecessary deaths owing to violence and persecution, physical and emotional suffering in certain sectors, and lost life opportunities for an entire generation of youth who grew up during the period (Xie et al., 2008). In brief, such a turbulent decade brought immense sufferings to the people of China.

Shortly after the beginning of the Cultural Revolution, a large-scale send-down movement campaign was launched at the national level, which affected nearly all urban families. This campaign sought to send the urban youth, after graduation from junior or senior high school, “up to the mountains and down to the countryside.” Lu (2007) comprehensively records the send-down movement. Small-scale send-down movements started in the 1950s. After the People’s Republic of China was established, the youth from urban areas were organized to relocate to the rural countryside, especially remote towns, to cultivate virgin land and/or work in farms as solutions to the employment problems in the cities. In 1953, the *People’s Daily* published the editorial “Organize school graduates to participate in agricultural production labor.” In 1955, Mao Zedong asserted that “the countryside is a vast expanse of the heaven and earth where we can flourish,” which later served as the slogan for the movement. In 1966, under the influence of the Cultural Revolution, university entrance examinations were suspended. Until 1968, many students were unable to be admitted into universities or gain employment. In 1969, thousands of youth were rusticated.

Xie et al. (2008) summarize the multiple factors that motivated such a nationwide policy of the Chinese government at the time: the desire to alleviate urban unemployment, the desire to cultivate Marxist ideology and communist ethics in the youth, and the need to develop China’s rural areas and

frontiers. Perhaps more fundamentally, Chairman Mao always stressed that it was necessary for educated young people to go to the countryside to be reeducated by the poor and lower middle-class peasants, and the government believed that the sent-down urban intellectual youth could promote themselves in many ways through experiencing hardships in rural areas. Such mentality is consistent with the desire to cultivate Marxist ideology and communist ethics in the youth.

Although some urban youth were inspired by the revolutionary and patriotic propaganda and voluntarily went down to the countryside, most were reluctant to separate from their parents and go to the backward rural areas to perform harsh manual labor. Thus, coercion was used and parents were threatened with job loss. In many cases, parents were permitted to send only one child (twin) down, and even if all children (twins) were sent down, the children stayed in the countryside for different durations. As one sent-down young person recounted:

*I was only 15 when I was sent down. No one wanted to go, but no one could resist. When I refused to go, those in charge of the residential committee came to our home every day and asked us to study Chairman Mao's instructions. A member of the worker's propaganda team came to live in our home and organized a study team for my family. My father was a cadre. He was locked up in a study team in his workplace and was not allowed to return home until his children agreed to go to the rural area. In the end, my mother begged me to go to the rural area (Deng, 1993, p. 60).*

For most youth, the send-down experience was traumatic and among the most difficult incidents in their lives. They suffered not only removal from their families but also lack of material supplies, an unfamiliar environment, and harsh physical labor. As shown in Zhou and Hou (1999), vast disparities in living environments were present between the rural and urban areas, and most urban youth had never lived in rural areas prior to their sent-down experience; they were sent to designated rural areas far from their home cities and were allowed to visit their families for only a few weeks in every three years; they also endured harsh manual work in the field, often for more than 10 hours a day, 7 days a week.

From 1966 until the send-down movement ended in 1978, approximately 17 million people, or 10.5% of the urban population at the time, were sent down to rural areas (Pan, 2002). Some sent-down youth returned to the cities during the Cultural Revolution, but only a small number had such

opportunities. In October 1978, the Community Party issued a document to end forced rustication and begin arranging for the sent-down people to return to the cities. Only about a million sent-down youth, or approximately 5% of the total number never returned to the urban areas because they were married to local farmers or were assigned non-agricultural local jobs (Li et al., 2010).

The send-down movement is a unique social experiment in modern China, and tens of millions youth were affected. Studying the effect of such a historical event on the youth who experienced the movement in the context of the Cultural Revolution remains of great interest.

### 3. Data

The data used in the present study are derived from the Chinese Twins Survey, which was conducted by the Urban Survey Unit of the National Bureau of Statistics (NBS) in June and July 2002 in five cities in China. The survey was funded by the Research Grants Council of Hong Kong. Some influential papers published in prestigious journals also employed this data set (e.g., Li et al., 2007; Huang et al., 2009; Li et al., 2010; Li et al., 2012) and confirmed the high quality of the data. This is the first socioeconomic twin data set in China and perhaps the first in Asia. The data set includes rich information on the socioeconomic situation of the respondents in the five cities of Chengdu, Chongqing, Harbin, Hefei, and Wuhan. Altogether, 4,683 respondents participated, of which 2,990 were twins. For the sample of twins, care was taken to distinguish whether the twins are identical (monozygotic, or MZ) or non-identical (fraternal, or DZ) twins on the basis of standard questions used in prior twin surveys. We consider a pair of twins to be identical if both respond that they have identical hair color, looks, and gender. Completed questionnaires were collected from 919 matched pairs of MZ twins (1,838 respondents) and 576 matched pairs of DZ twins (1,152 respondents). However, for each variable, a slightly different number of observations may occur because of missing values. Table 1 reports the summary statistics of MZ and DZ twins. For each variable reported, we restrict the sample such that it is non-missing for both twins in a pair.

Column 1 shows that 56% of the identical twins are male; on average, the twins were 37 years old and had 11 years of schooling. For the entire MZ twin sample, the twins had been sent down for an average of 0.7 year. For those in the affected cohorts (born in the period 1946–1961 or aged 41–



56 in 2002), however, 51% were sent down for rustication; those sent down stayed in the countryside for 3.5 years on average. The MZ twins in our sample had monthly average earnings of 888 yuan in 2002, where earnings include wages, bonuses, and subsidies.

Table 1: Summary Statistics, by Twin Pair Type

Variable	MZ twins		DZ twins	
		Standard		Standard
	Mean	Deviation	Mean	Deviation
	(1)	(2)	(3)	(4)
Send-down years for the entire sample	0.71	2.11	0.45	1.75
Proportion sent down for affected cohorts (aged 41–56 in 2002)	0.51	0.50	0.45	0.50
Send-down years for affected cohorts	1.74	2.90	1.67	3.04
Age	37.31	10.22	34.80	10.04
Male proportion	0.56	0.50	0.59	0.49
Years of education	11.24	2.96	11.35	3.07
Monthly wage in 2002 (including bonus and subsidies, in yuan)	888.50	517.93	835.33	548.30
Number of twins (pairs)	1,838 (919)		1,152 (576)	

Given that we rely on estimates based on the variation within the pairs of twins in the duration of forced rustication, an important feature of the data is the extent of within-twin pair variation in the send-down time. In total, 363 pairs of MZ twins and 156 pairs of DZ twins are in the affected cohorts (aged 41–56 in 2002). Table 2 shows that for 34% of the affected MZ twin pairs, neither twin was sent down; for 30% of the twin pairs, one was sent down; and for the remaining 36% of the twin pairs, both were sent down. The within-twin variation in send-down years is even larger. In 48% of the MZ twin pairs, the twins spent a different number of years in the countryside: 23% had 1–2 years' difference in send-down years, 21% had 3–5 years' difference, and the remaining 4% had a difference of over 5 years. The within-twin pair differences for DZ twins are also substantial and have a similar distribution.

