

# The Hidden Costs of Mental Depression: Implications on Social Trust and Life Satisfaction

**Chee-Ruey Hsieh**

School of Economics, the University of Nottingham Ningbo China  
199 Taikang East Road, Ningbo, 315100, China  
Telephone: +86-574-8818-0000 (ext. 8610)  
E-mail: [Hsieh.Chee-Ruey@nottingham.edu.cn](mailto:Hsieh.Chee-Ruey@nottingham.edu.cn)

**Siyuan Liu**

School of Economics, Peking University, Beijing, China, 100871  
Telephone: +86-188-1176-1606  
Email: [yuanhappy@163.com](mailto:yuanhappy@163.com)

**Xuezheng Qin\***

School of Economics, Peking University, Beijing, China, 100871  
Telephone: +86-10-6275-7237  
Fax: +86-10-6275-4237  
Email: [xqin@pku.edu.cn](mailto:xqin@pku.edu.cn)

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## **Abstract**

Mental health conditions such as depression is a rapidly rising epidemic and a major contributor to the overall global burden of disease. In addition to the direct medical costs and indirect economic costs that falls into the traditional boundary of disease burden estimation, many social costs associated with depression are hidden yet important. This paper provides empirical evidence on the existence of two hidden costs associated with depression: negative impact on social trust and life satisfaction. Based on the data obtained from 2012 China Family Panel Studies, our estimated results indicate that individuals who have a high tendency for depression or depressive symptoms are less likely to trust other people, and they also have significantly lower life satisfaction than their counterparts who are relatively mentally healthy. Given that trust is an important component of social capital, which in turn is an important input to foster economic growth in general and innovation in particular, the reduction in trust induced by the increasing prevalence of depression imposes a significant cost to the society in terms of poor economic performance. Similarly, as life satisfaction has been widely recognized as an important measure of well-being, our study also highlights that the increase in the prevalence of depression leads to a reduction in the well-being that individual can enjoy. All these costs are real, but did not receive sufficient attention in the previous research. The contribution of our research is to shed light on the existence of these hidden costs and to quantify the magnitude of such costs in the context of China.

**Key words:** Trust; Life Satisfaction; Depression; Disease Burden; Hidden Costs

**JEL Classification:** I10; I15; O10

## **I. Introduction**

The prevalence of mental depression has increased rapidly in recent decades, which in turn has generated scholarly interest around the world to investigate the economic burden of the disease. For example, Greenberg et al. (2015) report that the economic burden of depression in the United States was estimated at \$210.5 billion in 2010. Hsieh and Qin (2017) estimate that the annual costs attributable to depression and depressive symptoms in China are RMB 126 and 142 per person, which account for 6.9% and 7.8% of total personal expected medical spending respectively. In this line of research, the existing literature typically considers two types of costs associated with depression: (1) the direct cost, which includes the outpatient and inpatient medical cost for the treatment of depression and its complications; and (2) the indirect cost, or the opportunity cost of being depressive, which includes the morbidity costs caused by absenteeism (missed work days due to depression), presenteeism (reduced productivity while at work due to depression), and the mortality costs defined as the product of the number of deaths due to depression and the average expected future earnings. However, the real cost of depression to the individuals and society as a whole goes well beyond the traditional boundary of disease burden estimation. These social costs, despite their great implication to the individual quality of life and the overall economic development, have not been widely recognized in the literature and no attempts have been made to quantify such burden.

The purpose of this paper is to provide a conceptual analysis and empirical evidence on the importance of two hidden costs associated with depression: lower

social trust and lower life satisfaction. Specifically, we estimate the impacts of a mental depression indicator (CES-D20) on a series of variables measuring the individuals' tendency of trusting other people and their life satisfaction, using data from the 2012 China Family Panel Studies.

Our study contributes to the growing body of research on the link between health and wealth in general and the effect of health on economic growth and well-being in particular. Specifically, we attempt to bring three lines of research together: (1) the rising prevalence of mental health problems in the developing countries; (2) the role of trust in the economic development and (3) the determinants of life satisfaction and well-being. Although many studies have accumulated evidence on the rising prevalence and disease burden of mental health such as depression, the policy action lags behind the research. On average, high-income countries at most spend only about 5% of their health care resources on mental health in spite of a relatively large share of disease burden arising from this disease. This share is even smaller than 1% in low and middle-income countries. As a result, many international agencies have initiated the call to set mental health as a global development priority (World Bank Group and WHO, 2016). Specifically, they proposed for increasing investment on mental health care as an important strategy to close the gap of inadequate funding. Our research echoes this initiative by examining the costs of mental health in a more general framework that consider the link between health, wealth, and well-being, with a special focus on the impact on a fundamental source of economic growth: trust.

In recent years, trust has been recognized as one of the most fundamental culture value, which in turn determines many economic choices and hence further affects the speed of development and the wealth of nation (Algan and Cahuc, 2014; Alesina and Giuliano, 2015). Thus, trust has been classified as one of the deeper factors that affects economic growth and development (Spolaore and Wacziarg, 2013). The importance of trust has induced many researchers to pay attention on several questions such as how to measure trust and what are the major determinants of trust. For example, Luo (2005) proposed two types of trust: particularistic trust and general trust. The former one refers to the trust to specific individuals such as neighbors and doctors, while the latter refers to the general propensity to trust others. Alesina and Ferrara (2002) specifically examine the determinants of general trust. They find that both individual experiences (such as suffering from a major negative event) and community characteristics (such as living in a racially mixed community) have strong impacts on how much people trust each other. Although this study mentioned the potential role of individual health outcomes in the formation of trust, it did not measure in an explicit way on the relationship between the mental health status and the trust levels.

Similar to the growth in the research literature on trust, life satisfaction has also received increasing attention from both researchers and policy makers, partly because of the widely recognized limitation of the traditional well-being measures (such as GDP per capita) and the strong desire of seeking for empirical alternatives. Being an increasingly popularized concept, life satisfaction and its determinants have attracted substantial research efforts in recent years, which echoes the persistent interest in the

economic literature to identify the important drivers of economic growth. The existing studies have shown that income, health, job / daily activities, and family / social contacts are the four important dimensions that shape the variation in life satisfaction among individuals in different countries (Kapteyn et al. 2009). However, the relative importance of each specific factor may vary across individuals and countries. As the rising prevalence of mental health problems has become a global public health concern, it bears important implications to study the impact of depression on life satisfaction, which in turn may shed new light on the fundamental sources of economic development.

Our results indicate that individuals who have a higher tendency of suffering from depression or depressive symptoms are less likely to trust other people, and they also have significantly lower life satisfaction than their counterparts with better mental health. Given that trust is an important component of social capital, which in turn is a crucial input to foster economic growth in general and innovation in particular, the reduction in trust as induced by mental depression may impose a significant cost to the society in the form of weakened productivity and economic performance. This is a real cost that the society has to pay for the rising trend of depression and other mental health problems, but the empirical literature has devoted little research attention to quantify the magnitude of such costs. Similarly, our study also highlights another less-researched cost of depression: the increasing prevalence of depression leads to a reduction in the individual well-being in the form of lower life satisfaction. All these costs are real, but did not receive sufficient attention in the previous research, and thus we refer to them as hidden costs. The contribution of our research is to shed light on the existence of

these hidden costs and to estimate their quantitative magnitude using China, the world's largest developing country with the most rapidly increasing prevalence of depression, as an example.

The rest of the paper is organized as following. Section II provides the research background by briefly reviewing the existing evidence on three lines of research, namely mental health, trust and life satisfaction, and describes a conceptual framework on the linkage of these three dimensions. Section III describes the data and econometric models. Section IV shows the main results of our empirical analysis. The last section concludes the paper and discusses the implications of the findings.

## **II. Research Background**

### **2.1 The rising prevalence of depression**

Mental disorders in general as well as depression and anxiety disorders in particular are becoming more prevalent worldwide. For example, a WHO report indicates that the size of the world's population suffering from depression and/or anxiety increased from 416 million in 1990 to 615 million in 2013, suggesting that near 10% of the global population is affected (World Bank Group and WHO, 2016). Consequently, many studies have pointed out that the disease burden of depression and anxiety disorders is growing rapidly and is likely to have a substantial social and economic impact. A specific example is that mental illnesses account for nearly one quarter of all years lived with disability (YLD) in China (Yang et al. 2013). This study also finds that among the top 20 causes of YLD in China, seven of them are related to mental disorders, including major depressive disorder, alcohol use disorders, schizophrenia, anxiety disorders,

bipolar disorder, dysthymia, and drug use disorders.

In comparison to other non-communicable diseases (NCDs) with high disease burden and prevalence rate (such as hypertension, diabetes, etc.), the diagnosis and treatment for mental illnesses such as depression have two unique characteristics. First the rate of treatment for mental disorders are quite low, indicating that there is a significant level of under-treatment. For example, a recent study in the US finds that only about one-third of adults with screen-positive depression receive medical treatment (Olfson et al., 2016). The treatment rate is even lower in the low and middle income countries. A study in China suggests that less than one tenth of individuals with mental illness have ever received any type of mental health services (Philips et al. 2009). Second, in contrast to the high disease burden of mental illness in the world, the health care resources allocated to the treatment of mental illnesses are relatively low compared to general health care in both high and middle income countries. High-income countries on average spend about 5 to 14 percent of their health care expenditure on mental health care (Frank 2011), while in low income countries this ratio is as low as 1% (World Bank Group and WHO, 2016).

