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Parental Unemployment and Child Health in China

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ABSTRACT

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This paper studies the causal effect of maternal and paternal unemployment on child health in China, analyzing panel data for the period 1997-2004, when the country underwent economic reforms leading to massive layoffs. We find that paternal unemployment reduces child health, while maternal unemployment has beneficial child health impacts. Analysis of channels shows that paternal and maternal unemployment have different effects on income, time use, mothers' blood pressure, and certain health investments, including children's diets. Our results support the notion that traditional gender roles can explain why mothers' and fathers' unemployment affect child health so differently.

NON-TECHNICAL SUMMARY

When parents lose their job, this can affect the health of children through several channels. The loss of income typically has negative health effects, as spending on health care, food, etc. may decline. However, the increase in time available for child care (and other activities that indirectly benefit children's health) may improve child health. In this paper we show, using data from China for the period 1997-2004, that children's health deteriorates when their father becomes unemployed. Yet when their mother becomes unemployed, their health improves. We show that this difference is likely to be caused by the fact that households lose more income when the father loses his job, as working dads earn much more than working moms. Furthermore, mothers are primarily responsible for domestic duties and child care, and therefore maternal unemployment is more likely to improve child health through changes in time use. The negative effects of paternal unemployment on child health in China are a cause for concern, given recent announcements by the Chinese government indicating an expected 1.8 million layoffs in the coal and steel industry.

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1 Introduction

Healthy development of children is an important concern across societies, as illustrated by the Sustainable Development Goals' targets for reducing child stunting and wasting. Despite considerable gains in height and weight amongst children, estimates suggest that in 2015, 50 million infants (7.5%) were wasted and 159 million infants (23.8%) were stunted (UNICEF-WHO-The World Bank Group, 2015). Moreover, a vast amount of evidence suggests that childhood health influences health and economic outcomes later in life (Case and Paxson, 2010; Currie et al., 2010; Almond and Currie, 2011), so that any economic shock or policy reform that impacts children's health has potentially long lasting economic and social impacts.

An important channel through which macroeconomic conditions and policy reforms affect child health is through parental employment. The association between parental employment and child health can be explained from a simple model of child health production, where parents invest both time inputs and material inputs in child health (Currie, 2009). A loss of employment is typically associated with income and substitution effects that operate in different directions (Ferreira and Schady, 2009). Unemployment will lower income available for spending on market goods, including health care, non-household child care, and nutritious consumption, whilst lowering the opportunity cost of time so that we might observe increases in home-produced and time-intensive health investments.

Available evidence on the child health impacts of macroeconomic conditions indeed suggests an important role for parental employment, particularly mothers' labor supply. Bhalotra (2010) shows that in rural India, infant mortality is counter-cyclical, because recessions push rural women (but not men) into the agricultural labor force and reduce their use of health care. On the other hand, Miller and Urdinola (2010) find that child mortality in Colombia is pro-cyclical, as reductions in the global coffee price are associated with lower employment for women and increases in prenatal care and child vaccinations.[1] It thus appears that sub-

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[1] Further available evidence suggests that infant mortality in the US is pro-cyclical (Dehejia and Lleras-Muney, 2004), and being born during a recession improves childhood health in Western Europe (Angelini and Mierau, 2014)

stitution effects associated with changes in maternal employment dominate the child health impacts of macroeconomic cycles, but the existing studies do not provide direct evidence on the causal effect of paternal and maternal employment on child health in developing countries.

Differences in the impacts of maternal and paternal unemployment on children have been studied in most detail in relation to child schooling outcomes. Ruiz-Valenzuela (2015), investigating the impact of the Great Recession in Spain, finds that fathers' unemployment negatively affects child attainment in school whilst unemployment of mothers has no statistically significant effect. Rege, Telle and Votruba (2011), using plant closures in Norway, find that fathers' job loss leads to a substantial decline in children's graduation-year grade point average whilst mothers' job loss leads to non-significant improvements in school performance. They argue this is consistent with recent evidence suggesting men suffer an increase in mental distress as a result of job loss, and that maternal job loss induces less mental distress than paternal job loss (Eliason and Storrie, 2009; Kuhn, Lalive and Zweimuller, 2009). They also suggest that the positive effect of maternal job loss indicates that mothers respond by allocating greater attention towards child rearing. Kalil and Ziol-Guest (2008) reach similar conclusions from the analysis of children's academic progress in the US.

