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ABSTRACT

Echo Effects of Early-Life Health Shocks: The Intergenerational Consequences of Prenatal Malnutrition during the Great Leap Forward Famine in China*

Few studies have examined the "echo effect" of early-life shocks related to prenatal malnutrition, that is, whether the legacy of such shocks is transmitted to the next generation. This study addresses this gap by leveraging extreme malnutrition during the Great Leap Forward famine in China, and by examining the intergenerational consequences of the famine on those who were not directly impacted. Using a difference-in-differences framework, we estimate the causal effect of the famine on a wide range of outcomes of children of mothers who were exposed in-utero including income, education, employment, and intergenerational income mobility; indicators that have not been considered in detail in the literature. We further contribute by using a refined measure of famine exposure at the prefecture level in rural areas, and by exploiting rich data on those directly affected and their children. We find that on average, the famine had negative echo effects on second-generation outcomes. These echo effects are primarily due to the adverse impacts on daughters, perhaps reflecting a combination of positive selection of sons born to mothers exposed to prenatal malnutrition during the famine and cultural aspects such as son preference. Our results withstand a battery of robustness and specification checks.

JEL Classification: I15, J62, I32, P36, N45

Keywords: foetal origins, great leap forward famine, malnutrition, intergenerational impacts, labour market, China

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Section 1. Introduction

The Foetal Origins hypothesis attributed to Barker (2007) postulates that chronic health conditions are the result of nutritional deprivation experienced prenatally. This hypothesis has been applied by economists in a variety of contexts both in the developed and developing world. Economists have found that early-life experiences have important effects on human capital outcomes later in life. An explanation is that prenatal exposure to adverse environments "programs" the foetus to develop particular metabolic characteristics, likely through environmental effects on the epi-genome. One stream of the literature has used exposure to famine as a natural experiment to test this, exploiting famines across a variety of settings including 19th-century crop failures in Sweden and Finland, the Siege of Leningrad of 1941–44, the Dutch Hunger Winter of 1944–45, the Chinese Great Leap Forward (GLF) famine of 1959–61, and the Bangladesh famine of 1974 (Lumey *et al* 2011). Among these, the Chinese GLF famine stands out for its intensity and duration. The health and education impacts of the GLF famine on those who were either exposed *in utero* or exposed at very young ages are well analysed[1]. The overall conclusion of these studies is that the famine caused significant impairment in human capital. The few instances of positive impacts were attributed to positive selection or selection in mortality among those who survived (Gorgens *et al*. 2012, Xu *et al*. 2016).

An important question is whether there is an "echo effect" of extreme shocks related to prenatal malnutrition. That is, when the cohort conceived or born during famines starts to bear children of their own, do the health or socio-economic consequences of the famine pass on to their offspring who have not been directly affected? There are two reasons why the first

[1] Outcomes for this population that have been studied include excess male mortality (Almond *et al*. 2010), physical health as proxied by height and BMI (Fung and Ha 2010), hypertension (Huang *et al*. 2010), blood pressure, hyperglycemia and metabolic syndrome (Li *et al*. 2011a, 2011b), overall mortality (Song 2010), subjective health indicators for disability, physical pain, vitality and mental health (Fan and Qian 2015), physical health and cognitive abilities (Kim *et al* 2017) and economic indicators such as labour supply and income (Meng and Qian 2009).

generation's early-life malnutrition shocks may influence the human capital of the second generation. First, the child of a famine-born parent may suffer due to famine-induced defects in the parental reproductive system. Indeed, epidemiologists have shown that adverse *in-utero* experiences may permanently affect maternal growth and development and alter the mother's metabolism, providing an adverse environment for her fetus (Drake & Walker 2004). Second, parents born during famine may develop worse outcomes, which, by altering the environment in which children are raised, lead to lower achievements in the second generation.

The possibility of an intergenerational echo effect of the GLF famine was initially documented by Almond *et al*. (2010). As noted there, the famine may have had an impact on the generation that followed those who were directly exposed, leading to biased sex ratios among the children. Such an echo effect might be more salient for the children of women who suffered prenatal malnutrition during the famine. Girls are born with their complete reproductive genetic material that would carry imprints of the famine or have been conditioned by it. Importantly, these genetic pre-determinants cannot change over the life course. Hence, the fact that women are born with their complete "genetic coding" with little hope of correcting insults suffered very early on can have intergenerational consequences.

There is limited empirical research examining the intergenerational echo effect of the GLF famine on offspring labour market outcomes. Using data from the China Health and Nutrition Surveys and provincial weighted excess death rates (EDR) as an estimate of famine intensity, Kim *et al*. (2010) finds that children of those who were directly exposed to the famine work fewer hours and earn lower wages. Using data from the Monitoring Social and Economic Development of West China and province-level EDR to capture famine intensity, Zhang (2012) finds that children of women exposed to famine are more likely to be overweight and to have lower educational attainment. Kim *et al*. (2014) uses Chinese Census data in 2000 and province-level EDR to measure famine intensity. Recognizing that province-level EDR are likely to suffer from measurement error, they instrument this indicator with negative weather shocks that coincided with the timing of the famine and find lower schooling attainment in the second generation. Tan *et al*. (2017) uses data from the China Family Panel Studies and province-level EDR as the famine intensity measure to estimate intergenerational effects on children's cognitive abilities. They find children born to female survivors were not affected, but daughters of male survivors have lower cognitive scores. Finally, Wu (2016) uses China Health and Retirement Longitudinal Study (CHARLS) data and province-level EDR to analyse intergenerational impacts on children's education and finds that, contrary to the literature, those who had at least one parent exposed were likely to attain a higher educational level.

The limited research on the intergenerational consequences of the famine thus documents conflicting results the reasons for which are largely unknown. One reason may be the use of a famine exposure measure that is at an aggregate level. The famine intensity measure used throughout the intergenerational literature – province-level EDR – is a crude measure of famine exposure because it conflates estimates in rural and urban locales and does not recognise substantial within-province variation in famine intensity. The lack of consensus in results might also arise due to measurement error in famine intensity. Most data in these studies do not contain information on respondents' birthplace. The province in which the respondent is currently resident is thus often used as a proxy, possibly leading to errors in measurement. Moreover, EDR often come from official estimates of mortality that are prone to reporting bias. Finally, imperfect empirical designs that fail to adequately control for confounding factors may also lead to results that are inconclusive.

It is important, both from a research and policy standpoint, to have convincing evidence on the spill over effects of this disaster on subsequent generations. In particular, in the interests of equity, it is important to understand whether, by impeding the accumulation of human capital, the famine has had long-term effects on intergenerational social and income mobility. In the framework of Chetty *et al*. (2014) and Chetty *et al*. (2016), the famine may be viewed as a lottery.[2] The life prospects of children with parents born during famine and in regions that were severely impacted are likely to have followed radically altered trajectories compared to children whose parents were "luckier" in that they happened to be born in another period or in regions that escaped the brunt of the famine. The luckier children were thus the lottery winners whose circumstances continued on the trend they were on, experiencing beneficial outcomes compared to their parent's generation. However, the unlucky children are more likely to have faced a reduced outlook and to have experienced little upward mobility along many dimensions. A comprehensive understanding of such long-run dynamics is key to address the equity consequences of the GLF famine.

Our study tests the hypothesis that early-life shocks such as exposure to famine may have had an echo effect on the next generation by focusing on mothers who were affected by the GLF famine *in utero* – in theory, this is the group that suffered malnutrition in important prenatal stages and thus has the highest likelihood of transmitting their possibly defective genetic imprint to the next generation. Moreover, women born during the famine constitute a more representative sample than men born during the famine, as the latter are likely to be positively selected given they are relatively more fragile as fetuses. We examine the intergenerational labour market consequences of the famine using the CHARLS data. We identify causality by exploiting substantial variation in famine intensity both across time and across areas (cities/prefectures) in a difference-in-differences (DID) framework, and consider various labour market outcomes for children in the second generation including education, income, employment and intergenerational income mobility.

[2] We undertake a whole battery of tests in this study to convince the reader that this was the case.

We contribute to the literature on the long-term consequences of the famine in several ways. First, while the effects of the famine on those exposed *in utero* is well documented, the echo effects of the famine on important outcomes such as education, income, employment and income mobility of their children is much less researched, perhaps due to paucity of data covering both generations. We provide new evidence in this sphere.

Second, the CHARLS data allow us to use a better measure of famine exposure than most existing studies. In the CHARLS data, respondents' places of residence and birthplaces are known at the prefecture-level[3], which allows us to match respondents to famine severity measures in their prefecture of birth. We use Chinese Census data to construct prefecture-level cohort size shrinkage index (CSSI) indicators that vary by rural and urban areas. This type of cohort size-based measures are better than mortality-based measures as they capture both mortality and fertility dynamics that may have been induced by the famine. This fine-grained measure thus provides us with greater variation in famine intensity, which we leverage for identification. As depicted in Figure 1, the intensity of the famine varied across the provinces of China. This province variation is usually used to identify famine effects. Figure 2 depicts the prefecture/city-level variation in famine severity using CSSI measures in our data. Relying on information at this level of granularity thus allows much wider variation in measures of famine intensity.

Third, we paint a more comprehensive picture of intergenerational famine effects than has been done before by examining a range of labour market measures. We consider results disaggregated by gender of the child, which has also been missing in much of the literature. Lastly, we examine a range of potential mechanisms underlying the intergenerational effects we document by using information on mothers who were exposed *in utero*.

[3] On average, each province in China consists of about 10 prefectures and each prefecture consists of about nine counties.

We motivate our analysis by spotlighting one catchall measure of labour market performance – whether the child is currently working – and plot the impact of the famine on the propensity to work of children of famine survivors who are 15-40 years old (Appendix Figure 1). Non-parametric results depicted in Appendix Figure 1 show that girls with mothers who experienced more intense famine have relatively lower predicted work prevalence than girls with mothers exposed to less intense famine, particularly in early ages. However, these differentials are not salient for boys. The deficit evident for girls is of concern as the literature clearly documents that penalties incurred in employment at these early ages amplify over time. The strong negative impact on girls resonates across many of the other labour market indicators we consider in our DID specifications, thus emphasizing that these detrimental echo effects are more evident among female children of mothers who survived the famine. Results for male children are on average less severe or measured imprecisely. We attribute this to potential positive selection of sons born to mothers exposed to the famine in regions that were hard-hit (Kraemer 2000; Sanders and Stoecker 2015), and to son preference prevalent in China. As we demonstrate below, these results are robust to a variety of robustness checks and specification tests.

Section 2. Institutional background

The GLF famine in China from 1959–1961 was one of the worst in human history, and is estimated to have caused about 15–30 million excess deaths and approximately 30 million lost or postponed births (Ravallion 1997). From 1958-1961, the Communist Party of China launched the “Great Leap Forward” movement aimed at rapidly transforming the country from a predominantly agrarian one to an industrialized socialist economy. A massive campaign was initiated to adopt radical economic and social policies to accelerate the process of industrialization by “squeezing” the agricultural sector. It is believed that the famine was caused by a combination of factors, including declines in grain production due to bad weather, excessive procurement by the state, delayed response to food shortages, weakened production incentives due to the widespread collectivization program of 1958, and resource diversion towards massive industrialization (Chen and Zhou 2007; Meng *et al*. 2015).