Table 2: Within-Twin Variation in Rustication and Send-Down Years for Affected Cohorts (Aged 41–56 in 2002)

Variable	MZ twins		DZ twins	
	Count	Percent	Count	Percent
A. Within-twin variation in send-down dummy				
Neither sent down	124	34.16	60	38.46
One sent down	108	29.75	51	32.69
Both sent down	131	36.09	45	28.85
Total pairs	363	100	156	100
B. Within-twin variation in send-down years				
0 year	188	51.79	82	52.56
1–2 years	85	23.42	44	28.21
3–5 years	77	21.21	22	14.10
6 years or more	13	3.58	8	5.13
Total pairs	363	100	156	100

Alternatively, we can use a binary variable that indicates whether one was sent down to measure his or her send-down exposure. Such practice requires us to restrict the sample to MZ twin pairs where one twin was sent down and the other remained home. However, this practice has evident limitations. First, an individual who was sent down for 10 years could be much more affected than the other one sent down for only 1 year. Thus, it is very inaccurate to simply assume that those sent-down youths were equally affected by such experiences. In other words, such a binary variable cannot accurately measure respondents' send-down exposure, particularly when we know the actual duration of their send-down experience. Second, such practice requires us to exclude nearly 40% of the twin pairs where both were sent down but differ in the duration, which is not necessary and may further raise the concern of sample selection manipulation. Therefore, we use the duration of the send-down experience to measure respondents' send-down exposure, just as Li et al. (2010) do.

## 4. The Effect of the Send-Down Experience on Youth's Later Social Success

### 4.1. Empirical Specifications

We estimate the effect of the rustication experience on children's later earnings based on the fixed-effect method, and obtain the estimates based on the variation in send-down years within MZ twin pairs, which identifies the economic returns to rustication. We estimate the following earning equation:

$$w^{ij} = X^j \alpha + Z^{ij} \beta + \mu_j + e^{ij} + \varepsilon^{ij}, \quad (1)$$

where superscripts  $i$  and  $j$  refer to child  $i$  and family  $j$ , respectively;  $w^{ij}$  is the logarithm of earnings (wage) for child (twin)  $i$  in family  $j$ ;  $X^j$  represents a set of observed family characteristics, and  $Z^{ij}$  is a set of observed child-specific variables that affect earnings, in which the number of send-down years ( $r^{ij}$ ) are included;  $\mu_j$  is a family effect;  $e^{ij}$  denotes the child-specific endowment; and  $\varepsilon^{ij}$  is the disturbance term, which we assume to be independent of the  $Z^{ij}$  and  $\mu_j$ .

The ordinary least squares (OLS) estimate of the effect of send-down years in Equation (1) is likely biased. Such bias results from the fact that  $\mu_j$  and  $e^{ij}$  are usually correlated with  $Z^{ij}$ ; normally, we cannot control the effect of these two unobservable factors. For instance, if those sent-down youth are generally from disadvantaged families or have low endowment or ability (which cannot be measured accurately in general), then the OLS estimate of  $\beta$  would pick up the negative effect induced by these unobservable factors. However, we substantially eliminate such biases by obtaining a fixed-effect estimate for the MZ twin sample. MZ twins can be considered genetically identical and thus the endowment differences within MZ twins are normally small.<sup>2</sup> Moreover, the twins are also brought up in the same family. Thus, we could eliminate the effect of family

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<sup>2</sup>MZ twins may not be identical at birth. Differences in nutrient intake in the womb across MZ twins may matter for their later outcomes. As shown in Behrman and Rosenzweig (2004), a considerable variation exists in birth weight across MZ twins, and this variation is closely related to differences in their educational outcomes and earnings. Li et al. (2010) further find that parents exhibited favoritism toward the abler child and choose the low-endowment twin child to be sent down. In Section 4.4, we also investigate the potential difference within MZ twins and its implications on our empirical results.

background and endowment by taking a first difference of earning Equation (1) across the MZ twin sibling pairs. We obtain the first difference earning equation as follows:

$$w^{1j} - w^{2j} = (Z^{1j} - Z^{2j})\beta + \varepsilon^{1j} - \varepsilon^{2j}, \quad (2)$$

where the superscripts 1 and 2 refer to twins 1 and 2 in a pair. The family background and endowment effects are all eliminated by differencing. The estimate  $\beta_{MZ}$  based on Equation (2) provides an unbiased estimate of children's send-down experiences on their earnings as adults.

We hypothesize that the effects of the send-down experience on heterogeneous individuals are different. To empirically test this hypothesis, we divide the sample into "positive" and "passive" subgroups on the basis of respondents' stable personality traits and further estimate Equation (2) for each group respectively. We will discuss how to measure respondents' relevant traits in the next section.

#### 4.2. Measuring Respondents' Personality Trait of Resilience

We use respondents' personality traits, as indicated by their answers to relevant survey questions, to predict their resilience to adversity. The survey has two questions Q1 and Q2 below, which are similar to those found in standard Big Five personality traits assessments related to Neuroticism. As shown later, respondents' answers to these questions can provide insights into their levels of Neuroticism and their resilience to adversity.

Q1. Do you ever experience the following emotions?

	Very often	Sometimes	Rarely	Never
Sad	1	2	3	4
Angry	1	2	3	4

Q2. If you experience the following emotions, can you successfully control it in the proper expression level?

	Very often	Sometimes	Rarely	Never
Sad	1	2	3	4
Angry	1	2	3	4

The Big Five personality traits, also known as the Five-Factor Model (FFM), represent a widely accepted framework for understanding human personality. According to this model, personality can be described across five broad dimensions: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (McCrae and Costa, 2008). Among these, Neuroticism is most closely related to resilience. Neuroticism is characterized by a tendency to experience negative emotions more frequently and intensely than others. Individuals high in Neuroticism are often more sensitive to stress and more prone to mood swings, emotional instability, and feelings of insecurity. The literature has established that high levels of Neuroticism are associated with lower resilience due to this emotional instability and a tendency to experience negative emotions (Mroczek and Kolarz, 1998; Campbell-Sills and Stein, 2007). Therefore, respondents' answers to the above questions indicate their levels of Neuroticism and personality trait of resilience.

Our survey was conducted in 2002, many years after the send-down movement. Thus, the personality traits used to predict resilience are assessed several decades after respondents' send-down experience, raising concerns about the measure's validity and reliability. These traits could have been affected by the send-down itself or subsequent experiences. Therefore, we must confirm that the relevant trait used to predict resilience should be stable over time.