In this paper we analyze how paternal and maternal unemployment affect the health of children aged 0-17 in China. During the period 1990 – 2010 the percentage of stunted and underweight children under 5 in China fell from 32% and 13%, respectively, to 9.4% and 4%, but large regional and socio-economic disparities remain (WHO, 2014a). We analyze child health in the period 1997 to 2004, when China underwent widespread and far-reaching economic reforms. The labour market impacts of these reforms have been documented widely (e.g. Cai, Park and Zhao, 2008; Meng, 2012). As the reforms led to massive layoffs and sharp reductions in labour force participation rates, it provides an excellent setting to study the child health impacts of parental unemployment in a developing country context.

Our paper is closely related to two recent studies on parental unemployment and child health in the US and Sweden. Schaller and Zerpa (2015), using panel data for children

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aged 1-16 from the US medical expenditure survey, find that paternal unemployment reduces parent-rated child physical and mental health, while increasing the likelihood of depression and anxiety. Maternal unemployment also reduces parent-rated child health, but reduces the incidence of infectious diseases and the use of prescription drugs. The unemployment effects are identified based on child fixed effects and a focus on displacements due to business closures. Evidence based on administrative data from Sweden (Mork, Sjogren and Svaleryd, 2014) shows that maternal unemployment is associated with a small increase in hospitalization of children aged 3-18, while paternal unemployment has no significant effect. Mork, Sjogren and Svaleryd (2014) control for child fixed effects in their estimations, but as they are not able to distinguish different causes of unemployment, their estimates might be confounded. Job loss may be correlated with unobserved time-varying determinants of child health, for example if parents of children with poor health progression are more likely to quit work, or if parental productivity shocks affect both job loss and child health (Rege, Telle and Votruba, 2011).

We use the China Health and Nutrition Survey (CHNS), a panel survey with individual and household level data, including measures of health, nutrition, income, and employment. Availability of anthropometric and biomarker data for children is an important advantage of the CHNS data: unlike Schaller and Zerpa (2015) and Mork, Sjogren and Svaleryd (2014), we do not have to rely on medical care utilization or parent-rated health measures that may confound health with other determinants of diagnosis and treatment.

In a third recent paper closely related to ours, also analyzing the Chinese case with use of the CHNS data, Liu and Zhao (2014) find a negative association between child health and both fathers' and mothers' recent job loss (the event of losing one's job, rather than being jobless) during the period 1991-2006. However, a number of weaknesses in their empirical analysis, which we discuss in more detail below, cast doubt on the validity of the results, and similar to Mork, Sjogren and Svaleryd (2014) the causal effect of job loss on child health is not identified.

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Our analysis includes individuals across eight provinces for the period 1997 to 2004, when we observe a strong reduction in employment rates, in line with trends reported from other data sources for China. We estimate child fixed effects models and instrument parental unemployment using sex-specific employment rates in the household's county or city of residence. The identification thus comes from spatial variation in the employment impacts of the reforms. Similar approaches, exploiting regional labor market fluctuations, have been used in the analysis of schooling choices (Pinger, 2015) and returns to education (Carneiro, Heckman and Vytlacil, 2011), among others.

In line with Schaller and Zerpa (2015), we find that paternal unemployment leads to worse child health outcomes; it increases the incidence of underweight and stunting, and increases children's blood pressure. On the other hand, the coefficients for maternal unemployment are negative for underweight and stunting, and mothers' joblessness significantly lowers children's blood pressure and the probability that a child has been sick or injured in the last four weeks.

To assess the channels through which unemployment affects child health, we estimate the impact of unemployment on household income, time use of parents and children, and parents' blood pressure (as a proxy for their mental distress). Our results suggest that all three channels play a role in the differential health impacts of maternal versus paternal unemployment. Fathers' unemployment leads to greater income loss and increases mothers' blood pressure, while maternal unemployment reduces children's time on domestic chores and reduces her own blood pressure. Though income and time use are not measured accurately in our data, and our estimates are imprecise, the results are in line with the notion that traditional gender roles drive the differential unemployment impacts of mothers and fathers: descriptive statistics for our estimation sample confirm that women earn less than men and spent considerably more time on caring for young children and on domestic chores.