The GLF famine had features that facilitate causal empirical analysis. First, there was substantial variation in intensity across regions and across time with rural areas being hit the hardest. Although consistently high, mortality rates peaked in early 1960 (Becker 1996). The severity of the famine varied sharply across *and* within provinces. Second, there was little migration across regions. The Chinese government adopted the family register system, the "Hukou" system, to control the movement of people between urban and rural areas in 1958. During this time, nearly all rural Hukou residents were collectivized into village communal farms. The communes were managed in a quasi-military fashion and migration was prohibited. Therefore, there was almost no migration in rural areas during the famine.

Section 3. Data

Section 3.1. Study sample

We use data from the CHARLS - a longitudinal study of individuals aged 45 and older in China - designed to better understand the socioeconomic determinants and consequences of aging. The survey includes rich information on economic standing, physical and psychological health, demographics and social networks of aged persons. Importantly, the CHARLS questionnaire contains a "Family" section, which collects information on the main respondent's children, parents and siblings. From the information on children, we construct offspring labour market outcomes. We use information on CHARLS respondents and their spouses for parent-specific variables. The CHARLS data contains information on the respondent's birthplace at the prefecture level, which allows us to measure individual-specific famine exposure at the prefecture level.

The baseline wave of CHARLS was collected from 2011-2012 (Wave 1) and includes 10,257 households and 17,708 individuals in 150 counties/districts and approximately 120 prefectures/cities and 450 villages or urban communities in 28 provinces. These individuals were re-surveyed in 2013 (Wave 2) and in 2015 (Wave 3). We use the baseline sample for most of the analysis and rely on subsequent waves to impute missing values of key time-invariant variables.

For purposes of analysis, we include female respondents born between 1954 and 1962. These consists of those born during the famine (1959-1962) and those born within five years before the famine (1954-1958). We treat the 1962 cohort as being exposed to the famine as they would have been *in utero* during the famine. Our control birth cohorts include only those born before the famine. Next, we only include respondents who were born in rural areas. This is because the impact of the famine was primarily felt in rural areas whereas urban areas were more insulated due to the presence of food support programs. Given Hukou induced restrictions on migration, concentrating on rural areas provides a clean sample free from sorting-related selection dynamics. Finally, we concentrate on the biological children of CHARLS female respondents in our child sample.[4]

Section 3.2. Child-specific variables

We construct a range of dependent variables to capture offspring outcomes including children's income level, educational attainment, work status, and a measure of upward mobility in their income levels as compared to their parents (Chetty *et al*. (2014) and Chetty *et al*. (2016)). Further, we construct a set of child-specific variables to be used as controls including age, age squared, gender, birth order, and birth quarter of the year (Almond (2006),

[4] In our estimation sample, 98 percent of children are either the biological children of the respondent and their spouse or the biological child of the respondent alone.

Cook *et al*. (2019)). We also include the child's Hukou status --agricultural Hukou or non-agricultural Hukou-- to account for labour market differences between rural and urban areas.

Table 1 presents descriptive statistics of these child-specific variables separately for male and female children and for the combined sample. We begin by discussing the dependent variables in Panel A. Since child income was reported in very fine categories, we analyze the mid-points of these categories. The average values of the mid-points are 23,498 yuan for male children and 23,707 yuan for female children. Fewer female children have completed high school as compared to male children (29.2% versus 30.1%), are currently working (78.1% versus 89.2%), or have ever worked before (88.4% versus 92%). Female children have higher rates of upward mobility compared to male children (27.1% versus 26%).

Panel B reports the summary statistics for child-specific independent variables. The average age is 27.7 years, and 53.7% of children are men. Female children are more likely to be first-born compared to male children (44.5% versus 40.5%), and are more likely to be born in the first and the third quarters of the year. 85.9% of the children have agricultural Hukou status which is not surprising given they are born to mothers whose birthplace was rural. Female children are somewhat less likely to have an agricultural Hukou as compared to male children (85.7% versus 86.2%).

Section 3.3. Famine exposure measures

Two types of famine intensity measures have been used in the literature. The first type is based on famine-caused mortality increases (Lin and Yang 2000, Chen & Zhou 2007, Almond *et al*. 2010, Kim *et al* 2014, Kim *et al* 2017) primary among which are province-level famine-induced EDR calculated as the difference between mortality in famine years (1959–61) and mortality in the three years before the famine (1956–58). The second type of famine intensity measure is a cohort measure of all types of famine-induced cohort attrition that occurred during the famine (Huang *et al* 2010, Meng *et al* 2015, Xu *et al* 2016). There are several issues with the first type of measures: mortality-based famine intensity estimates. EDRs are based on government official reported mortality rates that may be subject to measurement error and some degree of under-reporting. Alternatively, cohort size-based famine severity measures utilize public-use samples of the Chinese Population Census that are known to be of high quality. Second, famine may have caused not only excessive deaths but also changed fertility dynamics through lost or postponed birth. The impact on fertility is not captured in mortality-based measures but is captured in cohort size-based measures.

We follow the second approach and construct cohort-size based measures of famine intensity using the one-percent sample of the 1990 China Population Census data. Following Xu *et al* (2016), we construct prefecture-level CSSI measures that vary by rural and urban areas. This measure of famine exposure allows us to capture substantial within-province variation, and variation tempered by the proportion of the area that is rural versus urban.

Our prefecture-level CSSI measure for the i^{th} prefecture is calculated as:

$$CSSI_i = \frac{N^i_{nonfamine} - N^i_{famine}}{N^i_{nonfamine}} \qquad (1)$$

Where $N^i_{nonfamine}$ denotes the average cohort size of those born during the three years preceding the famine (1956–58) and the three years after the famine (1962–64), and N^i_{famine} denotes the average cohort size of those born during famine years (1959–61).[5] A relatively high value of $CSSI_i$ indicates a larger reduction in cohort size thus greater famine intensity[6]. This prefecture-level CSSI is used in all regressions that follow. We also use province-level CSSI and province-level EDR in the robustness checks that follow. Appendix

[5] We experimented with slightly different years for these groups and our measures were relatively consistent.
[6] The CHARLS implemented a separate Life History Survey in a subsequent wave, which includes some questions related to experience with the famine. We use these data to check the integrity of our CSSI measure. Descriptively, the response to these life history questions is consistent with our prefecture-level CSSI measure: respondents who report experiencing starvation (and those with family members who starved to death) due to famine have significantly higher CSSI measures; the CSSI measure increases as respondents report larger numbers for those who perished due to food shortages.

Table 1 lists weighted mean CSSI measures by prefecture/cities in our data for mothers born between 1959 and 1962 whose birthplace is rural. It is clear that there is substantial within-province variation in famine intensity across cities[7].

To construct individual-level famine exposure measures, we matched prefecture-level CSSIs and provincial CSSIs to respondents based on their birth prefectures and provinces. The descriptive statistics of famine exposure for female respondents (mothers who were exposed *in utero*) are reported in Panel A of Table 2. The first measure is the linear version of $CSSI_i$. We use the non-linear version of $CSSI_i$ to ease interpretation of results in our DID models. This non-linear version conditions on $CSSI_i$ being at its 75th percentile value or higher in rural areas.[8] Respondents' exposure to the famine also depends on their year of birth and Panel A reports summary statistics for these indicators. Comparing proportions born in each cohort from 1954-1962, it is evident that there was a drop in births in the famine years from 1959-1961 followed by an increase post-famine in 1962.

Section 3.4. Other mother-specific variables

We construct mother-specific variables for use as controls in the child outcome models or as outcomes in the mechanisms analyses and look to Almond (2006) and Cook *et al*. (2019) for guidance on these measures. These mother-specific variables include age, age squared, an indicator for having completed high school or above, an indicator for having difficulty walking for 100 meters, an indicator for having had a stroke, an indicator for currently having any chronic health conditions, and the number of chronic conditions. Panel B of Table 2 presents these descriptive statistics. On average, mothers' age is 53.2 years. Around 7% of mothers have completed high school or more. While 68.6% of mothers report

[7] For example, in Shanxi province that borders northern Inner Mongolia, city-level exposure varied from 0.174 in Linfen to 0.456 in Yangquan. In Sichuan province where the famine was more severe, exposure varied from 0.463 in Ganzi to 0.689 in Meishan.

[8] Results were of similar signs but more noisy when other cut-offs were used.

having chronic conditions, the average number of chronic conditions is 1.4. Only 1.3% of mothers report having difficulty walking or having had a stroke.

Section 4. Empirical methodology

Section 4.1. Model and specifications

Exploiting the variation in famine exposure across birth cohorts and across prefectures, we use a DID model to identify the impact of the famine on outcomes of the second generation. Essentially, we compare offspring outcomes of those mothers who were exposed *in utero* to outcomes of those whose mothers were not exposed *in utero*. Most papers studying the GLF famine use birth cohorts born before and after the famine as the control group. We include only birth cohorts who were born before the famine as control to mitigate potential selection arising from differences in fertility and mortality trends in years that followed the famine. As noted in Currie and Vogl (2013), individuals conceived after the famine may have been affected by fertility responses to the famine. Therefore, they may have different socioeconomic characteristics. Using post-famine birth cohorts in the control group would mean, at the very least, that the composition of parents with children is different between the treatment and control groups. Hence, to identify impacts cleanly we only use birth cohorts born five years before the famine as the control group.

The treatment group includes cohorts born during the famine years. Further, given the length of human gestation periods, mothers born from January to October 1962 would have been partially exposed to the famine. Therefore, we also include the 1962 birth cohort in the treatment group. One might argue that those born several years before the famine would be 1-5 years old when the famine began, and thus at critical stages of development themselves. However, our focus is the intergenerational echo effect of *in-utero* exposure. To the extent that the control group may have also been adversely affected by the famine, we have a conservative bias in our results as the impacts we identify underestimate true causal effects of the famine. As noted above, selection is likely to be a bigger issue for identification if we include the post-famine birth cohorts in the control group.

We consider the following specification:

$$y_{ijkt} = \beta_1 + \beta_2 S_k + \beta_3 T_{jt} + \gamma_1 (T_{jt} \times S_k) + \beta_4 X_{ij} + \beta_5 P_{ij} + \alpha_t + \varepsilon_{ijkt} \quad (2)$$

where y_{ijkt} is the labour market outcome for child *i* of parent *j* who was born in prefecture/city *k* in year *t*. S_k denotes famine severity in prefecture/city *k* and is measured by CSSI in equation (1). To ease interpretation of results, S_k is a dichotomized measure created based on the 75th percentile value of CSSI in rural areas. $S_k = 0$ ("less intense") if the respondent's birth prefecture/city CSSI measure is lower than its 75th percentile value in rural areas, and $S_k = 1$ ("more intense") if the respondent's CSSI measure equals or exceed this threshold. T_{jt} is a dummy with value 1 if parent *j* was born during the famine years (1959-1962), and zero otherwise. X_{ij} are controls for maternal and child characteristics described above, P_{ij} are maternal birth province fixed-effects, and α_t is a set of maternal birth cohort fixed-effects. Regressions are weighted to national levels using weights provided in the CHARLS data[9]. Standard errors are clustered at the maternal birth-province level. The coefficient on the interaction term of the famine severity S_k and treatment dummy T_{jt}, γ_1, is the parameter of interest, representing the average effect of intense famine over the famine years. These are identified from variation in famine intensity across prefectures/cities in a given year and from variation in mothers' birth years in any given prefecture/city.