Figure 1 provides a conceptual framework that illustrates how under-funding and under-treatment work together to create a *vicious circle* in the mental health sector. It has been widely recognized that stigma is an important reason to explain the low treatment rate among individuals with mental illness. However, the under-funding problem in the mental health sector also creates several access barriers to prevent individuals with mental illnesses to receive appropriate health care. First, the low share



of health care funds allocated to mental health care often forces the government to impose high cost-sharing policies or less generous coverage for the insurance of mental health care. As a result, individuals with mental illness often need to pay a higher out-of-pocket expenditure in seeking medical treatment as compared to general health care. As noted in Frank and McGuire (2000), the demand for mental health services is more price elastic than that for general healthcare, indicating that the higher out-of-pocket costs are very likely to deter the use of mental health care. Second, the under-funding in the mental health sector also translates to the overall insufficiency and geographic misdistribution of healthcare resources for the appropriate delivery of mental health services, which in turn serves as the “availability barrier” for mental illness patients as they need to spend a higher time cost (in the form of long waiting or long distance travelling) in seeking care, especially in comparison to the non-mental health care patients. Third, the under-funding in the mental health sector also reduces the speed of technology adoption in local practices and hence creates an additional treatment gap, leading to further reduction in the potential effectiveness of medical treatment.

In summary, under-funding in the mental health sector creates several access barriers that *cause* under-treatment, which in turn is also a culprit to cause the under-funding, and hence a vicious circle takes shape. Frank (2011) identifies several reasons to explain the persistent trend of under-funds in the mental health sector across countries. One obvious reason arises from the budget rigidity in the public sector as many countries rely on the fixed budget to finance mental health sector. In a typical fiscal arrangement, the spending in the previous periods usually has a strong impact on

the size of budget in the current period. However, the existence of social stigma prevent the individuals with mental illness to form a strong interest group to persuade the decision makers for a higher share of health care budget, and the low treatment rate in mental illness may create a misperception on the benefits of effective treatment and the productivity of mental health care spending among the policymakers, which in turn plays an important role in shaping the public budget allocated to this sector. Thus, there is an urgent need to increase the awareness and understanding on the costs and benefits of the treatment for mental disorders, which in turn could be the key to break the vicious circle in the mental health sector. Our study contributes to this effort by increasing the understanding on the *social* benefits of depression treatment from the perspectives of social trust and life satisfaction, which are largely ignored in the previous investigations that primarily focuses on the *private* medical benefits. The importance of spelling out these social consequences of mental illness is implied by the literature on the impact of trust on economic development as well as on the determinants of life satisfaction and well-being, which is summarized in the following.

## **2.2 The role of trust in economic development**

In recent years, trust has received a great deal of attention in economics literature. Empirically, trust can be measured with surveys. The major data sources that have been widely used in this line of research include the World Values Survey (WVS) and the General Social Survey (GSS). These surveys measure trust by asking the following standard question: “*Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?*” Based on the answer to this

question, researchers often construct a trust indicator which equals 1 if the respondent answers “most people can be trusted” and 0 otherwise (Knack and Keefer, 1997; Alesina and Ferrara, 2002; Delhey and Newton; 2005; Delhey et al. 2011; Algan and Cahuc, 2014). The advantage of using a simple binary variable to measure the general trust in most people is that the results can be compared across countries.

A stylized fact obtained from the existing studies of general trust is that there are substantial variations in trust levels across countries. For example, based on the average responses to the trust question in various surveys obtained from 111 countries, Algan and Cahuc (2014) report that the average trust levels (measured by the percentage of samples expressing trust in most people) range from 3.8 in Trinidad and Tobago to 68.1 in Norway. The variations in trust levels across countries in turn have attracted many studies to investigate the determinants of trust on the country level (e.g., Knack and Keefer, 1997 and Delhey and Newton; 2005). These studies yielded several important and consistent findings. First, income inequality is associated with low trust. Second, ethnic and linguistic divisions are also associated with low trust. Third, good governance, in terms of formal institutions for protecting property and contract rights, is positively associated with high trust. Similarly, some other research efforts have been devoted to investigate the determinants of trust on the individual level, and they also find a consistent pattern (e.g., Glaeser et al., 2000; Alesina and Ferrara, 2002). First, high-income and well-educated individuals tend to have a higher trust in other people than the poor and low-educated people. Second, the community characteristics are important determinants of trust: individuals who live in racially mixed communities are

less likely to report that “most people can be trusted”, indicating that ethnic heterogeneity has a negative impact on trust.

One concern in the empirical measure of general trust is that people may interpret “most people” in different ways. Thus, relying on one simple question of general trust may not be sufficient to capture all the relevant contents of trust. For example, one puzzle found in the World Values Survey is that the trust level in China is very high, ranking number 4 among the 111 countries (Algan and Cahuc, 2014), despite the severe income inequality and social conflicts. Delhey et al. (2011) suggest that people may have different radius of relationship in mind when they answer the standard question in the general trust survey. Thus, they explore the questions on the determinants of trust by adding more information on specific trust, which measures the inner-group and outer-group trust. The inner-group trust refers to the trust in family, neighborhood and the people that the respondent know personally. By contrast, the outer-group trust refers to the trust in people that respondents meet for the first time and people of another religion or nationality. By adding the information obtained from the inner-group and outer-group trust surveys, Delhey et al. (2011) developed a radius-adjusted trust score that takes into account the variation of inner- and outer-group trust across countries. Their results indicate that the radius of “most people” is narrower in Confucian countries such as China and South Korea and wider in Western high-income countries. After this adjustment, the ranking of trust level for China slides down roughly 10 places among 51 countries in their study samples. This study indicates that the radius of trust matters in the international comparison.

Another line of research on trust is to investigate the impact of trust on economic performance. Aghion et al. (2010) provide evidence to support the argument that countries with low trust levels have strong public demand for regulation, which in turn discourages the spontaneous formation of trust. As a result, low trust and regulation interact together and create a vicious circle. This finding supports the argument in an experimental study that the control imposed by the principal is often perceived as a signal of distrust by the agent, which in turn leads to a reduction in the agent's performance (Falk and Kosfeld, 2006). This line of research indicates that low trust will impose a hidden cost to the society in terms of low economic performance.

In summary, the growing body of research on trust has increased our knowledge on its determinants and impacts, which in turn has put trust onto the center stage in mainstream economics (Algan and Cahuc, 2014). In spite of a growing body of research on trust, few studies have paid attention to the potential link between rising trend in mental health and trust, which is a gap that our study attempts to fill.

### **2.3 Life satisfaction and well-being**

Since the late 1990s, the measurement of subjective well-being such as life satisfaction and happiness has been widely studied in economics literature. The accumulated evidence provides consistent support to the notion that subjective well-being is a good proxy of individual utility (Frey and Stutzer, 2002; Kahneman and Krueger, 2006). Empirically, individual happiness and life satisfaction can be captured by surveys. Specifically, the standard question of measuring life satisfaction adopted in many surveys such as WVS and GSS is the following: "*All things considered, how*

*satisfied are you with your life as a whole these days?"* This question is often assessed on a five-point or ten-point scale from "very dissatisfied" to "very satisfied", which in turn provides a quantitative measure that allows the researchers to capture human well-being directly and to compare it across individuals and countries.

The previous studies have drawn several consistent conclusions on the determinants of subjective well-being. The most cited factor that accounts for the variations in life satisfaction is income. Based on the cross-section comparisons, both individual-level and country-level data show that richer people and richer countries, on average, report better life satisfaction levels and higher subjective well-being compared to poorer people and countries. In other words, income is positively correlated with life satisfaction at a given point in time. Overtime, however, subjective well-being, either measured by country- or individual- level data, does not increase significantly or even decreases slightly despite a considerable growth in per-capita income. For example, between 1958 and 1991, there was a six fold increase in real per capita income in Japan, but the average life satisfaction almost remained constant during this period (Frey and Stutzer, 2002). Similarly, the individual-level data also show that there was a slight decrease in the reported life satisfaction in China between 1994 and 2005 although the real income per capita increased by a factor of 2.5 during this period (Kahneman and Krueger, 2006).

There are two plausible explanations for the inconsistent pattern on the income - life satisfaction relationship between cross-section and time-series data, also dubbed the "income paradox". First, the rank or relative position in the income distribution of

the population or of one's peer group may play a more important role than the absolute income levels in accounting for the variation of life satisfaction across individuals, an argument also known as the relative income or social comparison hypothesis. For example, Huang et al. (2016) test this hypothesis using data obtained from Chinese Household Income Project and find that relative income is negatively associated with the happiness score. This suggests that an individual's absolute income is not as meaningful to life satisfaction as the individual's relative income.

Second, although life satisfaction and income are positively correlated in a cross-section dataset, the correlation is relatively low, around 0.20, indicating that only a small portion of the difference in life satisfaction among persons can be attributed to the difference in income. Thus, subjective well-being is not just a matter of income, and other non-income factors may be even more important in explaining the determinants of subjective well-being (Frey and Stutzer, 2002; Kahneman and Krueger, 2006). Among the non-income factors, Schnitzlein and Wunder (2016) emphasize the importance of family effects in shaping the subjective well-being. Specifically, they find that around 30% to 60% of the inequality in permanent well-being can be attributed to family background. Other non-income factors that have been widely studied include unemployment and institution. For example, the existing literature shows that unemployment, either measured on the individual or country level, has a significantly negative impact on the reported subjective well-being. Similarly, institutions that foster the direct participation in public decision-making such as referenda and decentralization have significantly positive impact on subjective well-being (Frey and

Stutzer, 2002).

Overall, past research has identified several important factors that influence the life satisfaction and happiness on both the individual- and country-levels, including income, family background, unemployment and institutional factors. By contrast, few studies have paid attention to the potential impact of rising prevalence in mental disorders on the subjective well-being, especially for the low- and middle-income countries such as China.