Turning to particular health investments, we find some evidence that maternal unemployment increases children's dietary diversity score (an indicator of the nutrient adequacy of diets), whereas paternal unemployment reduces children's dietary diversity score, and sig-

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nificantly reduces the intake of fats. To the best of our knowledge, this is the first study to investigate the causal effect of parental unemployment on the quality of children's diets, and the results suggest that this is one of the channels through which paternal unemployment reduces child growth.

The rest of the paper is organized as follows. Section 2 discusses the reforms in China and evidence of their impact on employment, and briefly outlines the theoretical framework. Section 3 describes the data, section 4 describes the methodology, and section 5 and 6 discuss the main results and analysis of heterogeneity. Section 7 concludes.

2 Context and theoretical framework

2.1 China's Economic Reforms and the Labor Market

In this paper we focus on China's State Owned Enterprise reforms in the second half of the 1990s, which had major impacts in the labor market. In 1994, the Chinese government initiated the privatization of small and medium State Owned Enterprises (SOEs), but initially, the government maintained tight control of worker lay-offs (Cai, Park and Zhao, 2008). The end of guaranteed employment followed when, in 1997, a more aggressive SOE restructuring program was implemented to deal with the sector's unsustainable financial situation. As a result, millions of workers were laid off from the state and collective sector through dismissals and forced early retirement. The labor force participation rate declined drastically, especially among women and the population aged 40 to 60 (Giles, Park and Cai, 2006; Cai, Park and Zhao, 2008). According to Zhang et al. (2008), who use data from the China Urban Household Survey for the period 1988-2004, the employment rate of men and women aged 16 to 60 fell from around 96 percent in 1997 to 89 percent (men) and 80 percent (women) in 2003. The rates reported in Zhang et al. (2008) are plotted in Figure 1. SOE restructuring has most strongly affected industries with highly competitive markets or depleted resources. The traditional industrial bases in the Northeast and Northwest were therefore the hardest

hit regions, with the majority of layoffs occurring in Liaoning, Jilin, Heilongjiang, Hubei, Hunan, Henan, and Sichuan provinces (Dong, 2003).

Figure 1
Urban employment rate, 1988-2004
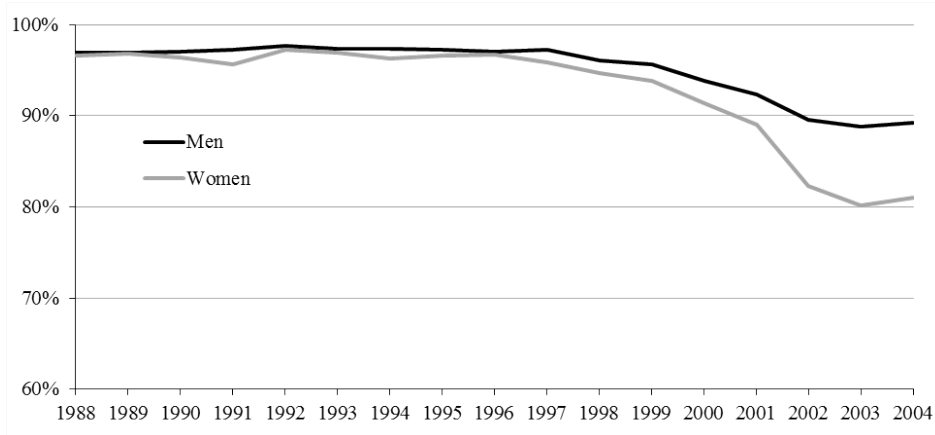
Source: China Urban Household Survey, as presented in Zhang et al. (2008, Table 1a)

In 1998 the Chinese government implemented a special social assistance program, providing subsidies, training, and job search assistance to workers laid-off under the SOE restructuring program. However, data collected in five Chinese cities by Giles, Park and Cai (2006) show that these public programs had limited coverage and that most unemployed relied on the support of other members in their household and on their own savings. Hence, becoming unemployed during this period meant a significant economic shock to the individual and his or her household.