To allow for differential effects of famine exposure across years from 1959-1962, we follow Chen and Zhou (2007) and interact famine severity and each of the birth cohort dummies separately in a related specification.

$$y_{ijkt} = \beta_1 + \beta_2 S_k + \beta_3 \sum_{t=1959}^{1962} C_{jt} + \sum_{t=1959}^{1962} \gamma_t (C_{jt} \times S_k) + \beta_4 X_{ij} + \beta_5 P_{ij} + \alpha_t + \varepsilon_{ijkt} \quad (3)$$

[9] These weights are used to adjust for the fact that the distribution of individuals in these data differ from the distribution of individuals nationally.

where C_{jt} represents mother's birth year cohort dummies for those born during the famine years. The coefficients γ_t on the interactions of famine severity and maternal birth cohort dummies represent the effect of intense famine on each birth cohort born in year *t* during the famine period.

We estimate equations (2) and (3) for all children and separately for male and female children. This is important for two reasons. First, foetuses may differ by gender in their ability to withstand negative shocks of this scale, and in how they respond to them. Second, there may be differential investments in boys compared to girls because of social norms such as son preference. These nuances would be lost if we did not consider offspring outcomes differentiated by gender of the child.

Section 4.2. Tests of the identifying assumptions

We test the validity of the identifying assumptions in several ways and follow recent papers in this regard including Bharadwaj *et al*. (2020). First, we check for selection on observables for our sample of children with mothers born before or during the famine. If selection of this nature is present, births in famine years do not constitute a representative sample. To ensure that births in famine years are comparable to those in pre-famine years, we consider samples of children of respondents born in the pre-famine years (1954-1958) and during the famine (1959-1962) and test whether these samples differ on observables. This is accomplished by regressing famine treatment status, that is, mothers born in the pre-famine years or during the famine, on all child-specific and respondent-specific variables and province dummies, and then testing for the joint significance of child-specific controls. Table 3 reports the results of these tests.

The estimates in Table 3 confirm that children born to mothers who were born in the famine years are not systematically different from children born to mothers whose years of birth preceded the famine. Few of the child-specific variables are significant across the columns in this table, and F-tests results indicate that these variables are jointly insignificant[10]. Hence we are confident that the impacts we measure are attributable to the famine rather than to differences in child characteristics across these samples.

Second, an important assumption for the DID model is that of parallel trends. That is the treatment and control groups should have been on comparable (parallel) paths until the famine shock occurred, and should not have been diverging before then. To ensure this, we compare those whose mothers' were subject to more intense famine with those whose mothers' experienced the less intense famine in the pre-famine years (1954-1958). These results are presented in Table 4. Panel A presents child outcomes measures in places where mothers experienced less intense famine (column 1), in places where mothers experienced more intense famine (column 2), and the differences in the estimates across these two groups (column 3). Panel A shows that outcomes are essentially the same across these areas. The remaining panels of Table 4 further underline that the parallel trends assumption is valid. There is essentially no statistical difference in any child characteristics noted in Panel B across these groups. Panel C shows that this is also true for mother characteristics. Overall, Table 4 provides evidence in support of the parallel trends assumption.

To further ensure the lack of pre-trends, we estimate equation (3) where the outcome is that the child is currently working (a representative measure among all the outcomes we consider) and broaden the window of time to 1953-1963. We follow Bharadwaj *et al*. (2020) and estimate this more flexible model to provide evidence for the absence of pre-trends in children's work propensities between regions with more intense famine and regions with less intense famine.[11] Figure 3 plots the coefficients on the interaction of famine intensity and

[10] This is underlined by the F-statistic reported on the null hypothesis that these variables are jointly equal to zero at the bottom of Table 3. In particular, the *p*-values on these F-statistics cannot reject that these variables are jointly zero at the 5 percent level, that is, these samples do not differ.

[11] This slightly broader span of time is taken into consideration only to verify dynamics in time periods beyond the 1954-1962 window we condition on in the analysis. With this, the treatment years remain the same (1959-1962), but the control years are slightly widened to include 1953-1958 and 1963.

respondent's year of birth variables (γ_t) with their corresponding 95% confidence intervals, separately for boys and girls. It is clear from Figure 3 that prior to the famine, there was little to no difference in the work propensities of children in cities/prefectures that differed subsequently in terms of how intensely mothers experienced the famine. In Panel A that considers boys alone, in all years before the start of the famine, the plotted coefficients are not significantly different from zero. This is also true in Panel B for girls; although there is some evidence that the girls sample has greater heterogeneity since the 95% confidence intervals are somewhat larger in Panel B than in Panel A. The effect of the famine becomes evident in 1959 for girls. Figure 3 thus broadly indicates that areas with more intense famine were on a comparable trajectory in terms of child work propensities as compared to areas with less intense famine, before the famine occurred. Hence, the subsequent impacts that we document on this and other outcomes may be attributed to the famine alone.

Third, we check to ensure the absence of selective fertility in our study sample. That is, parents with characteristics that could potentially explain our results should not select into having children in the time-period we consider. For example, if mothers of low socio-economic status predominantly chose to have children during 1959-1962, then labour market impacts on progeny could be explained by this fact (as opposed to the famine). We first check this descriptively by utilizing life histories information in the data[12]. These data reveal that 93% of the respondents reported that the famine-induced food shortages did not result in behaviors such as putting off marriages, postponing fertility, inability to give birth and/or having an abortion. Next to test for selective fertility formally, we follow Buckles and Hungerman (2013) and Bharadwaj *et al.* (2020) to estimate equation (3) with mother and child characteristics as the outcomes. These results are presented in Table 5 and show that the

[12] The CHARLS implemented a separate Life History Survey in a subsequent wave which included questions related to experience with the famine. One question asked the respondents "During those days, did the food shortage result in any of the following for your family: put off marriage, put off giving birth, could not give birth, artificial abortion, or none of that".

famine had little impact on relevant characteristics that could in of themselves explain children's outcomes.[13] Across mother's age, mother's literacy status, mother's marital status, mother's household per capita income, and child-specific characteristics such as age, gender, marital status and Hukou type, most of the estimated coefficients on the interaction terms reported in Table 5 are insignificant.

Section 5. Results

Section 5.1. Intergenerational effects of *in-utero* famine exposure

We present our main results from estimating equations (2) and (3) in Tables 6, 7 and 8. Table 6 and Table 7 present results separately for female and male children; Table 8 reports results for the combined sample. Panel A shows results from equation (2) and Panel B from equation (3). Each column reports coefficients from a separate regression on specific outcome variables. All regressions include the full set of controls discussed above but we report only the key variables of interest (β_2 and γ_t) in Tables 6 through 8.

We begin by considering results for female children presented in Table 6. The first column relates to child's income level where we analyze the mid-points of finely defined income categories. Column (2) relates to child's educational attainment, specifically, whether the child has completed high school or higher. Column (3) indicates whether the child is current working while Column (5) indicates whether the child has ever worked before. Column (4) evaluates intergenerational income mobility. Results in Panel A of Table 6 report that daughters born to mothers who experienced severe famine *in utero* earn substantially less, are less likely to be currently working and are less likely to have ever worked before (these impacts are all statistically significant). In particular, such daughters have an income level that is 12,542 Yuan lower than their counterparts.[14] Further, their probability of

[13] These characteristics are somewhat distinct from the other variables that we test as mechanisms that underlie impacts on children. Please see below.
[14] At the 2011 exchange rate of US dollar 1 = 6 Yuan, this is about 2,100 US dollars.

currently working is 10.9% lower and their probability of ever having worked before is 8.2% lower as compared to the control group of daughters. The estimated effects on child's education and on child's income mobility are also negative and sizable in magnitude, though these estimates are measured with noise.

Panel B reports differential treatment effects of famine across various birth cohorts. Regarding child's income, girls of mothers born in 1959 earn 22,149 Yuan less; girls of mothers born in 1960 earn 14,236 Yuan less; and girls of mothers born in 1962 earn 11,766 Yuan less, as compared to their counterparts. Considering child work propensities, the probability of currently working is 35.4% lower for girls of mother born in 1959, whereas this probability is 11.6% lower (but insignificant) for girls of mother born in 1960. Daughters of mothers born in 1959 are 12.2% less likely to have ever worked before whereas for girls whose mothers were born in 1960, 1961 or 1962, the likelihood of ever having worked before is lower by 11.1%, 5.2% and 4.3%, respectively. Though the negative effects on education and income mobility were statistically insignificant when famine birth cohorts were grouped together in Panel A, upon disaggregation, significant impacts may be discerned in 1960 for education and in 1959 for income mobility. Daughters of mothers exposed to severe famine in 1959, 1961 and 1962 are less likely to complete high school or above, although these impacts are measured imprecisely. Similarly, daughters of mothers exposed to severe famine in 1960 are less likely to experience upward income mobility (measured with noise).

In sum, the intergenerational impacts of the famine on these labour market outcomes of daughters indicate that on average, income, education, work propensities, and income mobility are lower among daughters whose mothers were born during 1959-1962 in more severely affected regions as compared to daughters with mothers who do not have these characteristics. The overall negative effect on these outcomes may be attributed to daughters of mothers born in 1959 and 1960, where the latter was the most intense year of the famine.

Results for male children are presented in Table 7 and some effects resonate with those found in Table 6. Results in Panel A show that boys born to mothers who experienced severe famine earn less, are less likely to complete high school or above, and are less likely to have ever worked before (though none of these effects are significant). Considering effects disaggregated by maternal birth cohorts, boys of mothers born in 1961 earn 17,293 Yuan less than their counterparts, and the probability of completing high school education or higher is 17.1% lower for boys of mothers born in 1959. The estimated effects on work propensities and income mobility are insignificant for all birth cohorts. In comparison to Table 6, the effects in Table 7 for male children show fewer impacts. Taken together, the estimates in Tables 6 and 7 indicate that daughters experienced worse labour market outcomes on average as compared to sons.

Table 8 presents results for the combined sample of daughters and sons of mothers who survived the famine. Many of the results from the daughters sample in Table 6 are evident in Table 8. As before, negative impacts are mainly driven by children of mothers born in 1959 and 1960. In particular, children of mothers born in 1959 who experienced severe famine earn 16,797 Yuan less and are 16% less likely to work currently. They are also 11.2% less likely to have high school education or above, 16.6% less likely to experience upward income mobility, and 5.4% less likely to have ever worked before, as compared to their counterparts (these impacts are insignificant). Children of mothers who experienced severe famine in 1960 are less likely to have high school education or above. They also earn less, are less likely to work currently or to have worked before, and are less likely to experience upward income mobility (again, measured imprecisely). Given the relatively few precise estimates for sons in Table 7, we conclude that the impacts in Table 8 are mostly due to effects on daughters of treated mothers.

Section 5.2. Mechanisms

We consider two types of potential mechanisms that underlie estimated effects. The first works through human capital impacts of the famine on mothers themselves who were exposed *in utero*. The second works through potential marriage market sorting of these mothers. To check for the first mechanism type, we evaluate a set of mother-specific outcomes including education, an indicator for having difficulty walking, an indicator for having any chronic conditions, and the total number of chronic conditions. For the second type of mechanism, we consider similar human capital outcomes of the spouses of mothers. We estimate models for these outcomes of mothers and their spouses using similar DID specifications.