### **III. Data and Method**

#### **3.1 Data source**

CFPS (China Family Panel Studies) is a nationally representative longitudinal survey designed and implemented by the Institute of Social Science Surveys (ISSS) of Peking University. This survey was conducted in 25 Chinese provinces (these provinces jointly cover 95% of the Chinese population) in five years (2008, 2009, 2010, 2011, 2012). In each wave, the CFPS survey samples about 15,000 households nationwide using the multi-stage probability proportional to size (PPS) sampling method, and all family members in each sample household are included. The questionnaire collects individual-, family-, and community-level information on the demographic, socioeconomic and health-related variables. In the 2012 CFPS survey, a full 20-question version of the CES-D (Center for Epidemiologic Studies Depression) questionnaire (Radloff, 1977) was administered to assess the respondents' mental health status.



The CES-D questionnaire is one of the most frequently used self-assessment tools for depression and depressive symptoms. An advantage of using this survey-based instrument is that the questions contained in CES-D are non-intrusive and related to every-day feelings<sup>1</sup>, which makes it easier for the respondents to answer, leading to better detection of their depressive symptoms compared to some other clinical instruments. This in turn may help to alleviate the underreporting problem commonly experienced among the mental illness patients (Bharadwaj et al., 2015). The CES-D20 questionnaire contains four subscales: somatic-retarded activity, interpersonal relations, depressed affect and positive affect. The former three measure negative emotions, while the latter measures positive ones. Respondents are asked to rate how often they experienced the specified emotions in the past week, with the options varying from 0 to 3 for each question (0 = rarely, 1 = little, 2 = occasionally, 3 = often). The CES-D score can thus be calculated based on the responses as follows:

$$\begin{aligned}
 CES - D = & \sum_i Score_{i,somatic} + \sum_j Score_{j,interpersonal} + \\
 & \sum_k Score_{k,depressed} + \sum_l (4 - Score_{l,positive})
 \end{aligned}
 \tag{1}$$

where  $Score_{i,somatic}$ ,  $Score_{j,interpersonal}$ ,  $Score_{k,depressed}$  and  $Score_{l,positive}$  represent the score for the i-th question on the somatic-retarded activity, the j-th question on interpersonal relations, the k-th question on the depressed affect and the l-th question on the positive affect, respectively. Thus, the overall CES-D score ranges from 0 to 60, with a higher score indicating more frequent occurrence of depressive symptoms and

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<sup>1</sup> Examples of the CES-D questions include: "How often do you feel that everything I did was an effort?"; "How often do you feel not like eating (your appetite is poor)?"

higher likelihood of depression. We use the CES-D score in our main analysis to measure an individual's tendency of mental depression.

The CFPS questionnaire also contains a module to measure the respondent's tendency to trust other people. This module includes seven questions, pertaining to the trustworthiness of most people in general (denoted as *trust\_dummy*) and the degree of trust by the respondent on the following people in particular (ranked by the degree of closeness in the interpersonal relationship) - parents, neighbors, medical doctors, cadres (government officials), strangers, and American (denoted as *trust\_parent*, *trust\_neighbor*, *trust\_doctor*, *trust\_cadre*, *trust\_stranger*, *trust\_american*, respectively). These trust-related questions are closely analogous to those used in the World Values Surveys, among which *trust\_dummy* for the general trust in other people is a binary (dummy) variable indicating a "yes or no" answer, and the other variables for the particularistic trust are ordinal scores varying between 0 and 10, with a higher score indicating more trust.

Similarly, CFPS also surveys people's satisfaction on their lives, using the following five questions: How much are you satisfied with your family? How would you rank the social status of your family in the local area? How much are you satisfied with your life? How would you rank the social status of yourself in the local area? How confident are you on your future? The answers to the above questions are ordinal scores (ranging from 1 to 5) and denoted as *satis\_family*, *ses\_family*, *satis\_self*, *ses\_self*, *confi\_self*, respectively, with higher scores indicating stronger life-satisfaction or confidence.

We restrict our sample to adult respondents aged between 16 and 99, and further drop the observations with missing information on the key variables such as gender, age and CES-D scores. Our final study sample contains 31,326 observations, covering China's 25 provinces with about 45% respondents from urban areas and 55% from rural regions.

### **3.2 Descriptive analysis**

Table 1 presents the sample summary statistics. In addition to the key variables (CES-D scores, trust and satisfaction related variables) introduced above, we also control the respondent's demographic and socioeconomic characteristics, and such variables include gender, age in years, marital status (married, single, divorced, widowed), education levels (primary school or below, middle school, high school, college or above), work status (employed, unemployed, out of labor force due to disability, out of labor force due to other reasons, not in the labor force), personal annual income (in 1,000 *yuan*), etc. To control the regional influences on the respondents' trust and satisfaction, we also control for the urban/rural status as well as the provincial dummies for their residential areas.

According to Table 1, about 51% of the respondents in our sample are female, and 45% live in the urban areas. About 80% of the respondents are married, and 14% are single; those who are divorced or widowed account for 1% and 5% of the full sample, respectively. The average age of our sample respondents is 45.

In the socioeconomic dimension, the average annual personal income is 11,568 *yuan*. As for the educational attainment, 50% of the respondents received primary school or below education, people who acquired middle and high school education

account for about 28% and 14% of the full sample, respectively; only 7% of the sample received college or above education. For work status, 72% of the respondents are employed, while the rest are not currently working due to various reasons (e.g., 10% are retired, and 8.12% are out of labor force due to disability, diseases or other reasons).

As mentioned above, the CES-D score ranges from 0 to 60, with a higher score indicating more depressive symptoms. The average CES-D score in our sample is 12.92, with a standard deviation of 7.96, suggesting that the respondents are on average mentally healthy. Radloff (1991)'s classical study suggests that the threshold CES-D values of 16 and 28 can be used to categorize a person's mental health status, i.e. a CES-D score between 16 and 28 suggests that the person has depressive symptoms, and a CES-D above 28 suggests that the person suffers from depression. According to this standard, around 27% of our sample respondents have depressive symptoms, and around 5% suffer from depression.

In terms of trust-related variables, Table 1 shows about 54% of respondents think that most people are trustworthy, indicating a relatively high level of general trust<sup>2</sup>. But when looking at the degrees of trust towards particular social groups, the trust score (0-10) varies significantly. The sample average trust score towards parents is 9.09, suggesting high level of trust among immediate family members in China. The average trust score is 6.40 for neighbors, 6.60 for medical doctors, 4.87 for government cadre, 2.19 for strangers, and 2.53 for foreigners (American), which suggests that the degree of trust declines with the distance in social connection.

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<sup>2</sup> According to the World Values Survey (WVS), China is among the high-trust societies in the cross-country comparison in terms of the degree of general trust (Delhey and Newton, 2005; Delhey et al. 2011).

The other set of outcome variables pertain to one's satisfaction towards life and family. In this dimension, Table 1 shows that the sample respondents are fairly satisfied, giving the average scores of 3.3 and 3.5 for the satisfaction on their lives and families (out of the possible values of 1 to 5). They also rank their socioeconomic status as "intermediate" on average, with the scores of 2.7 and 2.8 (on a scale of 1-5) for the assessment of themselves and their families, respectively. The average respondents also feel fairly confident about their future with the average score being 3.7 out of 5, although the standard deviation is relatively large (1.1).

### 3.3 Estimation method

#### 3.3.1 Baseline regression

Given the discrete and sequential nature of the dependent variables, we use the Probit / Ordered Probit model to evaluate the impact of mental depression on the individual's degree of trust and life satisfaction.

We use the binary variable *trust\_dummy* to measure people's general trust on others. The Probit model is used to estimate this impact:

$$H_i^* = \theta \cdot cesd_i + X_i\beta + u_i \quad (2)$$

$$\Pr(H_i = 0 | cesd, X) = \Pr(H_i^* \leq \omega | cesd, X) = F(\omega - \theta \cdot cesd_i - X_i\beta) \quad (3)$$

$$\Pr(H_i = 1 | cesd, X) = \Pr(H_i^* > \omega | cesd, X) = 1 - F(\omega - \theta \cdot cesd_i - X_i\beta) \quad (4)$$

where  $H_i$  denotes the respondent's answer of "whether most people are trustworthy". In this model, we assume that  $H_i$  is determined by the continuous latent variable  $H_i^*$  that represents the respondent's true degree of trust.  $cesd_i$  represents the mental health status as measured by the CES-D score of respondent  $i$ , with its

coefficient  $\theta$  being the key parameter of interest for this study.  $X_i$  is a vector of other individual characteristics such as age, gender, race, work status, etc., listed in Table 1. Variable  $H_i^*$  holds linear relationship with the explanatory variables (*cesd* and  $X$ ), the realization of  $H_i$  depends on the region in which  $H_i^*$  falls (whether above or below the threshold  $\omega$ ), with the corresponding probability determined by  $F(\cdot)$ , the cumulative distribution function of the standard normal distribution. The maximum likelihood estimation will be conducted on the above Probit model, which gives consistent estimates for  $\theta$  and  $\beta$ .

For the variables for particularistic trust that are ordinal in nature with more than two possible values (*trust\_parent*, *trust\_neighbor*, *trust\_doctor*, *trust\_cadre*, *trust\_stranger*, *trust\_american*), we use the Ordered Probit model, which takes the following form:

$$T_{ij}^* = \theta_j \cdot cesd_i + X_i \beta_j + u_{ij} \quad (5)$$

$$\Pr(T_{ij} = 0 | cesd, X) = \Pr(T_{ij}^* \leq \omega_{1j} | cesd, X) = F(\omega_{1j} - \theta_j \cdot cesd_i - X_i \beta_j) \quad (6)$$

$$\begin{aligned} \Pr(T_{ij} = t | cesd, X) &= \Pr(\omega_j \leq T_{ij}^* \leq \omega_{(t+1)j} | cesd, X) \\ &= F(\omega_{(t+1)j} - \theta_j \cdot cesd_i - X_i \beta_j) - F(\omega_j - \theta_j \cdot cesd_i - X_i \beta_j) \quad t = 1, \dots, 9 \end{aligned} \quad (7)$$

$$\Pr(T_{ij} = 10 | cesd, X) = \Pr(T_{ij}^* > \omega_{10j} | cesd, X) = 1 - F(\omega_{10j} - \theta_j \cdot cesd_i - X_i \beta_j) \quad (8)$$

where  $T_{ij}$  denotes the answer of question  $j$  of respondent  $i$ , ranging from 0 to 10 and taking on integer values. We assume  $T_{ij}$  is determined by the continuous latent variable  $T_{ij}^*$  that represents the respondent's true trust level towards particular groups of people. Since  $T_{ij}^*$  holds linear relationship with the explanatory variables (*cesd* and  $X$ ), the realization of  $T_{ij}$  depends on the intervals in which  $T_{ij}^*$  falls, with the corresponding probability determined by  $F(\cdot)$ , the cumulative distribution function of

the standard normal distribution. The maximum likelihood estimation based on the above specification gives consistent estimates for  $\theta_j$  and  $\beta_j$ .