2.2   Theoretical framework

To assess the child health impacts of parental unemployment, it is useful to start from the standard economic model of child health production as described by Currie (2009), in which child health is a source of household utility. Parents use both time inputs and material inputs to invest in child health; child health at time t further depends on past health, on exogenous productivity shifters, and on permanent individual productivity shifters. Productivity shifters affect the amount of health obtained from a given amount of health inputs: an example is

years of formal schooling (Grossman, 2000).

In this framework, parental unemployment will affect child health through a number of channels. First of all, it reduces the income available for spending on market goods such as health care, non-household child care, and nutritious consumption. This may reduce the quantity as well as the quality of material child health inputs. Second, unemployment reduces the opportunity cost of time so that we might observe increases in the quantity and quality of home-produced and time-intensive health investments. Third, as described by Schaller and Zerpa (2015) and Rege, Telle and Votruba (2011), unemployment may affect child health through parental stress, by reducing the quality of parental time investments and parents' child health productivity, or by a direct negative effect on child mental health.

Each of these channels can play a role in explaining why maternal unemployment would affect child health differently than paternal unemployment. Firstly, because fathers tend to have higher earnings than mothers, the income loss associated with paternal unemployment is typically greater. The increase in parental time investments in child health, on the other hand, might be greater for women, given traditional gender roles dictating that mothers are primarily responsible for child care and other household tasks (Kalil and Ziol-Guest, 2008; Rege, Telle and Votruba, 2011). Traditional gender roles can also mediate the impact of unemployment on psychosocial stress, as suggested by evidence of stronger gender differences in mental health effects of unemployment between married men and women than between single men and women (Artazcoz et al., 2004).

3 Data

The analysis uses the China Health and Nutrition Survey (CHNS), an open cohort panel survey.[2] The data covers nine provinces and three province level municipalities and was collected in nine waves between 1989 and 2011. We we use data for 8 provinces that were included in the three waves of 1997, 2000, and 2004, the period we analyze; Guangxi, Guizhou,

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[2]See http://www.cpc.unc.edu/projects/china for information on and access to the data.

Heilongjiang, Henan, Hubei, Hunan, Jiangsu, and Shandong.[3] Figure 2 shows the provinces used in the analysis; they vary in terms of geographical location, demographics, economics and health indicators.[4]

Figure 2
Map of provinces in analysis

Province in sample
Province not in sample
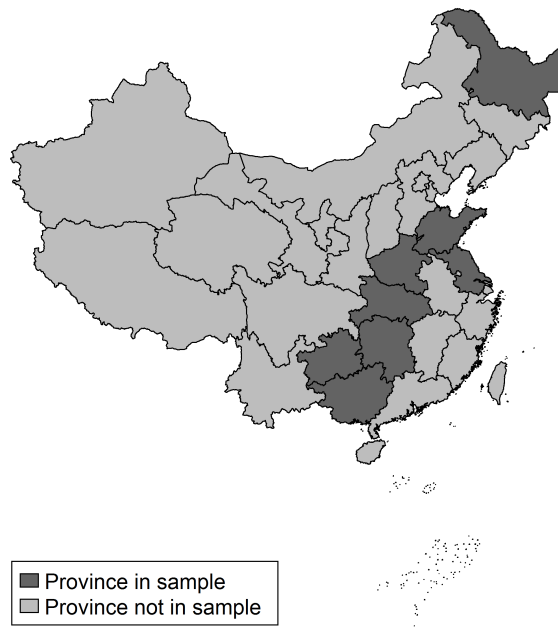
The data contain comprehensive measures of health and diets, as well as information on demographic and socioeconomic characteristics, income, and time use. We discuss the measures used in our analysis below, and provide summary statistics on the main variables in Table 1.

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[3]An additional province, Liaoning, was unfortunately dropped from the analysis in one of our rounds of interest - 1997 - and thus is not used in the analysis. In 2011, three province level municipalities were added to the sample: Beijing, Shanghai, and Chongqing. These areas are not included in our data due to no information being available for our period of interest.