We present results on the impact of mothers' exposure to famine on their human capital in Table 9A. The results show that mothers who experienced severe famine are 8.2% less likely to complete high school or above, compared to their counterparts (column (1)). Looking at the disaggregated effect across different cohorts, treated mothers born in 1959 are 14.5% less likely to complete high school or above, and treated mothers born in 1960 are 10.9% less likely to attain this level. Similar negative effects are also evident for mothers born in 1961 and 1962 although these are not precisely estimated. Column (2) presents impacts on mother's probability of having any chronic conditions and column (3) reports results on log total number of chronic conditions. The probability of having any chronic conditions is higher for treated mothers though the effect is not precisely estimated in the combined sample. In Panel B, treated mothers born in 1960 are 14.4% more likely to have chronic conditions; similarly, treated mothers born in 1961 are 22.7% more likely to have chronic conditions. Mothers who experienced severe famine also have a higher number of chronic conditions. Columns (4) and (5) present effects on mother's likelihood of having difficulty walking and mother's likelihood of previously having had a stroke. There is evidence that treated mothers are on average 3% more likely to have had a stroke, and this may be attributed to mothers born in 1960. These results underline that the famine eroded mother's human capital.

We present results on the impact of maternal exposure to famine on their spouse's measures in Table 9B. Discussing results in Panels A and B concurrently, column (1) reports the effect of mother's exposure on father's treatment status. It shows that mothers' who were exposed to severe famine are about 4% more likely to marry fathers who were similarly exposed, though this effect is not statically significant. Columns (2) to (6) show that mothers who were exposed to severe famine tend to marry fathers with worse education outcomes but better health outcomes. Specifically, mothers exposed to severe famine have spouses with a reduced likelihood of completing high school (by an insignificant 5.8% in Panel A) and a reduced likelihood of having had a stroke (by a significant 3.2% in Panel A). The aggregate impacts in Panel A are consistent with the differentiated impacts in Panel B across the columns of Table 9B.

Section 5.3. Heterogeneity in results

We next consider heterogeneity in results. Individuals face labour market conditions that differ substantially across rural and urban areas in China, which might be an alternative explanation for the impacts we document. Therefore, it is useful to investigate whether labour market treatment effects vary by a child's Hukou status, that is, whether a child holds an agricultural Hukou or a non-agricultural Hukou. To accomplish this, we estimate specifications that include a triple interaction term between mother's treatment status, the famine severity measure, and child's Hukou type, while controlling for child's Hukou type separately. These results are reported in Table 10.

Panel A of Table 10 reports results for daughters while Panel B reports results for sons. Considering the impact on daughters' outcomes, child's Hukou type itself has a strong predictive power on child's income and education. On average, daughters who have an agricultural Hukou earn relatively 19,250 Yuan less and are 58% less likely to obtain high school education or above. This is as expected as ownership of a rural Hukou often results in lower education opportunities and welfare provision from the government. Further, estimates indicate that for daughters with agricultural Hukou, the detrimental effects of the famine on income and education are significant and similar to those in our main results, while for daughters with non-agricultural Hukou, these negative effects are even more pronounced. Adverse impacts on other outcomes are also evident but these are measured with error. The estimates in Table 10 underline that Hukou status does matter, and daughters with non-agricultural Hukou appear to fare worse than daughters with agricultural Hukou along the dimensions we study.

Results in Panel B show that child's Hukou type affects income and education for sons too. However, as in the main results, there are few intergenerational famine effects for sons' outcomes except for income. For sons with non-agricultural Hukou, the unfavorable famine effect on income is statistically significant and large. For sons with agricultural Hukou, the detrimental famine effect on income is still significant but smaller in magnitude. In sum, these results emphasize that if anything, children with non-agricultural Hukou are more severely affected than children with agricultural Hukou. We attribute this to the possibly selected sample of children with non-agricultural Hukou in our data. As we only include mothers born in rural areas, children with non-agricultural Hukou are those who migrated from rural areas to cities and changed their occupation from the traditional agricultural sector to non-agricultural work. Such migration might result in a mismatch of employment skills or worse outcomes for these children due to weaker access to support networks. Finally, the relatively small sample of children with non-agricultural Hukou in the data signals that we should interpret these results with less confidence.

Section 5.4. Robustness checks

We conduct robustness checks to assess how sensitive our results are to different measures of famine intensity. We begin by considering how results vary when we use the aggregate cohort size-based measure of famine exposure - province-level CSSI. Only results for the mother-daughter sample are reported in Table 11. Panel A indicates that overall, some of the patterns revealed by using the prefecture/city-level CSSI are overlooked when we utilize the aggregate province-level measure. There are also counter-intuitive signs on impacts. For instance, the probability of experiencing upward income mobility is positive for daughters with mothers born in 1961 but negative for daughters with mothers born in the year that immediately follows.

Panel B reports results when famine intensity is measured with province-level EDR constructed using the same methodology as in Chen and Zhou (2007). The only difference is that to improve clarity, we define EDR in its non-linear form where the indicator takes the value 1 if the underlying continuous EDR variable is equal to or exceeds the 75th percentile cut-off (similar to our definition of famine intensity based on the CSSI measure) and is 0 otherwise. Although there are fewer results for income using this measure, provincial EDR predicts intuitive results for many outcomes especially when it comes to work status of the child. However, as before, there are unexpected signs evident here. We conclude that all in all, the EDR measure commonly used in previous papers performs quite well. However, the CSSI measure reveals relatively more precisely measured important labour market effects, especially when disaggregated cohort results are taken into consideration. The aggregated patterns in Panels C and D follow this trend. Finally, upon comparing these results to our main results in Tables 6 through 8, we find that the latter reveal more echo effects that are in keeping with intuition and that are measured with less noise. In conclusion, it is reassuring to see similar results from these provincial-level exposure checks - though there is less of a signal, overall the signs are almost all (intuitively) negative especially for whether the child has ever worked before. Thus while our main results are not sensitive to the use of provincial EDR (the conventionally used famine measure), these results in Table 11 underline the importance of using an alternate lens to measure famine exposure as we do in this analysis.

We conclude this section by noting that we also test for unobserved trends that vary by region and maternal birth cohorts. Our results based on prefecture-level CSSI measures are about the same if birth prefecture/city-level fixed-effects are used in place of mother's birth province fixed-effects. Results also remain approximately in the same ballpark if we add interactions of mother's birth province fixed-effects and mother's birth year fixed-effects. Moreover, we obtain similar results to our main estimates in Tables 6 through 8 when the control group is modified to include the 1955-1958 and 1963-1966 birth cohorts.[15]

Section 5.5. Falsification test

We present falsification tests that serve to demonstrate the validity of our DID design. We accomplish this by selecting birth cohorts from 1953-1956 as our "treated" group and birth cohorts from 1949-1952 as "control".[16] The 1953-1956 time period preceded the famine and thus no treatment impacts should be evident. Table 12 confirms that this is the case. For child income, educational attainment, work propensities and income mobility indicators, interaction coefficients are all insignificant except for a single instance. However, this impact is in the unexpected direction. The results in Table 12 confirm that those documented in the

[15] The results for these three additional robustness checks are available on request.
[16] All we do is shift our previously selected time frame of 1954-1962 ahead by a random number of years, in our case, 6 years. The only modification is that instead of starting in 1948, we begin in 1949 to acknowledge the fact that Chairman Mao's coming to power in that year significantly changed political and economic institutions in China thereafter.

main results of Tables 6 to 8 may be attributed causally to the famine, and that there are few omitted variables that threaten validity.

Section 6. Conclusion

This study examines the intergenerational echo effect of the GLF famine on labour market indicators of children of female famine survivors born in rural areas who would have experienced prenatal malnutrition. We contribute to the literature by using an improved finer measure of famine exposure and rich data on those directly exposed and their progeny. Difference-in-differences estimates of child outcomes that include income, educational attainment, work propensities and intergenerational income mobility reveal that impacts are evident among the second generation today, almost sixty years after the famine. Our results underline that in sum, the famine exerted adverse intergenerational impacts, predominantly on daughters. Daughters of famine survivors fared much worse along the labour market dimensions we consider as compared to sons, perhaps reflecting a combination of positive selection of boys born to mothers who suffered prenatally and cultural aspects such as son preference. We find evidence that the negative echo impacts of the famine are transmitted to children mainly through adverse effects on mothers' human capital. We present tests that support the robustness of these results. Alternative estimates using province-level famine intensity measures demonstrate the importance of using finer prefecture-level variation in famine exposure, as we undertake in this study.

Evidence that this disaster has long-run detrimental consequences on the labour market outcomes of the second generation necessitates awareness and action to mitigate these effects. Without effective ameliorative strategies to support and remedy some of these harmful consequences, it is possible that the negative fallout of the GLF famine will be experienced by future generations as well. This is especially so as our analysis reveals that women in the second generation were relatively more affected as compared to men, and as is well understood in the literature, mother's health and well-being is of primary importance in ensuring the human capital success of her children.