Similarly, for variables on life satisfaction (*satis\_family*, *ses\_family*, *satis\_self*, *ses\_self*, *confi\_self*), the model is specified as follows:

$$S_{ik}^* = \theta_k \cdot cesd_i + X_i \beta_k + u_{ik} \quad (9)$$

$$\Pr(S_{ik} = 1 | cesd, X) = \Pr(S_{ik}^* \leq \omega_{1j} | cesd, X) = F(\omega_{1j} - \theta_k \cdot cesd_i - X_i \beta_k) \quad (10)$$

$$\begin{aligned} \Pr(S_{ik} = t | cesd, X) &= \Pr(\omega_{(t-1)k} \leq S_{ik}^* \leq \omega_{tk} | cesd, X) \\ &= F(\omega_{tk} - \theta_k \cdot cesd_i - X_i \beta_k) - F(\omega_{(t-1)k} - \theta_k \cdot cesd_i - X_i \beta_k) \quad t = 2, 3, 4 \end{aligned} \quad (11)$$

$$\begin{aligned} \Pr(S_{ik} = 10 | cesd, X) &= \Pr(S_{ik}^* > \omega_{4k} | cesd, X) \\ &= 1 - F(\omega_{4k} - \theta_k \cdot cesd_i - X_i \beta_k) \end{aligned} \quad (12)$$

where  $S_{ik}$  denotes the answer by respondent  $i$  for the life satisfaction-related question  $k$ , which ranges from 1 to 5 and takes on integer values. Using the maximum likelihood method with the standard normal distributional assumption on  $u_{ik}$ , we can obtain the consistent estimates for  $\theta_k$  and  $\beta_k$ .

### 3.3.2 Instrumental variable (IV) regression

The above models implicitly assume that an individual's depression level is exogenous. However, the mental health status measure may suffer from endogeneity problem because of the following reasons: (1) unobserved factors such as lifestyles and ideology can affect both the degree of depression and one's trust on others as well as life satisfaction; (2) higher degree of trust and life satisfaction can contribute to better interpersonal relationship, which in turn benefits one's mental health.

To address the above endogeneity concern due to variable omission or reverse

causality, we use the CES-D scores of the respondent's biological relatives as the instrumental variables (IV). These variables include: the CES-D scores of the respondent's father (*iv\_f*), mother (*iv\_m*), both side of the parents (*iv\_p*), and the CES-D scores of the respondent's first biological child (*iv\_c*).<sup>3</sup> The reasons why we choose these IVs are as follows. First, the parental CES-D scores should be directly correlated with the individual's depression due to the heritability of depression. Prior studies such as McGue and Christensen (1997) estimate that such heritability ranges from 30% to 40%, which means that more than 30% of individuals with a family history of depression develop depression in their life. Second, parental CES-D scores should (arguably) not directly correlate with the individuals' own attitude toward trust and life satisfaction without affecting the individual's depression.

After employing the IVs, the abovementioned Probit and Ordered Probit model will be estimated using the two-stage maximum likelihood method as suggested by Wooldridge (2014). Table A1 in the Appendix reports the first stage regressions and the statistical tests on the validity of each IV. The F-tests on the joint significance of IVs in the first stage regressions indicate strong correlation of CES-D scores between parents and their offspring (the F statistics are well above 10, which is a commonly used threshold value), suggesting that the IVs are not likely to be weak. In addition, the Sargan test for the over-identification restrictions is carried out for the over-identified IV models [corresponding to the first stage regressions in Column (3)], and the comparatively high p-values for the Sargan tests suggest that the IVs are not likely to

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<sup>3</sup> The IV regressions are based on the sample of respondents whose biological relatives' information is available.



correlate with the error terms, providing supporting evidence on the validity of the IVs.

### **3.3.3 Sub-sample regression**

For robustness check purpose, we also conduct the sub-sample analysis on different population groups in our data. The groups are divided by the following criteria: gender (male vs. female), age (young vs. middle age vs. elderly), marital status (married vs. unmarried), residential region (rural vs. urban), and education level (primary school or below vs. middle school vs. high school vs. college or above). For the age groups, “young” includes individuals aged between 16 and 39, “middle age” includes individuals aged between 40 and 59, and “elderly” includes individuals aged 60 or above. For the marital status, the “unmarried” group includes individuals who are single, divorced, or widowed. Similar to the baseline full sample regressions, the sub-sample regressions are based on the Probit or Ordered Probit models, with the same set of control variables (the variable used as the group classification criterion is excluded).

## **IV. Results**

Table 2a reports the results of the baseline regressions on a series of trust variables ranging from general trust to particularistic trusts in six different relationships. The key explanatory variable is CES-D score which measure the individual propensity to have depression. The results show that there is a statistically significant and negative relationship between the CES-D score and the trust variables, indicating that the more depressive individuals are less likely to trust other people. We also calculate the marginal effects of changes in CES-D, and the results show that one standard deviation increase of the CES-D score will decrease the probability of trusting other people in

general by 5.7%. For particularistic trust, we find that the coefficient estimates of the CES-D score decreases with the distance of the relationship. For the inner circle such as the relationship with parents and neighbors, the coefficient estimates are in the range of 0.019 to 0.021. The estimated coefficients of CES-D decrease to about 0.015 for the trust on doctors and cadres, which represents the intermediate range in an individual's social connection. For people in the outer relationship circles such as strangers and foreigners (the Americans), the coefficient estimate is very small (about 0.004) and even becomes statistically insignificant for foreigners.

With regard to other control variables, the results also yield several interesting findings. First, we find that income and education are positively correlated with the general trust. This is consistent with the findings by Alesina and Ferrara (2002), and suggests that people in higher socio-economic status are more prone to trusting other people. However, the effect of education on the particularistic trust is not uniform across specific individuals: better educated people are more likely to trust parents, neighbors, strangers and the Americans, but they are less likely to trust doctors and cadres. A plausible explanation for this discrepancy is that the high education groups in China may be better informed about the corruption scandals (such as bribery taking behaviors) of the doctors and government officials, and thus they are more likely to hold a prejudice against these professionals.

Second, we found that many socio-economic variables, such as gender, age, marital status and residential place, do not have significant impacts on the general trust, but they have heterogeneous effects on the particularistic trust. For example, compared to

males, females are less likely to trust neighbors and strangers. By contrast, females are more likely to trust doctors and cadres than males. Similarly, compared to rural residents, urban residents are more likely to trust their parents, but are less likely to build a trusting relationship with other non-family member, including neighbors, doctors, cadres, strangers and the Americans.

Third, compared to people who are currently employed, those not in the labor force are more likely to have a general trust on other people. However, they may have less particularistic trust on specific individuals. For example, the unemployed are less likely to trust neighbors, doctors, cadres, and the Americans.

Table 2b reports the results of the baseline regressions on a series of life satisfaction variables ranging from the satisfaction of one's own life and one's family to the degree of confidence to one's future. The estimated coefficients reveal that the CES-D score has a significantly negative impact on life satisfaction, indicating that a high propensity for mental depression is associated with poorer subjective well-being. This finding provides strong evidence for the nexus between health and happiness. More precisely, we find that higher CES-D scores lead to lower satisfaction on one's family and one's life as well as a lower confidence to one's future. An interesting finding is that the marginal impact of CES-D scores on these three variable are almost identical, indicating that the negative impact of depression on life satisfaction is robust across different empirical measurements. In addition, we find that the CES-D score is negatively associated with the perception of social status (compared to other people in the same local areas) for both the respondents per se and their families. The marginal effects of

CES-D on these two variables are also similar, thus providing cross-validation on the findings of the two outcome variables. A comparison between the two sets of life satisfaction measures suggests that the impacts of mental depression are larger for self-perceived confidence [Column (1), (3) and (5)] than for socioeconomic status [Column (2) and (4)], as the latter is more objectively measured.

With regard to other control variables, the results are more homogenous across alternative measures of life satisfaction as compared to their estimated impacts on the trust variables. Specifically, we find that females have a higher life satisfaction than males, which can be explained by two plausible reasons: first, females are in an advantageous position to keep a good social network; second, women face a lower social pressure than men, especially in the labor market activities. Age has a nonlinear effect on life satisfaction, indicating a u-shaped relationship between age and subjective well-being: people tend to feel less satisfied about themselves and their families as they get older, but these perceptions start to improve after a certain age range, suggesting that the middle aged individuals are more likely to have a lower life satisfaction as compared to the young and elderly adults. Not surprisingly, we also find that marriage is associated with higher life satisfaction.

For the socioeconomic variables, we find income has a significantly positive effect on several indicators of life satisfaction, indicating that income still plays an important role in shaping individuals subjective well-being, especially with the backdrop of rapid income growth in China for the past three decades. In addition, we find education has a nonlinear effect on life satisfaction: compared to individuals with primary school

education or below, secondary education (middle and high school) does not seem to make people more satisfied with their live, but higher education (college or above) does. The work and residential status also have certain impacts on life satisfaction, but the effects are heterogeneous across different variables. Specifically, individuals who are out of the labor force due to disability or diseases have lower life satisfaction compared to the currently employed. By contrast, individuals who are out of labor force due to other reasons (such as schooling) have higher life satisfaction. People living in the urban areas are in general more satisfied with their family as compared to rural residents. However, urban residents have a lower perception on their social status in the local area and show a low confidence about their future life. This may reflect the fact that urban residents face a higher competitive pressure for survival than the rural residents.