The stability of personality traits is seen in two ways in the psychology literature: the mean levels of the traits of the same birth cohorts change little with age (mean-level stable), and retest correlations<sup>3</sup> show stability of individual differences (rank-order stable) (Costa and McCrae, 1991). The first concept of stability is similar to absolute stability over time; the second one refers to the extent to which individuals maintain their rank order in the distribution of a trait, e.g., whether introverts remain introverts, or become extraverts (Costa and McCrae, 1991).

The literature has established that personality traits are both stable and changeable throughout the life span (Bleidorn et al., 2022). Roberts et al. (2006) reveal that rank-order stability and mean-level change are better regarded as independent and can exist simultaneously. Specifically, rank-order stability refers to the relative placement of individuals within a group over time, whereas

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<sup>3</sup>In practice, researchers test the correlation of the relevant traits among individuals at intervals to investigate whether these traits are stable over time.

mean-level change denotes whether a group of people increases or decreases on trait dimensions over time. The existence of stability, at least as defined in terms of rank-order stability, does not preclude the existence of change, especially a mean-level change over time. Ample empirical evidence proves that rank-order stability and mean-level change coexist in the same longitudinal study (e.g., Roberts et al., 2001; Robins et al., 2002; Roberts et al., 2002).

Our identification strategy does not require the strong assumption of mean-level stability or rank-order stability. Instead, we assume that the trait used to predict resilience remains stable within twin pairs over time. Given that MZ twins are born genetically identical, if they still share some specific traits several decades later, we define these traits as being within-twin stable over time. Specifically, MZ twins may have had numerous different experiences over several decades; if such experiences do not affect these traits, we can conclude that they are indeed within-twin stable over time.

Since twins are more similar to each other than to other individuals and they are raised in the same family, they are more likely to remain similar in many traits. Therefore, our assumption of within-twin stability of personality traits is considerably less stringent than the concepts of mean-level stability and rank-order stability commonly discussed in the psychology literature.

In fact, within-twin stability can coexist with mean-level change. Specifically, even if a personality trait is within-twin stable in adulthood, it does not indicate that the trait is absolutely unchangeable or unaffected by the environment and experiences. Some psychologists reveal that individuals' personality traits are formed through the influences of their parents and other key people during childhood (Stoltz, 1997). MZ twins, who share similar genes, are raised in the same family and are primarily cared for by their parents during childhood. Consequently, they are likely to develop similar personality traits during this period, prior to their send-down experience. Furthermore, once these traits are formed, they are likely to remain within-twin stable over time in adulthood. Therefore, even if these traits are influenced by common factors (e.g., family background) shared by MZ twins, they can still be within-twin stable over time.

Such inferences are highly consistent with the literature. Empirical studies demonstrate that the Big Five personality traits remain stable in working-age adults over extended periods, with mean

population changes being small and consistent across age groups. Additionally, intra-individual changes are not significantly related to adverse life events and are not economically meaningful (e.g., Deborah and Schurer, 2012).

We now empirically examine whether the personality traits as reflected in the survey questions are within-twin stable over time. We focus on four relevant variables, namely, the respondents' answers to question Q1 related to their "sad" and "angry" emotion experiences (i.e., E-sad and E-angry) and question Q2 related to their ability to successfully control their sad and angry emotions (i.e., C-sad and C-angry). All these questions have four options: 1 ("very often"), 2 ("sometimes"), 3 ("rarely"), 4 ("never"). Table 3 presents the summary statistics for the within-MZ and -DZ twin variations in the four variables.

The upper panel shows that the mean of the within-MZ-twin difference for the four variables are between 0.5 and 0.7 and that the corresponding standard deviations are between 0.6 and 0.8. Furthermore, the lower panel indicates that over 50% of MZ twins exactly have the same answers to these questions (with the difference being 0), and nearly 40% of the twins have slightly different answers to these questions (with the difference being 1), whereas only approximately 2% or less of the twins have significantly different answers to these questions (with the difference being 3). Given the potential measurement error and that the smallest unit of these variables is 1, these MZ twins only show relatively small difference in their answers to these questions. This finding provides suggestive evidence that the traits measured by these variables are within-twin stable to some extent.

We now further verify whether these traits are stable on the basis of a fixed-effect estimation for the MZ twin sample. If a specific trait is within-twin stable, then it is determined by genes and common factors and would be unaffected by other factors. We estimate Equation (2), with the dependent variables being these four traits ("E-sad", "E-angry", "C-sad", and "C-angry") respectively, to check whether these traits are affected by the respondents' divergent characteristics and experiences, particularly their send-down experiences. We also include other variables in the

Table 3: Summary Statistics for the Within-MZ and Within-DZ Twin Variation in Several Traits

Within-twin differences												
Variables	E-sad			E-angry			C-sad			C-angry		
	MZ	DZ	T-test	MZ	DZ	T-test	MZ	DZ	T-test	MZ	DZ	T-test
Mean	0.602	0.579	0.023	0.562	0.660	-0.098***	0.552	0.614	-0.062	0.629	0.678	-0.049
S.D.	(0.712)	(0.699)	(0.038)	(0.670)	(0.726)	(0.037)	(0.753)	(0.773)	(0.041)	(0.789)	(0.838)	(0.043)
Distribution												
0	474 (51.8%)	305 (53.2%)		487 (53.1%)	272 (47.7%)		526 (57.9%)	306 (53.5%)		485 (53.2%)	297 (51.9%)	
1	343 (37.5%)	210 (36.6%)		353 (38.50%)	228 (40.0%)		290 (31.9%)	199 (34.8%)		310 (34.0%)	187 (32.7%)	
2	86 (9.4%)	52 (9.1%)		69 (7.5%)	62 (10.9%)		67 (7.4%)	49 (8.6%)		87 (9.5%)	63 (11.0%)	
3	12 (1.3%)	6 (1.1%)		8 (0.9%)	8 (1.4%)		26 (2.8%)	18 (3.1%)		30 (3.3%)	25 (4.3%)	
Observations (pair)	915 (100%)	573 (100%)		917 (100%)	570 (100%)		909 (100%)	572 (100%)		912 (100%)	572 (100%)	

Notes: (i) *T*-test is to test the difference between the mean of each variable for MZ and DZ twins. \*\*\*  $p < 0.01$ . (ii) Within-twin difference is an absolute value. For instance, if one twin answers “1” (“very often”) and the other answers “4” (“never”) regarding experiencing one emotion, then the within-twin difference in this variable is 3 (absolute value).