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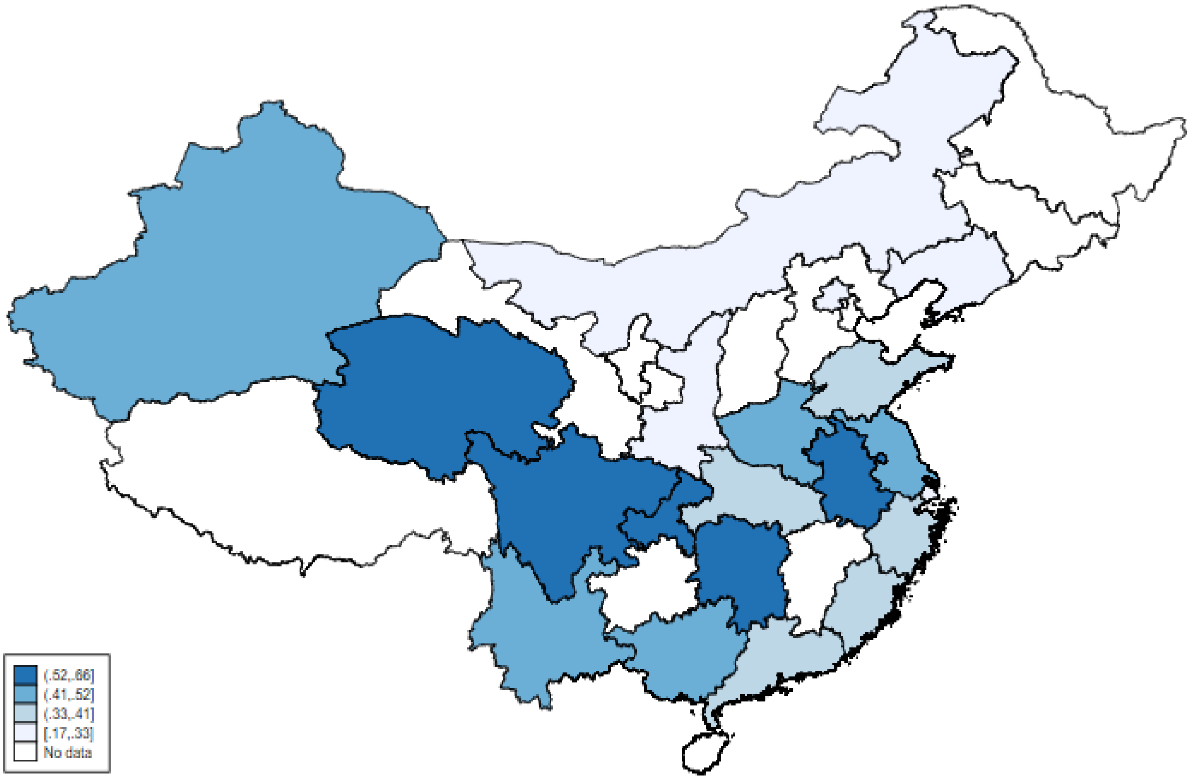
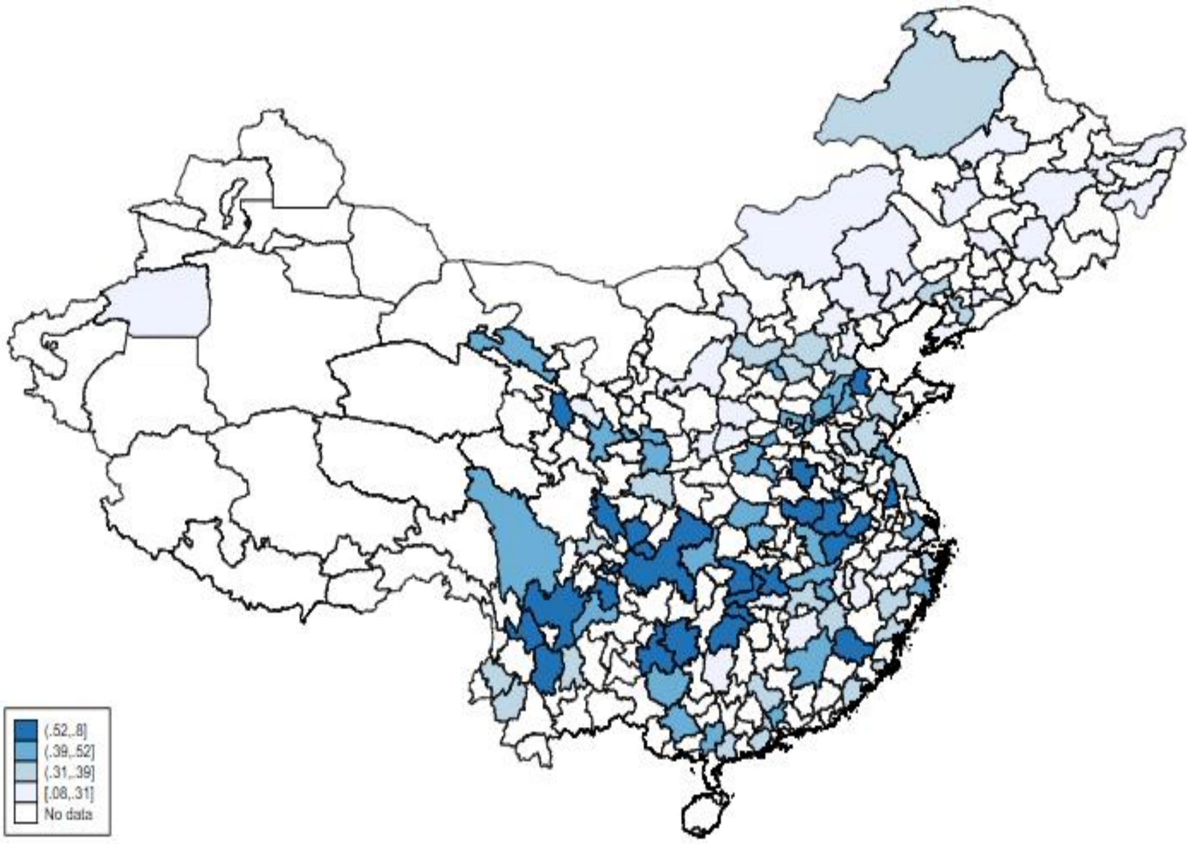
Figure 1: Provincial level cohort size shrinkage indices



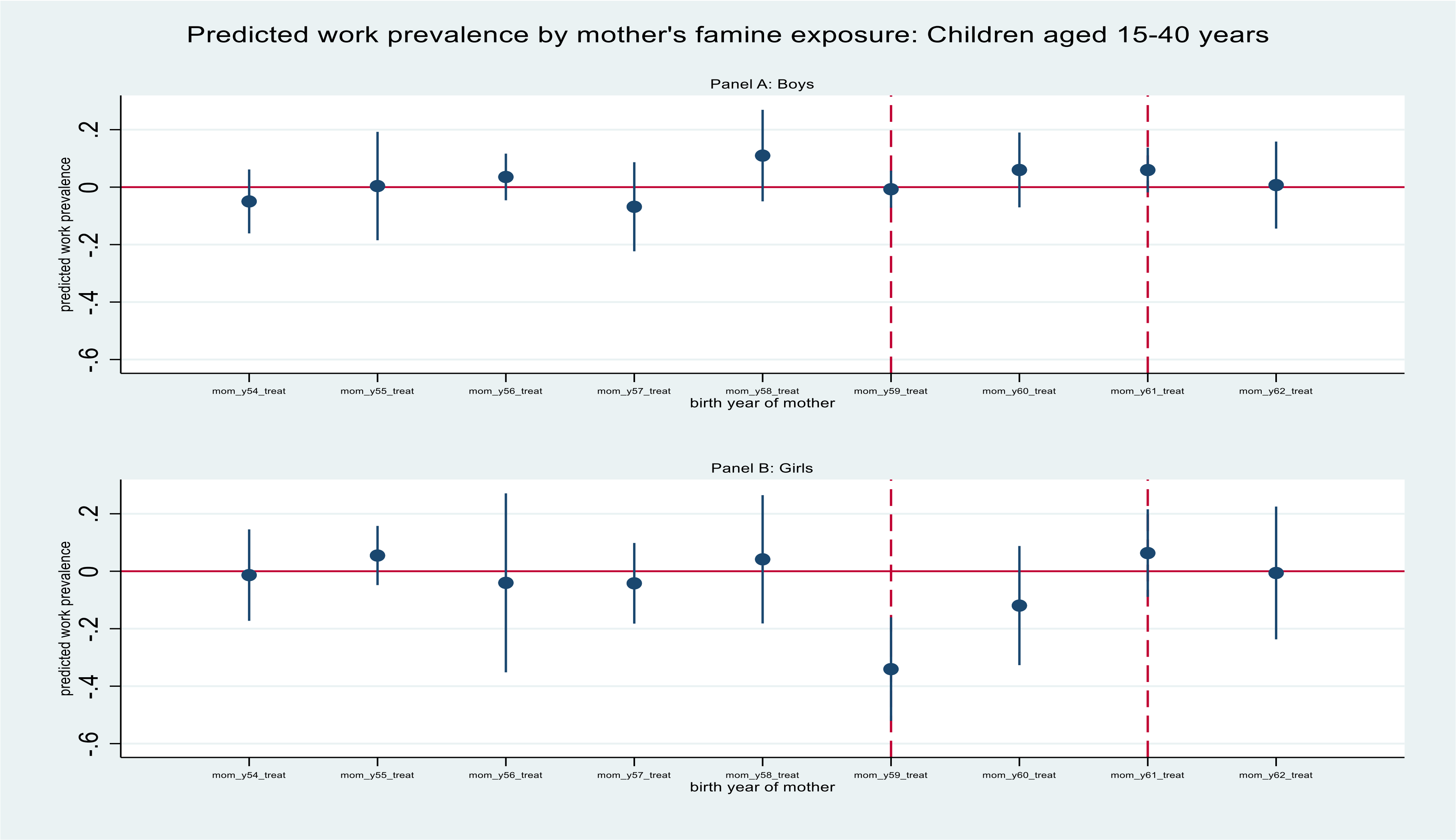
Note: Authors’ calculations.

Figure 2: Prefecture/city level cohort size shrinkage indices



Note: Authors’ calculations.

Figure 3: Impact of mother's famine exposure on children's predicted work prevalence: Check for pre-trends



Notes: Sample includes children born to respondents with year of birth in the 1953 to 1963 time window, whose birthplace was rural. Regressions include all child-specific characteristics such as age, age squared, birth order, Hukou status, and quarter of birth, and respondent-specific characteristics including mother's year of birth and mother's year of birth squared, and mother's birth cohort dummies from 1954 to 1962. Regressions include province fixed-effects and are weighted to national levels using weights provided in the CHARLS data. Standard errors are clustered by province. Each point is the interaction coefficient from a regression where birth cohort dummies from 1954 to 1962 are interacted with an indicator that mother's birth city CSSI is 75th percentile or higher in rural areas. Figure plots 95% confidence intervals.

Table 1: Summary statistics for children

	Male Children			Female Children			Combined		
	Mean	*Std. dev*	*N*	*Mean*	*Std. dev*	*N*	*Mean*	*Std. dev*	*N*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Child’s outcomes									
Child and spouse’s income categories middle point (in 1000 yuan)	23.498	25.374	2063	23.707	26.533	1765	23.592	25.901	3828
Child has completed high school or higher	0.301	0.459	2115	0.292	0.455	1874	0.297	0.457	3989
Child is currently working	0.892	0.310	2119	0.781	0.414	1878	0.841	0.366	3997
Child's income group is higher than parent's income group	0.260	0.439	2036	0.271	0.445	1753	0.265	0.441	3789
Child has ever worked before	0.920	0.272	2120	0.884	0.320	1879	0.903	0.295	3999
Panel B: Child-specific characteristics									
Child's age in years	27.666	5.038	2160	27.828	4.932	1916	27.741	4.989	4076
Child's age in years squared	790.757	282.696	2160	798.696	279.767	1916	794.432	281.337	4076
Child is male	1	0	2160	0	0	1916	0.537	0.499	4076
Child birth order is first born	0.405	0.491	2160	0.445	0.497	1916	0.423	0.494	4076
Child birth order is second born	0.356	0.479	2160	0.349	0.477	1916	0.353	0.478	4076
Child birth order is third born	0.160	0.366	2160	0.146	0.353	1916	0.153	0.360	4076
Child birth order is fourth born or higher	0.079	0.270	2160	0.060	0.238	1916	0.070	0.256	4076
Child's month of birth is in the first quarter	0.192	0.394	1052	0.262	0.440	1485	0.233	0.423	2537
Child's month of birth is in the second quarter	0.207	0.406	1052	0.176	0.381	1485	0.189	0.392	2537
Child's month of birth is in the third quarter	0.215	0.411	1052	0.237	0.425	1485	0.228	0.419	2537
Child's month of birth is in the fourth quarter	0.385	0.487	1052	0.325	0.469	1485	0.350	0.477	2537
Child has agricultural Hukou status	0.862	0.346	1870	0.857	0.350	1796	0.859	0.348	3666

Notes: Sample includes all children born to respondents with year of birth in the 1954 to 1962 time window, whose birthplace was rural. Statistics are weighted to national levels using weights provided in the CHARLS data. Column headings denote gender of the child.