Table 3a reports the IV regression results on the trust variables by taking account of the endogeneity of CES-D score. We use the mental health status of immediate family member as IV, and the regressions are restricted to the samples where the information on the family members' mental health status is available. As shown in the appendix Table A1, the CES-D scores of one's parent and child are positively associated with his or her own CES-D score. For this reason, we report in Table 3a four alternative specifications that use the CES-D score of different family member as IVs: (1) father; (2) mother; (3) both father and mother; and (4) the individual's first biological child. The IV regression results show that the impact of CES-D score on all trust variables are similar to the baseline regression results (column 1 of Table 3a), indicating that our basic results are robust to the control of endogeneity in the regressions. More precisely,

with the exception on the question on whether individuals trust the Americans, the estimated results show a consistent pattern that an increase in the propensity of depression leads to a reduction in both the general trust and particularistic trust, indicating that depression causes a lower trust not just for the general people but also for specific individuals, including parents, neighbors, doctors, cadre and strangers. These results are robust across alternative specification of instrumental variables.

Following the same identification strategy, Table 3b reports the IV regression results on a series of variables on life satisfaction that take account of the endogeneity of the CES-D score. The results are similar to those reported in the baseline regression model (Table 2b). In addition, the IV results are quite consistent across alternative instrumental variables. These results indicate that depression leads to a lower life satisfaction and they are robust across different specifications.

Tables 4a and 4b report the baseline regression results based on the subsample analyses, which provide the basis to investigate whether the estimated coefficients of CES-D score on the trust and life satisfaction variables are heterogeneous across different population groups. The results show that the impacts of CES-D score on various trust variables are not uniform across subpopulations. More precisely, the negative impact of depression on trust is larger for males than that for females and this pattern is consistent across all alternative measures of trust, indicating that the hidden cost of depression in the form of lower trust to other people or to specific individuals are higher for men than for women. Similarly, the magnitude of the detrimental effect of CES-D score on trust also varies across age groups. Depression in general has a

stronger impact on the young group (age 16 to 40) than the elderly (age 60 and above). With regard to regional variation, the results show that mental depression has a stronger effect on the propensity to trust other people among urban residents compared to rural residents, and this pattern is consistent for both the general trust as well as the particularistic trust. However, the disparity in the estimated coefficients seems small between the married and the unmarried groups.

We also find the existence of an education gradient in the estimated impact of depression propensity. Specifically, people with college degree or above tend to decrease their trust to other people in a more substantial way than less educated people when their CES-D scores are high. This education gradient is consistent across alternative measures of trust, indicating that a higher cost of depression in the form of lowering trust (both general trust and particularistic trust) is born by the individuals with better educational attainment.

The results reported in Table 4b also show a clear pattern on the heterogeneous impacts of mental depression on life satisfaction across different subpopulation groups. An interesting finding is that the life satisfaction regressions demonstrate a similar pattern of the heterogeneous effects as observed in the trust-related regressions. More specifically, males and the younger aged groups face a higher hidden cost of depression in terms of reduced life satisfaction, as compared to females and the older-aged groups, respectively. Similarly, compared to the rural residents, people living in the urban areas feel less satisfied with their life and family when they suffer from depression or depressive symptom. The education gradient also exists in the negative impact of CES-

D score on life satisfaction: better-educated people tend to suffer more from this negative impact than people with lower education levels.

## **V. Conclusions**

This paper contributes to the growing body of literature in three lines of research: rising prevalence of depression as a source of increasing global disease burden, trust as a rooted factor to promote economic growth, and life satisfaction as a measure of subjective well-being. Putting together, we highlight a conceptual framework that the rising prevalence of depression may impose two hidden costs on individuals and the society as a whole in that depression *causes* a reduction in trust and life satisfaction. Based on the data obtained from 2012 CFPS, our study provides evidence on the existence of these hidden costs with three major empirical findings:

First, the estimated results show that the propensity of depression measured by the CES-D score has significant and negative impact on a series of trust variables, including the empirical measures on general trust and particularistic trust towards specific groups ranging from parents, neighbors, doctors, cadre, strangers and foreigners. Similarly, the CES-D score also has a significant negative impact on a series of variables measuring life satisfaction, including the satisfaction of one's family and one's life, self-evaluation of own and family's social status, and the degree of confidence to one's future.

Second, these negative impacts are not just a correlation, but can also be interpreted as a *causal* relationship. By employing the instrumental variable regressions, our study finds that the negative impact still holds and remains statistically significant after



considering the endogeneity of CES-D score.

Third, the estimated coefficients of depression on trust and life satisfaction are not uniform across subpopulation groups. More precisely, we find that the detrimental effects of mental depression are stronger among the following four subgroups: males, young-aged people, urban residents and the well-educated individuals.

Given that trust has been characterized as one of the component of social capital, which in turn plays an important role to foster economic growth in general and innovation in particular, the decrease in trust *caused* by the rising prevalence of depression globally have an important consequence on the wellbeing for both individuals and the society as a whole. Similarly, life satisfaction has been recognized as an important component to measure the subjective well-being. A decrease in life satisfaction *caused* by the rising prevalence of depression also imposes a significant cost to individuals as well as to the society. An important implication of our study is that the burden of mental health conditions is not limited to their direct health consequences, but the impact on social and economic well-being is also substantial. As a result, the long-term costs of mental health problems and the value of investment in mental health resources will need to be reassessed when designing the mental health policies, particularly in the fast growing developing countries like China.

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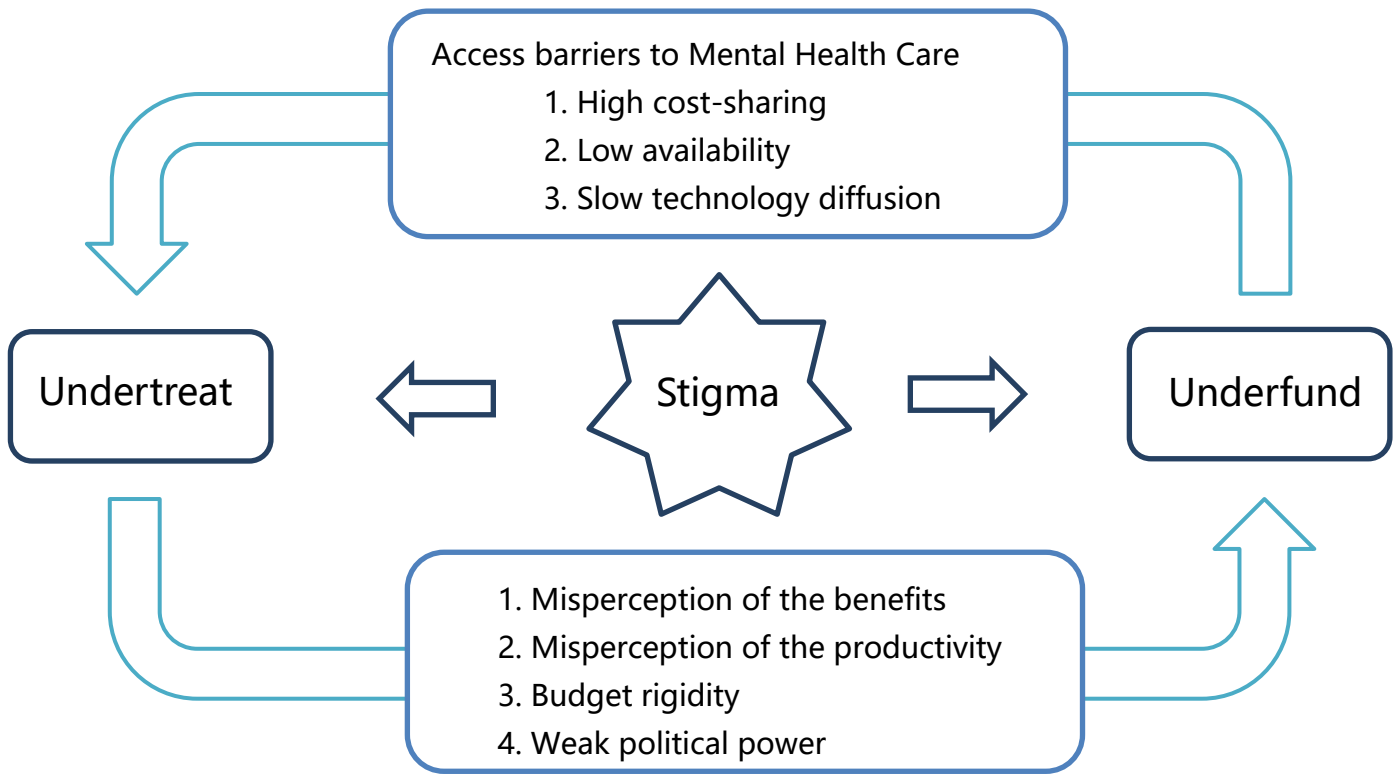
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**Figure 1 The Vicious Circle between Under-treatment and Under-funding in the Mental Health Sector**