Table 4: Within-MZ Estimates of the Effect of Send-Down Years on Several Traits

Variables	Dependent variables							
	E-sad (1)	E-sad (2)	E-angry (3)	E-angry (4)	C-sad (5)	C-sad (6)	C-angry (7)	C-angry (8)
Send-down years	-0.0304** (0.0153)	-0.0291* (0.0151)	-0.0126 (0.0144)	-0.00721 (0.0142)	-0.0177 (0.0156)	-0.0154 (0.0153)	-0.0170 (0.0167)	-0.0129 (0.0164)
Wage	0.0691 (0.0615)		0.0534 (0.0579)		-0.0319 (0.0630)		-0.130* (0.0667)	
Experience	0.0180** (0.00790)	0.0163** (0.00699)	-0.000753 (0.00743)	0.00200 (0.00659)	0.0150* (0.00834)	0.0124* (0.00722)	0.0148* (0.00859)	0.0121 (0.00764)
Education	0.0299* (0.0173)	0.0342** (0.0158)	0.0166 (0.0163)	0.0122 (0.0146)	-0.00759 (0.0177)	-0.00333 (0.0156)	0.00684 (0.0190)	0.00700 (0.0169)
Family income		0.0547** (0.0263)		0.00364 (0.0248)		-0.0549** (0.0265)		-0.0219 (0.0286)
Constant	2.066*** (0.239)	1.930*** (0.218)	2.450*** (0.225)	2.475*** (0.203)	1.584*** (0.248)	1.721*** (0.220)	1.665*** (0.261)	1.693*** (0.234)
Pairs of twins	854	909	854	909	853	908	853	908

Note: Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

regressions that may affect these traits, such as wage or family income, work experience, and years of schooling.<sup>4</sup> The estimation results are shown in Table 4.

Table 4 shows that the traits “E-sad,” “C-sad,” and “C-angry” are significantly affected by at least one variable, whereas “E-angry” is not significantly affected by any of the independent variable. Specifically, Columns 1 and 2 indicate that “E-sad” is significantly affected by the send-down years, work experience, and family income. The send-down experience has a significant negative effect on the respondents’ tendency to experience sad emotions, but the magnitude of the effect is fairly small. An additional year of send-down experience only reduces “E-sad” by approximately 0.03, that is, it slightly increases the respondents’ tendency to experience sad emotions.<sup>5</sup> Work experience significantly increases “E-sad,” and the magnitude of the effect is even smaller. An additional year of work experience only increases “E-sad” by 0.02, indicating that respondents who work more years are slightly less likely to experience sad emotions frequently. Unsurprisingly, family income significantly reduces the respondents’ tendency to experience sad emotions, but the magnitude of the effect is very small. An increase of 10,000 Yuan in annual family income only increases “E-sad” by approximately 0.06. These findings suggest that the trait “E-sad” is unstable because it is closely related to whether an individual is satisfied with the current state of her life.

Similarly, as shown in Columns 5-8, “C-sad” and “C-angry” are also significantly affected by wage or family income. Specifically, the respondents with higher family income are more able to control their sad emotions, and the respondents with higher wages could control their angry emotions to a greater extent. Again, the magnitude of these effects is not very large. By contrast, Columns 3 and 4 indicate that “E-angry” is not significantly affected by all the independent variables (with the estimates of all coefficients being very small and insignificant). Therefore, the variable “E-angry” seems to reflect the respondents’ stable personality trait.

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<sup>4</sup>As wage is part of family income, we include the two variables separately in the regression to examine the effect of each variable on the dependent variables.

<sup>5</sup>The variables “E-sad” and “E-angry” take four values, namely, 1 (“very often”), 2 (“sometimes”), 3 (“rarely”), and 4 (“never”). Thus, if the send-down experience reduces “E-sad,” then it indicates that the send-down experience increases the respondents’ tendencies to experience sad emotions “very often.”

Intuitively, “E-angry” measures whether individuals often experience anger and reflects whether they can keep a positive frame of mind, which is likely to indicate a stable personality. By contrast, individuals’ ability to effectively control their angry emotions may be affected by their social success. That is, individuals who have achieved higher social success may have likewise nurtured their ability to control their negative emotions in the process. Therefore, the trait “C-angry” is likely to be less stable.

Table 3 also confirms our aforementioned inferences. “E-angry” has the smallest mean and standard deviation of within-MZ-twin difference. Moreover, approximately 92% of MZ twins only show a slight difference in “E-angry” (with the difference being equal or less than 1), whereas only less than 1% of MZ twins show significant difference in it (with the difference being 3). It will later be presented that, among these four traits, the trait “E-angry” is more determined by genes than the other three.

In sum, an individual’s tendency to experience sad emotions partly depends on their satisfaction with their current life situation, making it an unstable personality trait. Similarly, the ability to control negative emotions can be continuously learned and improved through life experiences, which also renders it an unstable personality trait. In contrast, an individual’s tendency to experience angry emotions reflect their propensity for maintaining a positive mindset, which is likely a stable personality trait.

We thus use the variable “E-angry”, which measures respondents’ tendency to experience angry emotions and represents a within-twin stable personality trait, to predict respondents’ resilience to adversity. Specifically, we infer that respondents who frequently experience angry emotions are likely to be pessimistic and respond negatively to the send-down experience, and vice versa.

The psychology literature provides strong and direct support for this approach. As discussed earlier, the variable “E-angry” can reflect respondents’ levels of Neuroticism and resilience to adversity. Additionally, the literature provides direct evidence of a strong correlation between the tendency to experience angry emotions and resilience to adversity. Specifically, the tendency to experience anger is negatively correlated with optimism, and optimism is positively correlated with resilience (Ausbrooks et al., 1995; Yu and Zhang, 2007; Puskar et al., 2008; Herrman et al., 2011;

Segovia et al., 2012; Sourì and Hasanirad, 2011; López et al., 2015; Pathak and Lata, 2018; Gómez et al., 2018). Therefore, if respondents rarely experience angry emotions, they are likely optimistic and may respond positively to negative shocks, and vice versa.

The literature also confirms that the variable “E-angry” represents a stable personality trait. For instance, Boman et al. (2003) show that the tendency to experience anger is a relatively stable personality trait and is also closely related to optimistic and pessimistic expectations, which significantly influence responses to hardships, setbacks, and stressful circumstances.

While our assumption that the personality trait of resilience is within-twin stable over time may seem strong at first glance, it is largely reasonable and supported by the literature and the data. The findings discussed in this section reveal that MZ twins exhibit only minimal differences in many personality traits at the time of the survey. Furthermore, the distinct characteristics between MZ twins have a minimal or even negligible impact on these traits, including those typically susceptible to environmental and experiential factors. Even for those personality traits typically prone to significant changes over time in the general population, MZ twins demonstrated remarkable similarity at the time of the survey. These results affirm our hypothesis that the assumption of within-twin stability of personality traits is relatively weak, and this assumption aligns closely with the patterns observed in the data.