Table 2: Summary statistics for mothers

	Mean	*Std. dev*	*N*
Panel A: Mother's famine exposure measures			
Birth city cohort size shrinkage index (CSSI)	0.421	0.131	1509
Birth city CSSI is 75th percentile or higher in rural areas	0.207	0.405	1509
Year of birth is 1954	0.136	0.343	1733
Year of birth is 1955	0.126	0.332	1733
Year of birth is 1956	0.107	0.309	1733
Year of birth is 1957	0.12	0.325	1733
Year of birth is 1958	0.107	0.31	1733
Year of birth is 1959	0.084	0.278	1733
Year of birth is 1960	0.081	0.273	1733
Year of birth is 1961	0.099	0.299	1733
Year of birth is 1962	0.139	0.346	1733
Panel B: Mother-specific variables			
Mother’s age in years	53.248	2.736	1733
Mother’s age in years squared	2842.855	290.42	1733
Mother completed high school or above	0.074	0.261	1730
Mother has any chronic conditions	0.686	0.464	1649
Number of mother’s chronic conditions	1.359	1.371	1649
Mother has difficulty walking	0.013	0.112	1655
Mother has had a stroke	0.013	0.112	1723

Notes: Sample includes all respondent mothers with year of birth in the 1954 to 1962 time window, whose birthplace was rural. Statistics are weighted to national levels using weights provided in the CHARLS data and report unique values for each respondent.

Table 3: Representativeness of samples of children born in the pre-famine and during famine years.

	Mothers born in pre-famine years (1)	Mothers born during famine (2)
Child's age in years	-0.006	-0.002
	(0.011)	(0.006)
Child's age in years squared	0.000	0.000
	(0.000)	(0.000)
Child is male	0.012	-0.001
	(0.015)	(0.011)
Child's birth order	0.002	-0.003
	(0.008)	(0.004)
Child has agricultural Hukou	-0.043	0.008
	(0.029)	(0.014)
Child's month of birth is in the second quarter	-0.008	0.030*
	(0.020)	(0.017)
Child's month of birth is in the third quarter	-0.017	0.021
	(0.017)	(0.020)
Child's month of birth is in the fourth quarter	-0.003	0.013
	(0.015)	(0.016)
Joint significance of child-specific controls (χ^2 (7))	0.710	0.700
	[0.684]	[0.691]
N	2,941	2,941
R-squared	0.603	0.806

Note: Sample includes children born to mothers with year of birth in the pre-famine years (1954-1958) or during the famine (1959-1962), whose birthplace was rural. Regressions include mother's year of birth, mother's year of birth squared, and a constant term. Regressions include province fixed-effects and are weighted to national levels using weights provided in the CHARLS data. Standard errors clustered by province are reported in parentheses. The square brackets denote the *p*-values of the χ^2 tests of the joint significance of the child-specific controls. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Prefecture/city level average of child and mother's characteristics in rural areas by mother's birth city CSSI indicator in the years before the famine (1954-1958).

	Famine was less intense (1)	Famine was more intense (2)	Difference (3)
Panel A: Child's outcomes			
Midpoint value of child and spouse's income category	22.100 (1.296)	26.490 (2.605)	-4.390 (2.678)
Child has completed high school or higher	0.273 (0.021)	0.265 (0.041)	0.009 (0.043)
Child is currently working	0.828 (0.019)	0.845 (0.041)	-0.017 (0.041)
Child has ever worked	0.891 (0.018)	0.913(0.042)	-0.022 (0.038)
Child's income group is higher than respondent's income group	0.327 (0.027)	0.332 (0.042)	-0.006 (0.053)
Panel B: Child-specific characteristics			
Child's age in years	29.469 (0.268)	29.516 (0.681)	-0.048 (0.605)
Child's age in years squared	892.243 (15.759)	902.357 (38.287)	-10.115 (34.907)
Child is male	0.533 (0.017)	0.552 (0.022)	-0.019 (0.032)
Child's birth order	1.886 (0.043)	1.757 (0.057)	0.128 (0.080)
Child has an agricultural Hukou	0.871(0.016)	0.833 (0.033)	0.038(0.034)
Child's month of birth is in the first quarter	0.236 (0.025)	0.239 (0.031)	-0.003 (0.047)
Child's month of birth is in the second quarter	0.184 (0.017)	0.221 (0.028)	-0.036 (0.034)
Child's month of birth is in the third quarter	0.238 (0.017)	0.226 (0.027)	0.013 (0.033)
Child's month of birth is in the fourth quarter	0.342 (0.018)	0.315 (0.036)	0.027 (0.038)
Panel C: Mother-specific characteristics			
Mother's year of birth	1955.821 (0.069)	1955.746 (0.160)	0.075 (0.151)
Mother's year of birth squared	3825238 (271.609)	3824946 (627.475)	291.687 (589.694)

Notes: Author's calculations. Columns report percentages unless otherwise specified. "Less intense" includes areas where the mother's birth city CSSI measure is lower than its 75th percentile value in rural areas, "more intense" includes areas where the mother's birth city CSSI measure was the 75th percentile value or higher in rural areas. Statistics reported for all years before the famine (1954-1958) and include rural areas as per the mother's place of birth. Weighted to national levels with weights provided in the CHARLS data. Standard errors in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Tests for selective fertility

	Mother's age (1)	Mother is illiterate (2)	Mother is married (3)	Mother's HH income pc (4)	Child's age (5)	Child is male (6)	Child is married (7)	Child has ag. Hukou (8)
Mother's birth city CSSI is 75th percent.	0.319*	-0.039	0.012	4,178.096*	1.737**	0.043**	-0.002	-0.087
or higher in rural areas (INTFAM)	(0.186)	(0.082)	(0.055)	(2,148.974)	(0.801)	(0.020)	(0.055)	(0.052)
INTFAM x birth1959	-0.147	-0.240	-0.104	206.558	-0.381	0.110*	0.093*	-0.059
	(0.242)	(0.168)	(0.156)	(4,345.397)	(0.769)	(0.060)	(0.053)	(0.100)
INTFAM x birth1960	-0.277	-0.103	-0.226	-2,892.055	-0.282	-0.053	0.038	-0.053
	(0.275)	(0.131)	(0.223)	(2,368.049)	(0.926)	(0.078)	(0.068)	(0.094)
INTFAM x birth1961	-0.233	-0.041	0.085	-4,626.147	-0.416	-0.119	-0.017	0.033
	(0.229)	(0.111)	(0.114)	(4,258.187)	(0.989)	(0.076)	(0.102)	(0.048)
INTFAM x birth1962	-0.143	-0.125	0.128*	-7,053.277	-0.363	-0.010	-0.024	-0.038
	(0.186)	(0.100)	(0.072)	(4,597.824)	(1.164)	(0.082)	(0.071)	(0.052)
Constant	55.308***	0.657***	0.891***	2,213.495***	30.175***	0.499***	0.858***	0.956***
	(0.065)	(0.035)	(0.025)	(778.706)	(0.293)	(0.009)	(0.025)	(0.019)
N	1,678	1,678	1,678	1,659	3,597	3,566	3,525	3,230
R-squared	0.847	0.145	0.046	0.084	0.223	0.010	0.076	0.040

Note: Sample includes children born to mothers with year of birth in the 1954 to 1962 time window, whose birthplace was rural. Regressions include birth cohort dummies from 1959 to 1962, province fixed-effects, and are weighted to national levels using weights provided in the CHARLS data. Standard errors clustered by province are reported in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Intergenerational impacts of mother's exposure to famine on labour market outcomes of female children

	Midpoint of child and spouse's income category (1)	Child has high sch. or higher (2)	Child is currently working (3)	Child's income group is higher than resp. income group (4)	Child has Ever Worked (5)
Panel A					
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	9.559***	0.030	0.069	0.086	0.134*
	(3.283)	(0.070)	(0.060)	(0.091)	(0.068)
INTFAM x birth 1959-1962	-12.542***	-0.110	-0.109***	-0.082	-0.082**
	(3.013)	(0.083)	(0.033)	(0.101)	(0.036)
N	1,189	1,284	1,277	1,180	1,278
R-squared	0.185	0.241	0.100	0.078	0.154
Panel B					
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	9.291**	0.025	0.076	0.085	0.137*
	(3.570)	(0.071)	(0.061)	(0.098)	(0.071)
INTFAM x birth1959	-22.149*	-0.059	-0.354***	-0.254**	-0.122
	(11.749)	(0.210)	(0.087)	(0.113)	(0.100)
INTFAM x birth1960	-14.236**	-0.170*	-0.116	-0.124	-0.111
	(5.755)	(0.084)	(0.111)	(0.125)	(0.098)
INTFAM x birth1961	0.362	-0.190	0.062	0.216	-0.052
	(4.377)	(0.124)	(0.061)	(0.144)	(0.032)
INTFAM x birth1962	-11.766***	-0.052	-0.018	-0.051	-0.043
	(2.469)	(0.081)	(0.074)	(0.100)	(0.031)
N	1,189	1,284	1,277	1,180	1,278
R-squared	0.192	0.243	0.110	0.089	0.160
Child-specific variables	Y	Y	Y	Y	Y
Mother-specific variables	Y	Y	Y	Y	Y
Mother birth province FE	Y	Y	Y	Y	Y

Note: Sample includes female children born to female respondents with year of birth in the 1954 to 1962 time window, whose birthplace was rural. Regressions include all child-specific characteristics such as age, age squared, child with agricultural Hukou status, birth order and quarter of birth, and mother-specific characteristics including birth year, birth year squared. Regressions include maternal birth province fixed-effects and are weighted to national levels using weights provided in the CHARLS data. Standard errors clustered by maternal birth province are reported in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Intergenerational impacts of mother's exposure to famine on labour market outcomes of male children

	Midpoint of child and spouse's income category (1)	Child has high sch. or higher (2)	Child is currently working (3)	Child's income group is higher than resp. income group (4)	Child has ever worked (5)
Panel A					
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	1.422	0.057	-0.028	0.070	0.013
	(3.857)	(0.054)	(0.051)	(0.053)	(0.024)
INTFAM x birth 1959-1962	-6.775	-0.071	0.043	0.040	-0.015
	(5.366)	(0.094)	(0.053)	(0.100)	(0.034)
N	861	904	904	847	905
R-squared	0.261	0.292	0.227	0.178	0.255
Panel B					
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	0.633	0.060	-0.029	0.066	0.014
	(3.478)	(0.049)	(0.051)	(0.053)	(0.025)
INTFAM x birth1959	-10.332	-0.171**	0.002	-0.063	-0.031
	(6.810)	(0.082)	(0.035)	(0.147)	(0.023)
INTFAM x birth1960	-2.277	-0.037	0.068	-0.046	0.002
	(12.805)	(0.117)	(0.062)	(0.220)	(0.058)
INTFAM x birth1961	-17.293**	-0.124	0.075	0.067	0.032
	(8.042)	(0.229)	(0.051)	(0.237)	(0.028)
INTFAM x birth1962	0.434	0.077	0.035	0.058	-0.033
	(5.724)	(0.110)	(0.088)	(0.113)	(0.068)
N	861	904	904	847	905
R-squared	0.281	0.320	0.231	0.182	0.256
Child-specific variables	Y	Y	Y	Y	Y
Mother-specific variables	Y	Y	Y	Y	Y
Mother birth province FE	Y	Y	Y	Y	Y

Note: Sample includes male children born to female respondents with year of birth in the 1954 to 1962 time window, whose birthplace was rural. Regressions include all child-specific characteristics such as age, age squared, child with agricultural Hukou status, birth order and quarter of birth, and mother-specific characteristics including birth year, birth year squared. Regressions include maternal birth province fixed-effects and are weighted to national levels using weights provided in the CHARLS data. Standard errors clustered by maternal birth province are reported in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Intergenerational impacts of mother's exposure to famine on labour market outcomes of children (both genders combined)