**Table 1 Sample Summary Statistics of Key Variables**

| <b>variable</b>        | <b>definition</b>   | <b>Obs</b> | <b>mean</b> | <b>s.d.</b> |
|------------------------|---|------------|-------------|-------------|
| cesd                   | CES-D score (0-60)  | 31326      | 12.9188     | 7.9573      |
| trust_dummy            | most people are trustworthy (1=yes)                         | 31229      | 0.5432      | 0.4981      |
| trust_parent           | do you trust your parents (0-10)                            | 31109      | 9.0969      | 1.6826      |
| trust_neighbor         | do you trust your neighbor (0-10)                           | 31229      | 6.3696      | 2.2182      |
| trust_doctor           | do you trust the doctors (0-10)                             | 31203      | 6.6096      | 2.2563      |
| trust_cadre            | do you trust the cadres (0-10)                              | 31137      | 4.8762      | 2.4637      |
| trust_stranger         | do you trust strangers (0-10)                               | 31140      | 2.1891      | 2.1365      |
| trust_american         | do you trust the American (0-10)                            | 30266      | 2.5307      | 2.5032      |
| satis_family           | satisfaction of one's family (1-5)                          | 31254      | 3.4741      | 1.0465      |
| ses_family             | social status of one's family in local area (1-5)           | 31124      | 2.8397      | 0.9560      |
| satis_self             | satisfaction of one's life (1-5)                            | 31255      | 3.3170      | 1.0526      |
| ses_self               | social status of oneself (1-5)                              | 31073      | 2.6731      | 1.0200      |
| confi_self             | degree of confidence to one's future (1-5)                  | 31129      | 3.6702      | 1.1150      |
| gender                 | 0=male, 1=female  | 31326      | 0.5108      | 0.4999      |
| age                    | age in years (16-99)  | 31323      | 45.2082     | 16.6282     |
| urban                  | live in urban areas (1=yes)                                 | 31110      | 0.4515      | 0.4976      |
| pincome                | personal annual income (in 1000 Yuan)                       | 31298      | 11.0162     | 30.7444     |
| <b>marital status</b>  |   |            |             |             |
| married                | married (1=yes)   | 31323      | 0.7962      | 0.4028      |
| single                 | single (1=yes)  | 31323      | 0.1358      | 0.3426      |
| divorced               | divorced (1=yes)  | 31323      | 0.0131      | 0.1137      |
| widowed                | widowed (1=yes)   | 31323      | 0.0549      | 0.2278      |
| <b>education level</b> |   |            |             |             |
| primary                | primary school or below (1=yes)                             | 31326      | 0.5032      | 0.5000      |
| middle                 | middle school (1=yes)                                       | 31326      | 0.2828      | 0.4504      |
| high                   | high school (1=yes)   | 31326      | 0.1385      | 0.3454      |
| college                | college or above (1=yes)                                    | 31326      | 0.0755      | 0.2641      |
| <b>work status</b>     |   |            |             |             |
| employed               | currently employed (1=yes)                                  | 31326      | 0.7230      | 0.4475      |
| unemployed             | not working for pay (1=yes)                                 | 31326      | 0.0924      | 0.2895      |
| OLF_1                  | out of labor force due to disability or diseases<br>(1=yes) | 31326      | 0.0209      | 0.1430      |
| OLF_2                  | out of labor force due to other reasons (1=yes)             | 31326      | 0.0603      | 0.2381      |
| retired                | aged above 64 (1=yes)                                       | 31326      | 0.1035      | 0.3046      |
| cesd_f                 | CES-D score of one's father                                 | 5844       | 12.1145     | 7.6132      |
| cesd_m                 | CES-D score of one's mother                                 | 6646       | 14.5232     | 8.5693      |
| cesd_c                 | CES-D score of one's first born child                       | 5764       | 11.3232     | 6.4114      |

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Note: (1) Data Source: China Family Panel Studies (2012). (2) The statistics reported are sample mean and standard deviation of main variables. (3) The higher the trust score is, the more likely that one trusts in this group of people. Similarly, the higher the satisfaction score is, the more satisfied one is towards his or her life. (4) The definition of variable "trust\_dummy" is "whether most people are trustworthy or not".



**Table 2a Baseline Regressions on the Determinants of Trust**

| Variable         | trust_dummy<br>(1)       | parents<br>(2)           | neighbor<br>(3)          | doctor<br>(4)            | cadre<br>(5)              | stranger<br>(6)           | american<br>(7)          |
|------------------|--------------------------|--------------------------|--------------------------|--------------------------|---------------------------|---------------------------|--------------------------|
| cesd             | -0.0187***<br>(0.000998) | -0.0192***<br>(0.000971) | -0.0208***<br>(0.000864) | -0.0154***<br>(0.000854) | -0.0157***<br>(0.000857)  | -0.00446***<br>(0.000858) | 0.000443<br>(0.000877)   |
| gender           | -0.0197<br>(0.0153)      | -0.00672<br>(0.0148)     | -0.0637***<br>(0.0123)   | 0.0521***<br>(0.0122)    | 0.0629***<br>(0.0122)     | -0.152***<br>(0.0128)     | 0.0156<br>(0.0130)       |
| age              | -0.00397<br>(0.00329)    | -0.00670**<br>(0.00315)  | 0.00936***<br>(0.00268)  | -0.00145<br>(0.00269)    | -0.00321<br>(0.00272)     | -0.00512*<br>(0.00274)    | -0.00763***<br>(0.00280) |
| age <sup>2</sup> | 7.48e-05**<br>(3.62e-05) | -1.83e-05<br>(3.44e-05)  | -4.66e-05<br>(2.97e-05)  | 2.17e-05<br>(2.98e-05)   | 0.000141***<br>(3.01e-05) | 7.25e-05**<br>(3.05e-05)  | 6.72e-05**<br>(3.11e-05) |
| married          | 0.00245<br>(0.0230)      | -0.0103<br>(0.0225)      | -0.0421**<br>(0.0186)    | -0.00186<br>(0.0187)     | -0.0778***<br>(0.0188)    | -0.0450**<br>(0.0190)     | -0.0806***<br>(0.0196)   |
| middle           | 0.222***<br>(0.0186)     | 0.0912***<br>(0.0180)    | 0.0372**<br>(0.0149)     | -0.00767<br>(0.0149)     | -0.0470***<br>(0.0149)    | 0.0595***<br>(0.0156)     | 0.0608***<br>(0.0158)    |
| high             | 0.374***<br>(0.0241)     | 0.190***<br>(0.0235)     | 0.0687***<br>(0.0185)    | -0.0800***<br>(0.0184)   | -0.0956***<br>(0.0183)    | 0.177***<br>(0.0196)      | 0.207***<br>(0.0202)     |
| college          | 0.648***<br>(0.0339)     | 0.311***<br>(0.0326)     | 0.196***<br>(0.0238)     | -0.149***<br>(0.0229)    | -0.0443*<br>(0.0239)      | 0.473***<br>(0.0261)      | 0.505***<br>(0.0271)     |
| unemployed       | 0.0400<br>(0.0264)       | -0.0223<br>(0.0261)      | -0.0722***<br>(0.0210)   | -0.0775***<br>(0.0208)   | -0.0795***<br>(0.0207)    | -0.00797<br>(0.0224)      | -0.0377*<br>(0.0225)     |
| OLF_1            | 0.350***<br>(0.0386)     | -0.0865**<br>(0.0352)    | 0.255***<br>(0.0280)     | 0.0814***<br>(0.0274)    | 0.201***<br>(0.0284)      | 0.336***<br>(0.0295)      | 0.458***<br>(0.0295)     |
| OLF_2            | 0.103**<br>(0.0520)      | 0.186***<br>(0.0552)     | 0.126***<br>(0.0451)     | 0.122***<br>(0.0444)     | 0.0520<br>(0.0460)        | 0.0262<br>(0.0465)        | -0.0329<br>(0.0457)      |
| retired          | 0.157***<br>(0.0383)     | 0.0498<br>(0.0361)       | -0.0479<br>(0.0313)      | -0.0142<br>(0.0314)      | -0.104***<br>(0.0314)     | 0.0362<br>(0.0330)        | -0.0226<br>(0.0332)      |
| pincome          | 0.00110**<br>(0.000439)  | 0.000128<br>(0.000419)   | -3.90e-05<br>(0.000256)  | -0.000264<br>(0.000164)  | -0.000439**<br>(0.000217) | 0.000652*<br>(0.000369)   | 0.000518<br>(0.000431)   |
| urban            | -0.00539<br>(0.0165)     | 0.0347**<br>(0.0161)     | -0.103***<br>(0.0131)    | -0.161***<br>(0.0132)    | -0.202***<br>(0.0132)     | -0.0367***<br>(0.0138)    | -0.0248*<br>(0.0141)     |
| province         | yes                      | yes                      | yes                      | yes                      | yes                       | yes                       | yes                      |
| Observations     | 30,978                   | 30,859                   | 30,979                   | 30,953                   | 30,888                    | 30,892                    | 30,019                   |

Note: (1) Data Resource: China Family Panel Studies (2012). (2) All results are based on the ordered probit model. The reported statistics are the coefficient of the explanatory variables with the clustered robust standard errors shown in the parentheses. \*, \*\*, \*\*\* denote statistical significance at 10%, 5%, 1% levels, respectively.