### **4.3. Empirical Results on the Send-Down Experience**

According to the previous analysis, we categorize the sample into several subsamples based on the variable “E-angry”. Specifically, if both twins answer that they experience angry emotions “very often” or “sometimes,” we include them in the “passive” group, and if both twins answer that they “rarely” or “never” experience angry emotions, we include them in the “positive” group. Besides these two groups, in the case of some twins, one may answer “sometimes” and the other may answer “rarely” regarding experiencing angry emotions. Given the subtle difference between “sometimes” and “rarely,” it is very likely that, although these twins’ answers are not exactly the same, they

actually show minimal difference in their tendency to experience angry emotions. Therefore, we include these twins in a third subsample, which is the “neutral” group.<sup>6</sup>

We now use Equation (2) to estimate the effect of the send-down experience on the respondents’ later earnings for the entire MZ twin sample and each subsample.

The estimation results are demonstrated in Panel A in Table 5. Column 1 of Panel A shows that for the entire MZ twin sample, the send-down experience has a significantly positive effect on the respondents’ earnings. Specifically, an additional year of send-down experience increases the respondents’ earnings by approximately 3.5%. Furthermore, when we divide the entire sample into “positive,” “neutral,” and “passive” subsamples, we find that the effect of the send-down experience on the respondents’ earnings shows considerable differences across the three subsamples.

Specifically, Column 2 shows that for the “positive” subsample, the send-down experience has a much larger positive effect on the respondents’ earnings than that for the entire sample, that is, an additional year of send-down experience increases the respondents’ earnings by as much as 9.0%,<sup>7</sup> and the estimate is significant at the 5% level. Conversely, for the “neutral” subsample, Column 3 indicates that the estimate falls by more than half and becomes insignificant.

By contrast, Column 4 reveals that, for the “passive” subsample, the estimate even becomes negative, and an additional year of send-down experience reduces the respondents’ earnings by approximately 6.3%. Although this estimate is not significant and the p-value is approximately 0.13, it is still surprising and is in sharp contrast with the significantly positive estimate for the “positive” subsample. Furthermore, the t-test result (Column 5 of Panel A) verifies that the estimates for the “positive” and “passive” subsamples significantly differ (with the p-value being approximately 0.016), which indicates that a significant gap exists in the effect of send-down experience on respondents’ wage across positive and passive groups.

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<sup>6</sup> There are few twin pairs (less than one percent) in which one twin’s answer is “very often” and the other one’s is “never”, and such outliers are not classified into any of the three subsamples.

<sup>7</sup>  $e^{0.086} - 1 = 0.090$ .

Table 5: Fixed-Effect Estimates of the Effect of the Send-down Years on Log Wage, by Twin Pair Type and Group Type

Variables	A. MZ twins (Classification I)				<i>p</i> -value
	Entire sample (1)	Positive (2)	Neutral (3)	Passive (4)	(2)–(4) (5)
Send-down years	0.0344** (0.0144)	0.0864** (0.0382)	0.0412 (0.0258)	-0.0607 (0.0401)	0.0016
Observations	986	402	255	267	
A0. MZ twins (Controlling for parental transfers)					
Variables	Entire sample (1)	Positive (2)	Neutral (3)	Passive (4)	(2)–(4) (5)
Send-down years	0.0409* (0.0241)	0.106** (0.0486)	0.0517 (0.0376)	-0.0602 (0.0496)	0.0031
Observations	421	168	108	117	
B. DZ twins (Classification I)					
Variables	Entire sample (1)	Positive (2)	Neutral (3)	Passive (4)	(2)–(4) (5)
Send-down years	0.00294 (0.0336)	0.0156 (0.0430)	0.0287 (0.105)	-0.0799 (0.111)	0.4774
Observations	640	260	190	130	
C. MZ twins (Classification II)					
Variables	Positive I (1)	Positive II (2)	Passive II (3)	Passive I (4)	(1)–(4) (5)
Send-down years	0.397** (0.152)	0.0876* (0.0491)	-0.0602 (0.0491)	-0.529 (0.824)	0.001
Observations	61	260	225	8	

Notes: (i) Standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . (ii) All regressions include education, experience, and experience squared.

An alternative interpretation of the above results could be that parents favored the more negatively affected child with greater support for educational investments after returning home, or other advantages that conferred benefits later in life. Indeed, Li et al. (2010) provide evidence that parents felt guilt about choosing one sibling to be sent down, providing relatively more transfers to twins with more send-down exposure when they got married. If this is the case, then the positive

effects of the send-down experience might not reflect certain respondents “learning from adversity,” but might reflect the productivity of the parental transfers or compensatory behaviors after send-down.

To alleviate such concerns, we control for parental transfers at the time of their children getting married in our baseline regressions to control the potential compensatory effects and present the results in Panel A0 of Table 5. Panel A0 shows that the results remain similar to those baseline results presented in Panel A of Table 5, indicating that our results are not driven by the aforementioned parental compensatory behaviors.

As previously discussed, while “E-angry” is highly correlated with resilience, it does not directly measure resilience itself. Consequently, the prediction of respondents’ responses to the send-down experience based on “E-angry” may not be entirely accurate. Specifically, the “positive” subsample might include respondents who actually respond to hardships passively, potentially leading to an underestimation of the actual impact of the rustication experience on this group. Conversely, the “passive” group could contain respondents who respond positively to adversities, thereby underestimating the actual harm of the rustication experience on this group. Consequently, the actual gap in the effect of the rustication experience between the “positive” and “passive” subsamples could be much greater than previously estimated.

The above classification of the three subsamples (Classification I) is intuitive but not unique, and an alternative classification can be created utilizing the available information to a greater extent. Specifically, if both twins answer that they “never” experience angry emotions, we include them in the “Positive I” subsample, which is actually the extremely positive group; if both twins “rarely” experience angry emotions, we include them in the “Positive II” subsample, which can be considered as the modestly positive group. Similarly, if both twins answer that they “sometimes” experience angry emotions, we include them in the “Passive II” subsample, which is the modestly passive group; if both twins experience angry emotions “very often,” we include them in the “Passive I” subsample, which is the most passive group.

This classification (Classification II) is more specific than Classification I and identifies the extremely positive and passive groups respectively, and we expect the gap in the effect of the send-

down experience across these subsamples would significantly widen. Of course, we only keep the sample in which both twins provide exactly the same answer to the question, at the price of having less than 60% of the entire sample left.<sup>8</sup>

Panel C of Table 5 presents the within-MZ-twin estimates of the effect of the send-down experience for the four subsamples. The gap in the estimates across these subsamples becomes considerably larger. Column 1 presents that for the most positive group (“Positive I”), an additional year of send-down experience increases the children’s earnings in adulthood by more than 32.8%, with the estimate being significant at the 5% level. In contrast, Column 2 indicates that for the less positive group (“Positive II”), the effect becomes much smaller and less significant.