[4]Despite this, the sample was not intended to be a representative sample of the whole of China, though there is some evidence to suggest that characteristics of households and individuals in the data are comparable to those from national samples (Chen et al., 2015).

TABLE 1

Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Age	9.987	3.913	0	17	4090
Boy	0.542	0.498	0	1	4090
Weight for age z-score	-0.849	1.117	-4.93	3.638	4090
Height for age z-score	-0.91	1.127	-4.906	3.395	4090
Underweight	0.149	0.356	0	1	4090
Stunted	0.171	0.376	0	1	4090
Sick or injured during last 4 weeks	0.044	0.205	0	1	4035
Systolic blood pressure z-score	-0.493	1.048	-3.87	4.917	3295
Diastolic blood pressure z-score	0.298	0.782	-2.113	3.878	3293
Hypertensive	0.055	0.229	0	1	3289
Any immunizations last 12 months	0.799	0.401	0	1	2084
Any preventive health service last 4 weeks	0.065	0.247	0	1	3916
Log carbohydrates (g)	5.509	0.438	1.351	6.577	3924
Log fat (g)	3.784	0.682	-0.916	5.18	3897
Log proteins (g)	3.892	0.43	1.125	4.928	3909
Log energy (kcal)	7.413	0.392	4.359	8.339	3916
Dietary diversity	4.03	0.969	1	6	3927
Mother jobless	0.158	0.365	0	1	4090
Father jobless	0.065	0.247	0	1	4090
Household income (2011 Yuan)	18786.9	16605.9	-19769.2	199004.4	4051
Household income per capita	4490.6	4281.9	-3953.8	66334.8	4051
Child's time on chores (minutes per day)	7.342	24.649	0	250	3505
Mother's time on chores	149.501	94.873	0	654	4090
Father's time on chores	25.279	47.691	0	300	4090
Health insurance	0.187	0.39	0	1	3973

Notes: Blood pressure is measured only for children aged 7 and older. Children's time on chores is recorded only for children aged 6 and older. Immunizations are recorded only for children younger than 12.

3.1 Health and nutrition

The CHNS collects a number of indicators of health status of children and parents. We use height and weight of children, an indicator for whether they have been sick or injured in the last four weeks, and measures of blood pressure for both parents and children. Anthropometric outcomes and blood pressure are measured by trained health professionals, avoiding bias associated with self-reported measures of health.

Height- and weight-for-age z-scores are calculated with reference to US child growth stan-

dards.[5] Height reflects the impact of all inputs into child health up to the period studied; it is generally regarded as a good marker of nutritional status, with deficits reflecting long-term, cumulative, insufficient inputs to health (WHO, 1995). Weight captures contemporaneous health and reflects both muscle and fat content; this can change rapidly according to nutrition. We also calculate an indicator for underweight (weight-for-age < 2 s.d. below reference mean) and one for stunting (height-for-age < 2 s.d. below reference mean). According to these indicators, 15 per cent of children in our sample are underweight, and 17 per cent of children are stunted (Table 1).

Blood pressure is a measure of overall cardiovascular health. Studies have shown that there is a strong link between psychosocial stress and hypertension and other cardiac disease (Kaplan and Nunes, 2003; Rozanski et al., 2005), with the proposed mechanism being that chronic stress affects blood pressure levels through interactions between the sympathetic nervous system and hormones (McEwen, 2006; Rainforth et al., 2007). The WHO has argued that socioeconomic factors such as "unemployment or fear of unemployment may have an impact on stress levels that in turn influences high blood pressure." (WHO, 2013, p.19).

Blood pressure amongst children varies according to age, sex and height; we therefore standardize children's blood pressure into z-scores using blood pressure standardization formula provided by the US National Institutes of Health (NIH, 2005). We also investigate impacts on hypertension of children, defined as blood pressure larger than the 95th percentile.[6] There is evidence that, amongst younger children, poor family environment is associated with heightened cardiovascular reactivity to stress (Repetti, Taylor and Seeman, 2002) and this is proposed as one mechanism through which elevated blood pressure of children is associated with lower socioeconomic status (Chen, Matthews and Boyce, 2002). There is also evidence

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[5]Z-scores are calculated using the Stata command -zanthro- and the US 2000 CDC growth reference. A WHO reference is available as well, but allows calculating height-for-age z-scores only for children age 0-10, which is a smaller age range then we use in our estimations. Our results for height-for-age are robust to using the WHO reference, which produces very similar z-scores.