**Table 2b Baseline Regressions on the Determinants of Life Satisfaction**

| Variables        | satis_family<br>(1)       | ses_family<br>(2)         | satis_self<br>(3)         | ses_self<br>(4)           | confi_self<br>(5)         |
|------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| cesd             | -0.0425***<br>(0.000925)  | -0.0248***<br>(0.000932)  | -0.0436***<br>(0.000930)  | -0.0215***<br>(0.000914)  | -0.0443***<br>(0.000945)  |
| gender           | 0.139***<br>(0.0127)      | 0.111***<br>(0.0129)      | 0.171***<br>(0.0126)      | 0.0680***<br>(0.0129)     | 0.0464***<br>(0.0128)     |
| age              | -0.0184***<br>(0.00283)   | -0.0108***<br>(0.00292)   | -0.0229***<br>(0.00285)   | -0.00182<br>(0.00287)     | -0.0283***<br>(0.00286)   |
| age <sup>2</sup> | 0.000248***<br>(3.12e-05) | 0.000176***<br>(3.25e-05) | 0.000326***<br>(3.15e-05) | 0.000103***<br>(3.19e-05) | 0.000183***<br>(3.16e-05) |
| married          | 0.0983***<br>(0.0198)     | 0.128***<br>(0.0202)      | 0.111***<br>(0.0196)      | 0.119***<br>(0.0198)      | 0.141***<br>(0.0197)      |
| middle           | -0.00925<br>(0.0155)      | 0.0761***<br>(0.0157)     | -0.0168<br>(0.0155)       | 0.00999<br>(0.0157)       | 0.0702***<br>(0.0157)     |
| high             | -0.0308<br>(0.0194)       | 0.0971***<br>(0.0192)     | -0.0487**<br>(0.0190)     | 0.0474**<br>(0.0195)      | 0.0519***<br>(0.0193)     |
| college          | 0.0146<br>(0.0248)        | 0.185***<br>(0.0239)      | 0.0415*<br>(0.0245)       | 0.189***<br>(0.0248)      | 0.0171<br>(0.0243)        |
| unemployed       | 0.0249<br>(0.0223)        | -0.000956<br>(0.0223)     | 0.0399*<br>(0.0224)       | -0.0171<br>(0.0225)       | -0.000445<br>(0.0225)     |
| OLF_1            | -0.0856*<br>(0.0490)      | -0.139***<br>(0.0502)     | -0.126**<br>(0.0495)      | -0.255***<br>(0.0492)     | -0.206***<br>(0.0497)     |
| OLF_2            | 0.264***<br>(0.0290)      | 0.250***<br>(0.0283)      | 0.364***<br>(0.0286)      | 0.285***<br>(0.0292)      | 0.0329<br>(0.0291)        |
| retired          | 0.0277<br>(0.0322)        | -0.0450<br>(0.0345)       | -0.00196<br>(0.0325)      | 0.00103<br>(0.0338)       | 0.00167<br>(0.0329)       |
| pincome          | 0.000786***<br>(0.000293) | 0.000846***<br>(0.000283) | 0.000604***<br>(0.000208) | 0.000651<br>(0.000418)    | 0.000966***<br>(0.000305) |
| urban            | 0.0299**<br>(0.0137)      | -0.129***<br>(0.0137)     | -0.0168<br>(0.0136)       | -0.165***<br>(0.0139)     | -0.0287**<br>(0.0139)     |
| province         | yes                       | yes                       | yes                       | yes                       | yes                       |
| Observations     | 31,004                    | 30,874                    | 31,005                    | 30,824                    | 30,879                    |

Note: (1) Data Resource: China Family Panel Studies (2012). (2) All results are based on the ordered probit regressions. The reported statistics are the coefficient of the explanatory variables with the clustered robust standard errors shown in the parentheses. \*, \*\*, \*\*\* denote statistical significance at 10%, 5%, 1% levels, respectively.

**Table 3a IV Regressions on the Impact of CES-D on Trust**

| Dep. Variable  | baseline<br>(1)           | iv_f<br>(2)              | iv_m<br>(3)              | iv_p<br>(4)               | iv_c<br>(5)               |
|----------------|---------------------------|--------------------------|--------------------------|---------------------------|---------------------------|
| trust_dummy    | -0.0187***<br>(0.000998)  | -0.0181***<br>(0.00106)  | -0.0183***<br>(0.00107)  | -0.0183***<br>(0.00104)   | -0.0191***<br>(0.00109)   |
| trust_parent   | -0.0192***<br>(0.000971)  | -0.0186***<br>(0.001)    | -0.0189***<br>(0.00101)  | -0.0188***<br>(0.000988)  | -0.0195***<br>(0.00102)   |
| trust_neighbor | -0.0208***<br>(0.000864)  | -0.0206***<br>(0.000861) | -0.0205***<br>(0.00087)  | -0.0206***<br>(0.000849)  | -0.0203***<br>(0.000876)  |
| trust_doctor   | -0.0154***<br>(0.000854)  | -0.0146***<br>(0.000858) | -0.0145***<br>(0.000869) | -0.0149***<br>(0.000846)  | -0.0155***<br>(0.000872)  |
| trust_cadre    | -0.0157***<br>(0.000857)  | -0.0149***<br>(0.000854) | -0.0147***<br>(0.000864) | -0.0150***<br>(0.000843)  | -0.0157***<br>(0.000874)  |
| trust_stranger | -0.00446***<br>(0.000858) | -0.00429***<br>(0.00089) | -0.00415***<br>(0.0009)  | -0.00432***<br>(0.000878) | -0.00423***<br>(0.000907) |
| trust_american | 0.000443<br>(0.000877)    | 9.36E-05<br>(0.000908)   | 0.000175<br>(0.000917)   | 0.000179<br>(0.000894)    | 0.00112<br>(0.000924)     |

Note: (1) The reported results are based on the IV ordered probit model, implemented by the 2-stage maximum likelihood estimation. (2) The reported statistics are the coefficient of the explanatory variables with the clustered robust standard errors shown in the parentheses. \*, \*\*, \*\*\* denote statistical significance at 10%, 5%, 1% levels, respectively. (3) Column iv\_f using the CES-D score of individual's father as the instrumental variable. Similarly, iv\_m for mother's CES-D score, iv\_p for both father and mother, iv\_c for the individual's first biological child.

**Table 3b IV Regressions on the Impact of CES-D on Life Satisfaction**

| <b>Dep. Variable</b> | <b>baseline</b>          | <b>iv_f</b>              | <b>iv_m</b>              | <b>iv_p</b>              | <b>iv_c</b>              |
|----------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                      | <b>(1)</b>               | <b>(2)</b>               | <b>(3)</b>               | <b>(4)</b>               | <b>(5)</b>               |
| satis_family         | -0.0425***<br>(0.000925) | -0.0444***<br>(0.000901) | -0.0448***<br>(0.000910) | -0.0448***<br>(0.000889) | -0.0433***<br>(0.000920) |
| ses_family           | -0.0248***<br>(0.000932) | -0.0259***<br>(0.000913) | -0.0261***<br>(0.000924) | -0.0260***<br>(0.000899) | -0.0253***<br>(0.000921) |
| satis_self           | -0.0436***<br>(0.000930) | -0.0449***<br>(0.000906) | -0.0447***<br>(0.000917) | -0.0449***<br>(0.000894) | -0.0441***<br>(0.000923) |
| ses_self             | -0.0215***<br>(0.000914) | -0.0220***<br>(0.000903) | -0.0221***<br>(0.000915) | -0.0221***<br>(0.000891) | -0.0215***<br>(0.000918) |
| confi_self           | -0.0443***<br>(0.000945) | -0.0453***<br>(0.000914) | -0.0453***<br>(0.000926) | -0.0452***<br>(0.000902) | -0.0450***<br>(0.000932) |

Note: (1) The reported results are based on the IV ordered probit model, implemented by the 2-stage maximum likelihood estimation. (2) The reported statistics are the coefficient of the explanatory variables with the clustered robust standard errors shown in the parentheses. \*, \*\*, \*\*\* denote statistical significance at 10%, 5%, 1% levels, respectively. (3) Column iv\_f using the CES-D score of individual's father as the instrumental variable. Similarly, iv\_m for mother's CES-D score, iv\_p for both father and mother, iv\_c for the individual's first biological child.

**Table 4a Sub-sample Regressions on the Impact of CES-D on Trust**

|           | Variable                   | trust_dummy<br>(1)      | trust_parent<br>(2)     | trust_neighbor<br>(3)    | trust_doctor<br>(4)      | trust_cadre<br>(5)       | trust_stranger<br>(6)     | trust_american<br>(7)    |
|-----------|----------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|---------------------------|--------------------------|
| Gender    | Male                       | -0.0203***<br>(0.00149) | -0.0216***<br>(0.00141) | -0.0240***<br>(0.00120)  | -0.0203***<br>(0.00119)  | -0.0185***<br>(0.00120)  | -0.00514***<br>(0.00123)  | 0.000928<br>(0.00126)    |
|           | Female                     | -0.0175***<br>(0.00132) | -0.0175***<br>(0.00124) | -0.0184***<br>(0.00106)  | -0.0117***<br>(0.00106)  | -0.0137***<br>(0.00106)  | -0.00405***<br>(0.00111)  | 0.000182<br>(0.00112)    |
| Age       | Young                      | -0.0233***<br>(0.00185) | -0.0257***<br>(0.00179) | -0.0256***<br>(0.00147)  | -0.0203***<br>(0.00147)  | -0.0186***<br>(0.00146)  | -0.00793***<br>(0.00151)  | -0.000934<br>(0.00152)   |
|           | Middle age                 | -0.0179***<br>(0.00149) | -0.0178***<br>(0.00140) | -0.0196***<br>(0.00120)  | -0.0147***<br>(0.00120)  | -0.0154***<br>(0.00120)  | -0.00340***<br>(0.00125)  | 0.00148<br>(0.00127)     |
|           | Elderly                    | -0.0154***<br>(0.00191) | -0.0167***<br>(0.00175) | -0.0178***<br>(0.00155)  | -0.0120***<br>(0.00155)  | -0.0128***<br>(0.00155)  | -0.00181<br>(0.00161)     | 0.00106<br>(0.00167)     |
| Marriage  | Unmarried                  | -0.0182***<br>(0.00216) | -0.0193***<br>(0.00204) | -0.0224***<br>(0.00173)  | -0.0145***<br>(0.00172)  | -0.0149***<br>(0.00172)  | -0.00358**<br>(0.00178)   | 0.00163<br>(0.00180)     |
|           | Married                    | -0.0187***<br>(0.00111) | -0.0193***<br>(0.00105) | -0.0203***<br>(0.000897) | -0.0157***<br>(0.000894) | -0.0158***<br>(0.000894) | -0.00456***<br>(0.000930) | 0.000182<br>(0.000949)   |
| Region    | Rural                      | -0.0133***<br>(0.00131) | -0.0180***<br>(0.00122) | -0.0189***<br>(0.00106)  | -0.0147***<br>(0.00106)  | -0.0144***<br>(0.00105)  | -0.00277**<br>(0.00109)   | 0.00256**<br>(0.00112)   |
|           | Urban                      | -0.0275***<br>(0.00153) | -0.0207***<br>(0.00146) | -0.0239***<br>(0.00122)  | -0.0167***<br>(0.00121)  | -0.0195***<br>(0.00122)  | -0.00837***<br>(0.00127)  | -0.00415***<br>(0.00129) |
| Education | Primary school<br>or below | -0.0149***<br>(0.00128) | -0.0176***<br>(0.00118) | -0.0171***<br>(0.00103)  | -0.0123***<br>(0.00103)  | -0.0120***<br>(0.00103)  | -0.00172<br>(0.00107)     | 0.00189*<br>(0.00110)    |
|           | Middle school              | -0.0222***<br>(0.00203) | -0.0186***<br>(0.00196) | -0.0243***<br>(0.00164)  | -0.0180***<br>(0.00163)  | -0.0189***<br>(0.00163)  | -0.00800***<br>(0.00169)  | -0.00196<br>(0.00172)    |
|           | High school                | -0.0311***<br>(0.00297) | -0.0237***<br>(0.00290) | -0.0311***<br>(0.00237)  | -0.0197***<br>(0.00234)  | -0.0239***<br>(0.00236)  | -0.0110***<br>(0.00243)   | -0.000619<br>(0.00244)   |
|           | College or<br>above        | -0.0304***<br>(0.00452) | -0.0291***<br>(0.00452) | -0.0268***<br>(0.00349)  | -0.0317***<br>(0.00349)  | -0.0319***<br>(0.00351)  | -0.0134***<br>(0.00354)   | -0.00812**<br>(0.00353)  |