The effect turns negative for the passive groups. Specifically, Column 3 shows that for the modestly passive group (“Passive II”), an additional year of send-down experience reduces children’s earnings in adulthood by approximately 6%, though the estimate is not significant. Finally, Column 4 reveals that for the most passive subsample (“Passive I”), the effect becomes extraordinarily large, with an additional year of send-down experience decreasing children’s earnings in adulthood by nearly 45%. However, given that this subsample includes only eight pairs of twins, it is unsurprising that the coefficient is not precisely estimated. Column 5 again presents that the estimates for the “positive I” and “passive I” subsamples significantly differ, with a p-value of approximately 0.001.

In summary, the results in Table 5 presents a clear pattern wherein respondents’ personality traits may play a vital role in determining the effect of the send-down experience on their future social success. From the most positive to the most passive subsamples, such an effect decreases monotonously and sharply, which is consistent with our expectation.

#### **4.4. Potential Differences and Spillovers within MZ Twins**

In this section, we examine the effect of the potential differences within the MZ twins on our empirical results by comparing the within-MZ and within-DZ twin estimates, and we also discuss the

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<sup>8</sup>As shown in Panel B of Table 3, for all the four questions, more than 50% of MZ twins’ answers are exactly the same (with the within-twin difference being 0).



potential spillover effect of the send-down experiences within MZ twin pairs. As shown in the previous section, the within-MZ twin estimate identifies the economic returns to rustication, and as revealed by Li et al. (2010), the difference between the within-MZ and within-DZ twin estimates reveals the sign of the correlation between rustication and endowment.

We have obtained the estimates of the effect of the send-down experiences on children's adult earnings based on the MZ twin sample with Equation (2). We can also obtain similar estimates for the DZ twin sample. As  $e^{1j} \neq e^{2j}$  for DZ twins, the fixed-effect estimator cannot remove the endowment effects; thus, the estimator is likely biased. For the DZ twin sample, the first difference becomes

$$w^{1j} - w^{2j} = (Z^{1j} - Z^{2j})\beta + e^{1j} - e^{2j} + \varepsilon^{1j} - \varepsilon^{2j}. \quad (3)$$

Given that the endowments  $e^{1j} - e^{2j}$  are unobservable, if  $\text{corr}(Z^{1j} - Z^{2j}, e^{1j} - e^{2j}) \neq 0$ , then  $\beta_{DZ}$  will be biased.

As shown in Li et al. (2010), if  $\beta_{DZ} > \beta_{MZ}$ , then the cross-child difference in the unobserved endowment ( $e^{1j} - e^{2j}$ ) is positively correlated with the cross-child difference in send-down years ( $r^{1j} - r^{2j}$ ), that is, the child with higher endowments in a family was sent down for a longer time; similarly, if  $\beta_{DZ} < \beta_{MZ}$ , parents show favoritism and choose to have the better-endowed child stay in the household. Li et al. (2010) further suggest that the sign of the difference between the within-DZ and the within-MZ estimates of  $\beta$  also indicates the direction of any bias in the within-MZ estimate  $\beta$  due to any remaining differences in endowments across MZ twins, under the assumption that parents respond in the same way to child endowment differences across the two types of twin pairs. Thus, if  $\beta_{DZ} < (>)\beta_{MZ}$ , then parents exhibit favoritism toward the stronger (weaker) child, and any bias in the within-MZ estimate must be negative (positive).

Panel B of Table 5 presents the estimation results for the DZ twin sample. Column 1 shows that the estimate for the entire DZ twin sample is only slightly larger than 0 and is not statistically significant. Columns 2 and 3 show that for the "positive" and "neutral" subsamples, the estimates are slightly larger than 0 and are not significant, whereas Column 4 suggests that for the "passive"

group, the estimate becomes negative and is still not significant. In addition, the t-test result indicates that the estimates for the “positive” and “passive” subsamples are not significantly different.

Furthermore, by comparing the estimates of Panels A and B, we find that for the “positive” groups, the estimate for the MZ twin sample is much larger than for the DZ twin sample. This result indicates that for the “positive” DZ twin sample, parents exhibit favoritism toward the stronger child and choose the less able child to be sent down for a longer time. In addition, if parents in the corresponding “positive” MZ twin sample respond in the same way, then the estimate in Column 1 of Panel A would be the lower bound of the effect of the send-down experience on the “positive” subsample. By contrast, for the “neutral” and “passive” subsamples, the MZ-twin and DZ-twin estimates are not significant and exhibit minimal differences; thus, the parents in these groups exhibit no obvious favoritism toward the abler or less able child. In other words, if the send-down and the stay-home twins show no differences in ability or other characteristics, then the estimates for these subsamples of the MZ twin sample would present unbiased ones of the effect of send-down experience on these people.

Alternatively, we can interpret the preceding estimates for the MZ- and DZ-twin samples in a different way. The gap in the effect of the send-down experience between “positive” and “passive” DZ twins is relatively small and not significantly different from zero (i.e., Columns 2 and 4 of Panel B of Table 5 are 0.0156 and -0.0799, respectively), but the gap for the corresponding two MZ groups is much larger and significant (i.e., Columns 2 and 4 of Panel A of Table 5 are 0.0864 and -0.0607, respectively). Thus, if we would hypothetically eliminate the within-DZ twin differences to obtain a MZ twin sample, such a gap would increase considerably. Therefore, any potential within-twin differences can reduce the gap in the effect of the send-down experience across heterogeneous groups. Furthermore, even if some differences still exist between MZ twins, if we continue to reduce such differences and finally obtain a perfect sample in which both twins were completely similar, we could probably obtain a larger estimate of the gap in the effect of the send-down experience between the “positive” and “passive” groups.

Another potential concern is that there may be within family spillovers in the effect of the send-down experience. In particular, having one sibling forcibly relocated to the countryside would be a

traumatic experience that might affect the entire family, including twins who stayed home and were separated from their siblings. Actually, we do not deny the existence of the potential within family spillovers of the send-down experience. However, such spillovers do not pose a problem for interpreting our results. Specifically, we do not impose the strong assumption that the stay-home twins were completely unaffected by their siblings' send-down experience, and we only anticipate that the send-down twins might be more affected by their rustication experience than their stay-home siblings. Our within-twin estimates aim to capture such differences in the effects of send-down experience between twins who were and were not sent down.

#### **4.5. Further Investigation: The Gender Differences**

We have presented strong evidence that the effect of the send-down experience on the children's adult wages differs significantly across heterogeneous subsamples. A following question is whether males and females respond to the send-down experience differently. We now further examine the gender differences in the effect of early hardships on people's future social success.

Panel A of Table 6 shows the within-MZ-twin estimates of the effect of the send-down experience on the males' and the females' wages in adulthood under Classification I. The estimates differ significantly for the male and female subsamples.

Column 1 presents that for the entire male sample, the estimate is only slightly larger than 0 and is not significant. By contrast, Column 5 reveals that for the entire female sample, the estimate is much larger and is significant at the 5% level. Surprisingly, the send-down experience generally has a significant positive effect on the females' future earnings and has almost no effect on the males' earnings. Therefore, the significant positive estimate for the entire MZ twin sample we determined previously (Column 1 of Panel A in Table 5) is mainly due to the positive effect of the send-down experience on females.