	Midpoint of child and spouse's income category (1)	Child has high sch. or higher (2)	Child is currently working (3)	Child's income group is higher than resp. income group (4)	Child has ever worked (5)
Panel A					
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	6.062**	0.046	0.035	0.085	0.080*
	(2.642)	(0.050)	(0.036)	(0.054)	(0.045)
INTFAM x birth 1959-1962	-10.441***	-0.099	-0.039	-0.036	-0.047
	(3.724)	(0.063)	(0.028)	(0.087)	(0.028)
N	2,050	2,188	2,181	2,027	2,183
R-squared	0.190	0.250	0.093	0.090	0.147
Panel B					
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	5.675**	0.047	0.036	0.083	0.083*
	(2.647)	(0.048)	(0.037)	(0.056)	(0.046)
INTFAM x birth1959	-16.797*	-0.112	-0.160**	-0.166	-0.054
	(8.564)	(0.117)	(0.075)	(0.105)	(0.063)
INTFAM x birth1960	-8.610	-0.136**	-0.051	-0.079	-0.068
	(6.543)	(0.055)	(0.086)	(0.125)	(0.075)
INTFAM x birth1961	-7.890	-0.180	0.066*	0.121	-0.015
	(5.510)	(0.143)	(0.036)	(0.163)	(0.025)
INTFAM x birth1962	-7.435***	-0.003	0.001	-0.000	-0.044
	(2.482)	(0.078)	(0.043)	(0.085)	(0.041)
N	2,050	2,188	2,181	2,027	2,183
R-squared	0.197	0.259	0.098	0.095	0.150
Child-specific variables	Y	Y	Y	Y	Y
Mother-specific variables	Y	Y	Y	Y	Y
Mother birth province FE	Y	Y	Y	Y	Y

Note: Sample includes both male and female children born to female respondents with year of birth in the 1954 to 1962 time window, whose birthplace was rural. Regressions include all child-specific characteristics such as age, age squared, child with agricultural Hukou status, birth order and quarter of birth, and mother-specific characteristics including birth year, birth year squared. Regressions include maternal birth province fixed-effects and are weighted to national levels using weights provided in the CHARLS data. Standard errors clustered by maternal birth province are reported in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 9A: Potential mechanisms- impacts of mother's exposure to famine on their own outcomes

	Having high sch. or higher	Having any chronic conditions	ln(number of chronic conditions)	Having difficulty walking	Had a stroke before
	(1)	(2)	(3)	(4)	(5)
Panel A					
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	0.012	-0.007	-0.054	-0.011	-0.020***
	(0.020)	(0.065)	(0.063)	(0.009)	(0.004)
INTFAM x birth 1959-1962	-0.082***	0.125	0.191**	0.014	0.030**
	(0.027)	(0.085)	(0.086)	(0.013)	(0.013)
N	1,513	1,439	1,439	1,440	1,503
R-squared	0.066	0.054	0.072	0.032	0.026
Panel B					
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	0.011	-0.005	-0.054	-0.010	-0.020***
	(0.020)	(0.064)	(0.063)	(0.009)	(0.004)
INTFAM x birth1959	-0.145**	0.158	0.197	0.048	0.007
	(0.052)	(0.131)	(0.128)	(0.040)	(0.009)
INTFAM x birth1960	-0.109**	0.144**	0.166	-0.006	0.107*
	(0.043)	(0.069)	(0.125)	(0.012)	(0.058)
INTFAM x birth1961	-0.067	0.227*	0.249*	0.012	0.003
	(0.061)	(0.122)	(0.124)	(0.007)	(0.014)
INTFAM x birth1962	-0.028	0.066	0.178	0.000	0.022
	(0.028)	(0.111)	(0.116)	(0.011)	(0.027)
N	1,513	1,439	1,439	1,440	1,503
R-squared	0.069	0.059	0.075	0.036	0.035
Mother-specific variables	Y	Y	Y	Y	Y
Mother birth province FE	Y	Y	Y	Y	Y

Note: Sample includes female respondents with year of birth in the 1954 to 1962 time window, whose birthplace was rural. Regressions include mother-specific exogenous characteristics including birth year, birth year squared, and mother's birth province fixed-effects and are weighted to national levels using weights provided in the CHARLS data. Standard errors clustered by province are reported in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 9B: Potential mechanisms- impacts of mother's exposure to famine on her spouse's outcomes

	Spouse's birth city CSSI is 75th percentile or higher	Having high sch. or higher	Having any chronic conditions	ln(number of chronic conditions)	Having difficulty walking	Had a stroke before
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	0.917***	-0.001	-0.043	-0.007	-0.028	0.017
	(0.023)	(0.042)	(0.033)	(0.044)	(0.018)	(0.010)
INTFAM x birth 1959-1962	0.044	-0.058	-0.022	0.041	0.006	-0.032**
	(0.036)	(0.052)	(0.052)	(0.064)	(0.007)	(0.013)
N	1,356	1,382	1,322	1,322	1,341	1,374
R-squared	0.882	0.102	0.063	0.064	0.071	0.026
Panel B						
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	0.919***	-0.002	-0.047	-0.015	-0.028	0.016
	(0.021)	(0.044)	(0.034)	(0.049)	(0.018)	(0.010)
INTFAM x birth1959	-0.009	-0.047	-0.029	0.002	0.004	-0.048**
	(0.058)	(0.081)	(0.104)	(0.084)	(0.014)	(0.023)
INTFAM x birth1960	0.074	-0.139**	-0.373***	-0.427***	0.017*	-0.033**
	(0.046)	(0.052)	(0.085)	(0.083)	(0.009)	(0.013)
INTFAM x birth1961	0.115***	-0.224*	0.037	0.043	-0.000	-0.021*
	(0.038)	(0.122)	(0.138)	(0.154)	(0.006)	(0.010)
INTFAM x birth1962	0.029	0.077	0.077	0.235**	0.003	-0.028*
	(0.057)	(0.046)	(0.068)	(0.093)	(0.011)	(0.014)
N	1,356	1,382	1,322	1,322	1,341	1,374
R-squared	0.883	0.119	0.075	0.082	0.072	0.035
Mother-specific variables	Y	Y	Y	Y	Y	Y
Mother birth province FE	Y	Y	Y	Y	Y	Y

Note: Sample includes female respondents with year of birth in the 1954 to 1962 time window, whose birthplace was rural. Regressions include mother-specific exogenous characteristics including birth year, birth year squared, and mother's birth province fixed-effects and are weighted to national levels using weights provided in the CHARLS data. Standard errors clustered by province are reported in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Heterogeneity in intergenerational famine impacts on offspring labour market outcomes by child's Hukou status (agricultural vs. non-agricultural Hukou).

	Midpoint of child and spouse's income category	Child has high sch. or higher	Child is currently working	Child's income group is higher than resp. income group	Child has ever worked
	(1)	(2)	(3)	(4)	(5)
Panel A. Impact on daughters					
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	9.420***	0.023	0.068	0.087	0.132*
	(3.224)	(0.073)	(0.059)	(0.090)	(0.067)
INTFAM x birth 1959-1962	-21.741***	-0.467***	-0.149	-0.024	-0.185
	(4.347)	(0.155)	(0.155)	(0.186)	(0.128)
Child having agricultural Hukou	-19.250***	-0.580***	0.003	-0.002	-0.004
	(3.624)	(0.048)	(0.047)	(0.069)	(0.030)
INTFAM x birth 1959-1962 x child agricultural Hukou	11.383***	0.443***	0.050	-0.073	0.128
	(3.949)	(0.147)	(0.180)	(0.143)	(0.137)
N	1,189	1,284	1,277	1,180	1,278
R-squared	0.187	0.251	0.101	0.078	0.156
Panel B. Impact on sons					
Birth city CSSI is 75th percentile or higher in rural areas (INTFAM)	1.800	0.057	-0.027	0.071	0.013
	(3.746)	(0.054)	(0.052)	(0.053)	(0.024)
INTFAM x birth 1959-1962	-24.983**	-0.104	0.027	0.013	-0.021
	(9.463)	(0.192)	(0.034)	(0.171)	(0.027)
Child having agricultural Hukou	-20.423***	-0.592***	-0.028	-0.055	-0.011
	(3.740)	(0.033)	(0.022)	(0.059)	(0.021)
INTFAM x birth 1959-1962 x child agricultural Hukou	21.731***	0.041	0.020	0.032	0.007
	(7.429)	(0.187)	(0.049)	(0.143)	(0.036)
N	861	904	904	847	905
R-squared	0.267	0.292	0.227	0.178	0.255
Child-specific variables	Y	Y	Y	Y	Y
Mother-specific variables	Y	Y	Y	Y	Y
Mother birth province FE	Y	Y	Y	Y	Y

Note: Sample includes male and female children born to female respondents with year of birth in the 1954 to 1962 time window, whose birthplace was rural. Regressions include all child-specific characteristics such as age, age squared, birth order and quarter of birth, and mother-specific characteristics including birth year, birth year squared. Regressions include maternal birth province fixed-effects and are weighted to national levels using weights provided in the CHARLS data. Standard errors clustered by maternal birth province are reported in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 11: Intergenerational famine impacts of mother's exposure on labour market outcomes of daughters using province-level exposure.

	Midpoint of child & spouse's income category (1)	Child has high sch. or higher (2)	Child is currently working (3)	Child's income group is higher than resp. income group (4)	Child has ever worked (5)
Panel A					
Birth province CSSI is 75th per.	16.160**	0.065	0.138	0.376*	-0.076**
or higher in rural areas (INTFAM)	(7.814)	(0.089)	(0.375)	(0.188)	(0.029)
INTFAM x birth1959	-10.196	-0.172***	-0.213**	-0.135	-0.074
	(11.505)	(0.060)	(0.084)	(0.101)	(0.102)
INTFAM x birth1960	-14.974***	-0.113	-0.050	-0.029	-0.108
	(4.612)	(0.082)	(0.113)	(0.123)	(0.089)
INTFAM x birth1961	5.708	-0.086	0.089	0.387***	-0.027
	(4.728)	(0.094)	(0.077)	(0.107)	(0.035)
INTFAM x birth1962	-7.693***	-0.054	0.016	-0.080	-0.044
	(2.460)	(0.065)	(0.054)	(0.094)	(0.042)
Panel B					
Birth province EDR is 75th per.	2.951**	-0.071***	-0.043**	-0.053	0.064***
or higher in rural areas (EDR)	(1.323)	(0.024)	(0.017)	(0.039)	(0.014)
EDR x birth1959	-16.285*	-0.152**	-0.156*	-0.177	-0.115*
	(8.319)	(0.061)	(0.076)	(0.116)	(0.059)
EDR x birth1960	-10.040	-0.184**	-0.180**	-0.074	-0.179*
	(6.516)	(0.080)	(0.077)	(0.113)	(0.090)
EDR x birth1961	1.796	-0.097	0.129**	0.274*	-0.045
	(3.096)	(0.110)	(0.060)	(0.137)	(0.030)
EDR x birth1962	-4.013	0.000	-0.104**	-0.084	-0.102**
	(3.976)	(0.034)	(0.048)	(0.116)	(0.043)
Panel C					
Birth province CSSI is 75th per.	16.696**	0.067	0.143	0.415**	-0.073***
or higher in rural areas (INTFAM)	(7.526)	(0.090)	(0.376)	(0.195)	(0.025)
INTFAM x (birth1959-birth1962)	-7.132**	-0.100**	-0.031	0.015	-0.066
	(3.316)	(0.042)	(0.047)	(0.092)	(0.046)
Panel D					
Birth province EDR is 75th per.	5.185***	-0.074***	-0.057**	-0.087*	0.092***
or higher in rural areas (EDR)	(1.764)	(0.022)	(0.022)	(0.045)	(0.021)
EDR x (birth1959-birth1962)	-5.923*	-0.086*	-0.079*	-0.027	-0.111**
	(3.219)	(0.047)	(0.046)	(0.112)	(0.040)