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Note: (1) The reported results are based on the ordered probit regressions for each subsample. (2) The reported statistics are the coefficient of the explanatory variables with the clustered robust standard errors shown in the parentheses. \*, \*\*, \*\*\* denote statistical significance at 10%, 5%, 1% levels, respectively. (3) Group Young includes individuals aged between 16 and 40; group Middle age includes individuals aged between 40 and 60 (include 40); group Elderly includes individuals aged above 60 (include 60). (4) Group Unmarried includes individuals who are single, divorced, or widowed.

**Table 4b Sub-sample Regressions on the Impact of CES-D on Life Satisfaction**

| Variable  |                            | satis_family<br>(1)      | ses_family<br>(2)        | satis_self<br>(3)        | ses_self<br>(4)          | confi_self<br>(5)        |
|-----------|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Gender    | Male                       | -0.0447***<br>(0.00127)  | -0.0275***<br>(0.00127)  | -0.0458***<br>(0.00127)  | -0.0256***<br>(0.00126)  | -0.0470***<br>(0.00128)  |
|           | Female                     | -0.0408***<br>(0.00112)  | -0.0229***<br>(0.00112)  | -0.0417***<br>(0.00112)  | -0.0185***<br>(0.00111)  | -0.0423***<br>(0.00113)  |
| Age       | Young                      | -0.0265***<br>(0.00156)  | -0.0437***<br>(0.00155)  | -0.0215***<br>(0.00155)  | -0.0472***<br>(0.00156)  | -0.0426***<br>(0.00157)  |
|           | Middle age                 | -0.0221***<br>(0.00126)  | -0.0426***<br>(0.00127)  | -0.0214***<br>(0.00126)  | -0.0409***<br>(0.00127)  | -0.0449***<br>(0.00128)  |
|           | Elderly                    | -0.0259***<br>(0.00164)  | -0.0397***<br>(0.00164)  | -0.0198***<br>(0.00162)  | -0.0424***<br>(0.00164)  | -0.0447***<br>(0.00165)  |
| Marriage  | Unmarried                  | -0.0392***<br>(0.00182)  | -0.0242***<br>(0.00183)  | -0.0447***<br>(0.00184)  | -0.0214***<br>(0.00182)  | -0.0460***<br>(0.00185)  |
|           | Married                    | -0.0434***<br>(0.000947) | -0.0250***<br>(0.000946) | -0.0433***<br>(0.000948) | -0.0216***<br>(0.000939) | -0.0440***<br>(0.000955) |
| Region    | Rural                      | -0.0395***<br>(0.00111)  | -0.0228***<br>(0.00111)  | -0.0402***<br>(0.00111)  | -0.0203***<br>(0.00111)  | -0.0397***<br>(0.00112)  |
|           | Urban                      | -0.0472***<br>(0.00130)  | -0.0274***<br>(0.00130)  | -0.0487***<br>(0.00130)  | -0.0232***<br>(0.00129)  | -0.0509***<br>(0.00131)  |
| Education | Primary school<br>or below | -0.0396***<br>(0.00109)  | -0.0229***<br>(0.00109)  | -0.0403***<br>(0.00109)  | -0.0188***<br>(0.00108)  | -0.0398***<br>(0.00110)  |
|           | Middle school              | -0.0452***<br>(0.00173)  | -0.0273***<br>(0.00174)  | -0.0464***<br>(0.00174)  | -0.0245***<br>(0.00173)  | -0.0474***<br>(0.00175)  |
|           | High school                | -0.0478***<br>(0.00250)  | -0.0270***<br>(0.00251)  | -0.0484***<br>(0.00251)  | -0.0276***<br>(0.00249)  | -0.0523***<br>(0.00253)  |
|           | College or above           | -0.0532***<br>(0.00373)  | -0.0278***<br>(0.00384)  | -0.0599***<br>(0.00377)  | -0.0250***<br>(0.00376)  | -0.0652***<br>(0.00383)  |

Note: (1) The reported results are based on the ordered probit regressions for each subsample. (2) The reported statistics are the coefficient of the explanatory variables with the clustered robust standard errors shown in the parentheses. \*, \*\*, \*\*\* denote statistical significance at 10%, 5%, 1% levels, respectively. (3) Group Young includes individuals aged between 16 and 40; group Middle age includes individuals aged between 40 and 60 (include 40); group Elderly includes individuals aged above 60 (include 60). (4) Group Unmarried includes individuals who are single, divorced, or widowed.

**Table A1 IV Regression: First-stage Results (Dep. Var. = cesd)**

| Variables        | cesd                    |                         |                       |                         |
|------------------|-------------------------|-------------------------|-----------------------|-------------------------|
|                  | (1)                     | (2)                     | (3)                   | (4)                     |
| cesd_f           | 0.224***<br>(0.0126)    |                         | 0.163***<br>(0.0154)  |                         |
| cesd_m           |                         | 0.218***<br>(0.0104)    | 0.159***<br>(0.0133)  |                         |
| cesd_c           |                         |                         |                       | 0.256***<br>(0.0167)    |
| gender           | 1.440***<br>(0.184)     | 1.505***<br>(0.170)     | 1.386***<br>(0.186)   | 2.030***<br>(0.198)     |
| age              | 0.138**<br>(0.0672)     | 0.120**<br>(0.0582)     | 0.0901<br>(0.0822)    | 0.106*<br>(0.0557)      |
| age <sup>2</sup> | -0.00166*<br>(0.000959) | -0.00151*<br>(0.000806) | -0.00113<br>(0.00125) | -0.000494<br>(0.000598) |
| married          | -1.094***<br>(0.234)    | -1.061***<br>(0.225)    | -0.847***<br>(0.245)  | -2.237***<br>(0.425)    |
| middle           | -1.063***<br>(0.226)    | -1.208***<br>(0.209)    | -0.883***<br>(0.242)  | -1.256***<br>(0.230)    |
| high             | -1.574***<br>(0.258)    | -1.777***<br>(0.238)    | -1.357***<br>(0.270)  | -1.369***<br>(0.333)    |
| college          | -1.908***<br>(0.294)    | -1.934***<br>(0.280)    | -1.560***<br>(0.310)  | -1.807***<br>(0.433)    |
| unemployed       | 0.0197<br>(0.435)       | -0.00200<br>(0.408)     | 0.0858<br>(0.459)     | -0.965**<br>(0.402)     |
| OLF_1            | 7.253***<br>(1.196)     | 8.423***<br>(1.200)     | 7.800***<br>(1.449)   | 6.767***<br>(1.146)     |
| OLF_2            | -0.953***<br>(0.267)    | -0.891***<br>(0.246)    | -0.751***<br>(0.279)  | -2.319***<br>(0.487)    |
| retired          | 3.698***<br>(0.967)     | 5.084**<br>(2.004)      | 3.945***<br>(1.392)   | -0.00726<br>(0.597)     |
| pincome          | 0.00144<br>(0.00440)    | 0.000179<br>(0.00189)   | 0.00160<br>(0.00476)  | -0.0193***<br>(0.00496) |
| urban            | -0.0528<br>(0.181)      | -0.269<br>(0.169)       | -0.0505<br>(0.190)    | -0.149<br>(0.218)       |
| province         | yes                     | yes                     | yes                   | yes                     |
| F-value          | 315.73                  | 438.07                  | 219.67                | 234.37                  |
| Observations     | 5,764                   | 6,562                   | 5,007                 | 5,746                   |

Note: (1) The reported statistics are the coefficient of the explanatory variables (cesd) with the clustered robust standard errors shown in the parentheses. \*, \*\*, \*\*\* denote statistical significance at 10%, 5%, 1% levels, respectively. (2) Column iv\_f using the CES-D score



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of individual's father as the independent variable. Similarly, *iv\_m* for mother's CES-D score, *iv\_p* for both father and mother, *iv\_c* for the individual's first biological child. (3) The p-values for the Sargan test associated with the IV regressions in Column (3) are generally high (above 0.1), indicating that the IVs are likely to be valid.