Furthermore, though the estimate for the entire male sample is nearly zero and not statistically significant, such finding does not signify that the send-down experience has no effect on the males' earnings. Column 2 indicates that for the "positive" male subsample, the send-down experience has a positive effect on the respondents' earnings, and an additional year of send-down experience

Table 6: Within-MZ Estimates of Effect of Send-Down Years on Log Wage, by Gender and Group Type

Variables	A. Classification I							
	Male				Female			
	Entire sample	Positive	Neutral	Passive	Entire sample	Positive	Neutral	Passive
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Send-down years	0.0120	0.0864	0.0263	-0.283***	0.0419**	0.0842	0.0825	-0.0328
	(0.0250)	(0.0548)	(0.0293)	(0.0957)	(0.0175)	(0.0537)	(0.0495)	(0.0439)
Pairs of twins	423	165	121	105	292	119	71	81
Variables	B. Classification II							
	Positive I	Positive II	Passive II	Passive I	Positive I	Positive II	Passive II	Passive I
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Send-down years	0.602*	0.0456	-0.271**		0.481***	0.119	-0.0195	
	(0.323)	(0.0636)	(0.104)		(0.140)	(0.0796)	(0.0587)	
Pairs of twins	19	109	87	5	25	69	64	1

Notes: (i) Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. (ii) All regressions include education, experience, and experience squared.

increases their earnings by approximately 9.0%. The estimate is not significant (with the p-value of about 0.13) but much larger and more significant than the estimate for the entire male sample. For the “neutral” male subsample, Column 3 reveals that the estimate becomes much smaller and less significant. For the “passive” subsample, Column 4 shows that the estimate becomes negative and significant at the 1% level, and an additional year of send-down experience reduces individuals’ earnings by as much as 24.7%, which is an extremely large negative effect. Again, the t-test result confirms that the estimates for the “positive” and “passive” male subsamples are significantly different.

By contrast, for the female sample, Columns 6 and 7 show that the estimates for the “positive” and “neutral” subsamples are similar, and an additional year of send-down experience increases the respondents’ earnings by more than 8%. Again, the estimates are not significant (with the p-value of about 0.13). Column 8 indicates that for the “passive” female subsample, the estimate is only slightly smaller than 0 and not significant, which stands in sharp contrast to the significant and substantial negative estimate for the male “passive” subsample in Column 4. The t-test result shows that the estimates for the “positive” and “passive” female subsamples differ significantly, which indicates a significant gap exists in the effect of send-down experience on respondents’ wage across positive and passive females.

Panel B of Table 6 presents similar estimates for male and female subsamples under Classification II. For the male sample, Column 1 presents that for the “Positive I” subsample, the send-down experience has a huge positive effect on their earnings. An additional year of the send-down experience increases their earnings by as much as 82%, and the estimate is significant at the 10% level. Column 2 reveals that for the “Positive II” subsample, the estimate becomes much smaller and insignificant. Conversely, for the “Passive II” subsample, Column 3 presents that the estimate becomes very negative and significant at the 1% level, and an additional year of send-down

experience decreases the respondents' earnings by as much as 24%. Finally, for the "Passive I" subsample, as we only have five observations, we cannot obtain a meaningful estimate. By contrast, the estimates for the female sample differ in many ways. Column 5 presents that for the "Positive I" subsample, the send-down experience also has a large positive effect on the respondents' earnings, and an additional year of send-down experience increases their earnings by about 62%, and the estimate is significant at 1% level. Column 6 presents that for the "Positive II" subsample, the estimate becomes much smaller and is not significant. On the contrary, for the "Passive II" subsample, Column 7 presents that the estimate becomes negative but is only slightly smaller than 0 and is not significant, which stands in sharp contrast to the significant and substantially negative estimate for the male "Passive II" subsample in Column 3. Finally, for the "Passive I" subsample, as we only have one observation, we cannot obtain a meaningful estimate. However, we can deduce that even if the effect of the send-down experience on this group is negative, it should be relatively modest.

In summary, our results indicate that the effect of the send-down experience on the respondents' later earnings shows much larger variation for males than for females. For positive males, the send-down experience has a large positive effect on their future social success, whereas for passive males, the send-down experience significantly reduces their future earnings. By contrast, though the send-down experience also has a sizable positive effect on the positive females' future earnings, it has almost no effect on the passive females' earnings. Therefore, the effect of negative shocks on males goes to two extremes, while females generally seem to be more resilient than males.

Such a significant gender difference in the effect of negative shocks is not difficult to explain. Compared with females, males exhibit much larger variation in job performances and excel in many industries. For instance, a majority of artists, scientists, and statesmen are males. Meanwhile, most criminals are also males. Thus, males may also go to two extremes when faced with negative shocks.

By contrast, females differ from males in physical structure and many other traits. Females play a crucial role in producing offspring, enduring immense suffering in the process. Therefore, for females, a greater resilience to negative shocks may result from the division of duty arising from nature.

## **5. Nature or Nurture?**

In the previous section, we provide compelling evidence that children's heterogeneous responses to negative shocks produce completely different outcomes. Then a more fundamental question emerges: why do children respond to negative shocks differently and what determines such personality trait of resilience? Specifically, is the trait a nature, or could it be nurtured? We now provide suggestive answers and interpretations to these challenging issues.

Given that the trait "E-angry" is within-twin stable, we infer that it is determined by genes or common factors that both twins share (e.g., family background), or both. To identify the roles that genes and family background play in determining children's response to negative shocks, we compare the within-pair differences for the trait "E-angry" of three samples (MZ twin, DZ twin, and mixed pair). Specifically, we construct a third "mixed-pair" sample in which the two children of each pair are from different families. We can randomly select one child from a family to match with the other one from another family to form a pair and obtain such a new sample.

MZ twins not only share 100% of their genes but are also from the same family. By contrast, DZ twins are also brought up in the same family but only share 50% of their genes. Finally, for the third mixed-pair sample, both children of each pair are from different families and have different genes. Therefore, we can compare the within-pair differences of the trait of the MZ and DZ twin sample to identify the effect of genes, and we can further compare the corresponding differences across the MZ, DZ, and mixed-pair samples to identify the effect of family background. Table 7 presents the within-pair differences in the trait "E-angry" for the three samples.