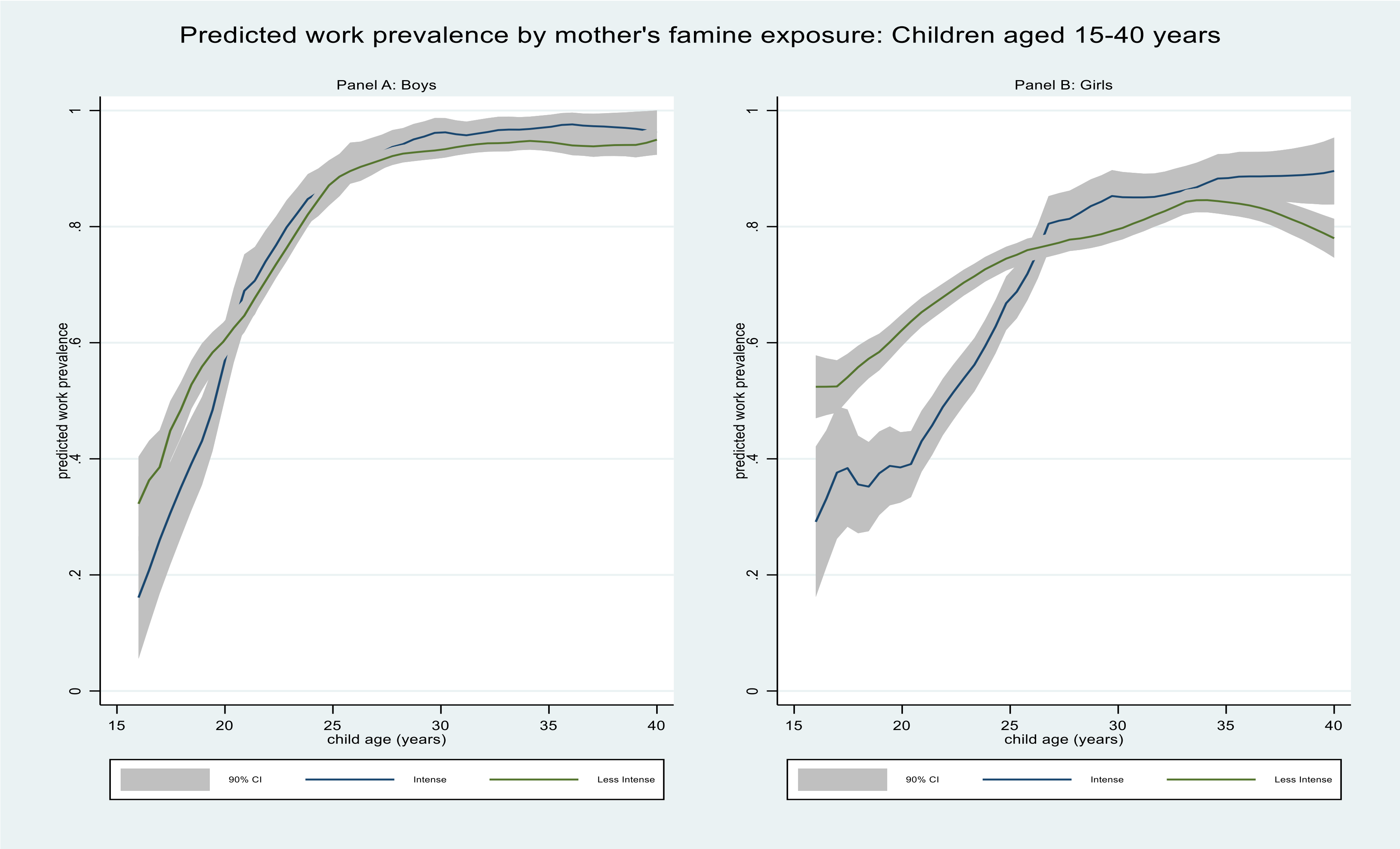
Note: Sample includes children born to mothers with year of birth in the 1954 to 1962 time window, whose birthplace was rural. Regressions include child-specific characteristics such as age, age squared, birth order, Hukou status, and quarter of birth, and mother-specific characteristics including mother's year of birth and mother's year of birth squared, and birth cohort dummies from 1959 to 1962. Regressions include a constant term and province fixed-effects, and are weighted to national levels using weights provided in the CHARLS data. Standard errors clustered by province are reported in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 12: Intergenerational famine impacts of mother's exposure on labour market outcomes of daughters: Falsification test.

	Midpoint of child & spouse's income category	Child has high sch. or higher	Child is currently working	Child's income group is higher than resp. income group	Child has ever worked
	(1)	(2)	(3)	(4)	(5)
Birth city CSSI is 75th percentile	3.137	-0.041	0.001	0.056	0.035
or higher in rural areas (INTFAM)	(6.026)	(0.054)	(0.044)	(0.081)	(0.038)
INTFAM x birth1953	-1.100	0.002	0.022	0.138	0.045
	(6.194)	(0.055)	(0.049)	(0.151)	(0.040)
INTFAM x birth1954	3.066	0.109*	0.013	-0.034	0.055
	(6.715)	(0.059)	(0.056)	(0.082)	(0.038)
INTFAM x birth1955	1.741	-0.091	0.076	0.184	0.036
	(6.007)	(0.059)	(0.059)	(0.219)	(0.052)
INTFAM x birth 1956	-2.332	0.042	-0.046	0.011	0.002
	(4.523)	(0.086)	(0.160)	(0.138)	(0.034)
Constant	-6945192.468	140,386.200	-59,757.675	-72,025.656	67,924.525
	(5689327.884)	(91,122.384)	(123,021.467)	(94,379.652)	(51,390.306)
N	1,486	1,644	1,638	1,482	1,640
R-squared	0.154	0.332	0.097	0.085	0.089

Note: Sample includes children born to respondents with year of birth in the 1949 to 1956 time window, whose birthplace was rural. Regressions include child-specific characteristics such as age, age squared, birth order, Hukou status and quarter of birth, and respondent-specific characteristics including mother's year of birth, mother's year of birth squared, and birth cohort dummies from 1953 to 1956. Regressions include province fixed-effects and are weighted to national levels using weights provided in the CHARLS data. Standard errors clustered by province are reported in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Appendix Figure 1: Impact of mother's famine exposure on children's predicted work prevalence



Notes: Sample includes children born to respondents with year of birth in the 1949 to 1969 time window, whose birthplace was rural. Graphs are weighted to national levels using weights provided in the CHARLS data. "Intense" denotes areas where mother's birth city CSSI has a value that is higher than the 75th percentile or higher in rural areas, "less intense" denotes areas where mother's birth city CSSI is less than its 75th percentile value in rural areas. Figure plots 90 percent confidence intervals.

Appendix Table 1: Mean value of city cohort size shrinkage (CSSI) indices

Province	City	CSSI	Province	City	CSSI	Province	City	CSSI
Anhui	Anqing	0.685	Hunan	Changde	0.546	Sichuan	Meishan	0.689
Anhui	Bozhou	0.546	Hunan	Loudi	0.585	Sichuan	Mianyang	0.632
Anhui	Chaohu	0.800	Hunan	Shaoyang	0.546	Sichuan	Nanchong	0.641
Anhui	Fuyang	0.546	Hunan	Yiyang	0.558	Sichuan	Neijiang	0.629
Anhui	Huainan	0.331	Hunan	Yueyang	0.613	Sichuan	Yibin	0.632
Anhui	Liuan	0.711	Jiangsu	Lianyungang	0.418	Tianjin	Tianjin	0.462
Chongqing	Chongqing	0.586	Jiangsu	Suzhou	0.544	Xinjiang	Akesu	0.071
Fujian	Fuzhou	0.388	Jiangsu	Yancheng	0.340	Yunnan	Baoshan	0.332
Fujian	Ningde	0.375	Jiangsu	Yangzhou	0.540	Yunnan	Chuxiong	0.552
Fujian	Putian	0.339	Jiangxi	Ganzhou	0.403	Yunnan	Kunming	0.381
Fujian	Zhangzhou	0.356	Jiangxi	Jingdezhen	0.381	Yunnan	Lijiang	0.378
Gansu	Dingxi	0.498	Jiangxi	Jiujiang	0.400	Yunnan	Lincang	0.358
Gansu	Pingliang	0.514	Jiangxi	Nanchang	0.457	Yunnan	Zhaotong	0.387
Gansu	Zhangye	0.449	Jiangxi	Shangrao	0.253	Zhejiang	Huzhou	0.308
Guangdong	Guangzhou	0.405	Jiangxi	Yichun	0.351	Zhejiang	Lishui	0.394
Guangdong	Jiangmen	0.385	Jilin	Siping	0.267	Zhejiang	Ningbo	0.380
Guangdong	Maoming	0.377	Liaoning	Anshan	0.389	Zhejiang	Taizhou	0.384
Guangdong	Qingyuan	0.377	Liaoning	Chaoyang	0.248			
Guangdong	Foshan	0.405	Liaoning	Dalian	0.305			
Guangdong	Shenzhen	0.446	Liaoning	Jinzhou	0.381			
Guangxi	Guilin	0.586	Neimenggu	Chifeng	0.119			
Guangxi	Hechi	0.515	Neimenggu	Hulunbuir	0.264			
Guangxi	Nanning	0.445	Neimenggu	Xilingol	0.163			
Guangxi	Yulin	0.334	Qinghai	Haidong	0.568			
Guizhou	Qiandongnan	0.564	Shaanxi	Baoji	0.238			
Guizhou	Qiannan	0.536	Shaanxi	Hanzhong	0.347			
Hebei	Baoding	0.315	Shaanxi	Weinan	0.254			
Hebei	Chengde	0.207	Shaanxi	Yulin	0.108			
Hebei	Shijiazhuang	0.349	Shandong	Binzhou	0.546			
Heilongjiang	Jixi	0.133	Shandong	Dezhou	0.510			
Henan	Anyang	0.514	Shandong	Jinan	0.405			
Henan	Jiaozuo	0.437	Shandong	Liaocheng	0.426			
Henan	Pingdingshan	0.448	Shandong	Linyi	0.302			
Henan	Puyang	0.519	Shandong	Weihai	0.427			
Henan	Xinyang	0.501	Shandong	Zaozhuang	0.347			
Henan	Zhengzhou	0.475	Shanxi	Linfen	0.174			
Henan	Zhoukou	0.549	Shanxi	Xinzhou	0.178			
Hubei	Enshi	0.522	Shanxi	Yangquan	0.456			
Hubei	Huanggang	0.446	Shanxi	Yuncheng	0.238			
Hubei	Jingmen	0.407	Sichuan	Ganzi	0.463			
Hubei	Xiangfan	0.396	Sichuan	Liangshan	0.549			

Notes: Sample includes mothers with year of birth in the 1959 to 1962 time window, whose birthplace was rural. Table reports weighted means. Author's calculations.