Given that the only difference between the MZ and DZ twins is that the former have more similar genes than the latter, we first compare the within-twin difference in the trait “E-angry” of MZ and DZ twins to examine whether genes are a critical determinant of the traits. Columns 1, 2 and 4 of Table 7 shows that the within-MZ twin difference of the trait “E-angry” is significantly smaller than the corresponding within-DZ twin differences. Given that more similar genes result in a smaller within-twin difference in the trait “E-angry” for MZ twins, we infer that genes constitute an important determinant of this trait.<sup>9</sup>

Table 7: Within-Pair Differences in the Trait “E-angry”, by Pair Type

	Within-pair differences for the trait “E-angry”				
	MZ	DZ	Mixed	T-test	
	twin pair	twin pair	pair	(2)–(1)	(3)–(2)
	(1)	(2)	(3)	(4)	(5)
Mean	0.562	0.660	0.844	0.098***	0.184***
S.D.	(0.670)	(0.726)	(0.740)	(0.037)	(0.036)
Observations (pair)	917	570	1487		

Notes: (i) Standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

We further examine the role that family background plays in the formation of the trait “E-angry”. Suppose that family background does not matter, then the difference across the three samples

<sup>9</sup>Some researchers use the “ACE” model to identify the genetic and environmental determinants of individuals’ behavior, where A represents additive genetic effects, C is common environment, and E denotes idiosyncratic environment. However, this model carries strong assumptions that are unlikely to hold, specifically, that the three factors are uncorrelated with one another. Thus, we do not use it for our analysis.



would be that MZ twins have the same genes, and DZ twins only share 50% of their genes, while mixed-pairs children have completely different genes. Under this circumstance, we expect that the gap of the within-pair difference of the trait “E-angry” between MZ and DZ twin samples would be similar to that between DZ twin and mixed-pair samples. However, as shown in Columns 4 and 5 of Table 7, the latter (0.184, Column 5) is almost twice as large as the former (0.098, Column 4). Therefore, we can safely reject the null hypothesis that family background does not matter for the trait “E-angry”. In other words, given that children from different families show much larger difference in the trait “E-angry” than children brought up in the same family, we can infer that family background also plays an important role in the formation of such a trait.

We further compare the family backgrounds of MZ twins across different groups (“Positive I,” “Positive II,” “Passive II,” and “Passive I”) to examine the correlation between children’s family backgrounds and their potential responses to negative shocks. Given that the parental education level is a strong indicator of family income class, we use it to measure family background and divide families into lower, middle, and upper classes. Table 8 presents the education levels of MZ twins’ fathers and mothers for the four subgroups. For children in the extremely passive group (“Passive I”), the average education levels of their fathers and mothers are lowest, indicating that they were brought up in the most disadvantaged families. By contrast, for children belonging to the extremely positive group (“Positive I”), the average education levels of their fathers and mothers are higher than those of the “Passive I” group but lower than those of the other groups, which suggests that they are from middle-class families. Children with the highest parental education levels generally belong to the neutral groups who are neither very positive nor very passive.<sup>10</sup>

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<sup>10</sup>The *t*-test results show that fathers’ and mothers’ education levels of “Positive I”, “Neutral” (“Positive II” and “Passive II”), and “Passive I” groups are significantly different.

Table 8: Education of MZ Twins' Parents, by Twins Group Type

Variable	Positive I	Positive II	Passive II	Passive I
Father's education (year)				
Mean	7.1	8.2	8.5	5.4
S.D.	(4.6)	(4.6)	(4.5)	(3.4)
Mother's education (year)				
Mean	5.8	6.9	6.8	3.6
S.D.	(4.3)	(4.2)	(3.9)	(1.9)
Observations (pair)	63	220	191	10

A potential explanation for such findings is that family background plays an important role in the formation of children's resilience. Children from lower-class families face numerous disadvantages and do not receive decent family education and attention during their formative years when personality traits and non-cognitive skills, such as resilience, are developed. Therefore, they are not only more likely to experience negative shocks but also tend to respond to them passively. By contrast, children from upper-class families have parents who can provide them with the best environment and family education when growing up. However, such children lack the opportunities to receive crisis education and are not well prepared for potential setbacks or hardships and thus are not likely to respond to negative shocks very positively when they occur. Finally, children from middle-class families can receive decent family education and are aware that life is not completely easy. Thus, they are less likely to be spoiled by an overly comfortable environment and will generally respond to negative shocks positively.<sup>11</sup>

<sup>11</sup>Given that the random gene is also an important determinant of individuals' resilience, the considerable variation of parental education for every group is unsurprising. For instance, for children in "Passive I" group (i.e., extremely passive group), although a

However, if children's resilience is determined not only by genes but also by family education, then why is it unaffected by other factors such as formal education? In other words, if such a trait could be nurtured, why could it still be within-twin stable over time? As discussed earlier, there is a crucial period in children's lives for forming important traits after they were born, during which they are mainly cared for by their parents, and thus family education plays a dominant role. Such a period is likely to occur before children attend primary school. Furthermore, once both twins have developed these traits during childhood under the influence of their parents, these traits may become stable and remain unaffected by their subsequent experiences, such as formal education and future work experience.

Given that children's resilience is determined by their genes and the family education they received during childhood, possibly, some individuals are born optimistic, whereas some could develop optimism through the support of their parents. These findings have important policy implications. Policymakers could provide families, especially those on low incomes, with public services to improve the family education received by their children.

Our interpretation is consistent with the findings in the literature, which provides abundant evidence that family environment has important influence on children's personality traits (e.g., Nakao et al., 2000; Cunha and Heckman, 2007; Deckers et al., 2015). Undoubtedly, parents are their children's first teachers and can exert significant influence on their children's characters and personality traits. Stoltz (1997) reveals that individuals' resilience is formed through the influences of their parents and other key people during childhood. Therefore, unsurprisingly, children from different family backgrounds exhibit great variation in resilience because their parents play a critical role in the formation of their personality traits, include resilience.

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large share are from lower-class families, it is still possible that some who have the worst genes are from middle- or upper-class families.

## 6. Conclusions

We investigate the effect of the send-down experience on children's future adult earnings and provide the first rigorous evidence that children's personality traits play a vital role. Specifically, children with favorable personality traits who are likely to respond to hardships positively benefit from the send-down experience, whereas children with unfavorable personality traits who have a high tendency to respond to sufferings negatively or passively are harmed by the rustication experience. The evidence is consistent with our hypothesis that children's personality trait of resilience to adversities can mitigate or even reverse the impacts of negative shocks. We further examine the determinants of children's such personality traits and find that genes and family background seem to play important roles in shaping resilience in children's childhood. In other words, some children are born optimistic, whereas some children could develop optimism through the support of their parents.

Our findings also suggest that children from disadvantaged families are likely to respond to negative shocks passively rather than positively. Given that most of the children in developing countries who suffered from negative shocks are from disadvantaged families, we can explain why previous literature has found abundant and strong evidence for the overall detrimental effect of negative shocks on affected children: many of them passively respond to the shocks. However, our interpretation of the negative effect of such shocks on child development differs significantly from that of the existing literature, and our findings also have dissimilar policy implications. The most decisive disadvantages such children encounter may not be the negative shocks they experience but the poor family education they receive, which hinders them from forming crucial non-cognitive skills, such as resilience. Therefore, improving family education those children receive may be as important as or even more important than protecting them from potential negative shocks.

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