[6]Yan et al. (2013) show that reference diastolic blood pressure levels for Chinese children have similar 95th percentile values compared to the US reference tables, and differences for systolic blood pressure are small.

that elevated resting blood pressure in children can result from exposure to conflict and negative social interactions (Evans et al., 2013). Blood pressure readings are available only for children aged seven or above; three measurements of blood pressure are recorded, and we use the average of these three in our analysis.

Besides current health, health insurance coverage and use of any preventive health services during the past four weeks are reported for children of all ages, as well as the type of service received. Almost 19 percent of children have medical insurance, and 5.5 per cent received some type of health service during the past four weeks. In almost 85% of cases where a child received a health service, this was a general health or child health examination. It is not clear, however, to what extent these examinations are truly used for preventive care, rather than (part of) diagnosis or treatment. For children younger than 12, the survey further records whether any immunizations were received during the past 12 months, which was the case for almost 80 per cent of children under 12 in our sample.

Child nutrition is a health investment that is also likely to be affected by parents' income and time use. While there are studies on the relationship between maternal employment and breastfeeding (see, for example, Baker and Milligan (2008)), we are not aware of studies that analyze the effect of parental unemployment on nutrition of older children. Children's height-for-age and weight-for-age z-scores are typically used as indicators of their nutritional status, but individual level data on nutrition are usually not available. The CHNS, however, includes data on dietary intake for three consecutive days (randomly allocated from Monday to Sunday) for all individuals, including food consumed at home and away from home. Macronutrient intake values based on these dietary data – average daily intake of protein, fat, carbohydrates, and total energy – are available in the public use CHNS data. In addition, we calculate dietary diversity scores, with use of China's 1991, 2002, and 2004 Food Composition Tables. First, all foods consumed are grouped into six food categories. These are starches; vegetables and fruit; meat and fish; eggs; legumes, nuts and seeds; and milk and milk products. Next, the dietary diversity score is calculated as the number of

different food groups that were consumed over the past three days, ranging from zero to six. Dietary diversity scores reflect the nutrient adequacy of diets, and although they have been validated for different countries and age groups, there is no international consensus on the number and type of food groups to include in the scores for different age groups (FAO, 2010). Recent evidence for children age 1 to 9 in South Africa suggests that scores based on 6, 9, 13, and 21 food groups are all highly correlated to micronutrient diet adequacy and significantly correlated with height-for-age and weight-for-age (Steyn et al., 2014). The average score in our sample is 4.03, with a standard deviation of close to 1.

3.2 Employment, income, and time use

The CHNS further collects employment details and income of all persons aged 16 and older (18 and older as of the 2004 wave), as well as household level farming and non-farm business income. In our analysis, we consider a work status transition from working to not working as job loss. This includes dismissals as well as retirement and voluntary quits. While the CHNS data does include information on whether a person is looking for a job, we cannot observe the reason why someone quit working. If we would include as unemployed only those actively searching for work, we would exclude all so-called discouraged workers. Discouraged workers are formally not part of the labor force and therefore not officially considered unemployed, but we prefer to include them in our analysis, as large scale economic reforms are likely to increase disguised unemployment through discouragement.

In the CHNS sample, the employment rate as a fraction of the labor force (i.e. excluding any discouraged workers) declined by three to four percentage points between 1997 and 2004 (Figure 3(a)), with a slightly stronger decline for men than women. Employment rates stabilize after 2004. Figure 3(b) shows that employment as a fraction of the population (including discouraged workers) fell by 12 percentage points for men and 15 percentage points for women between 1997 and 2004.[7] Though the direct impact of the reforms was strongest

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[7]All employment rates reported here are based on the male population age 25-55 and female population age 25-50.

in urban China and most research on the impacts of SOE restructuring has focused on urban labor markets, we find similar trends in employment rates in the urban and rural sample (Figure 4). The trend is less pronounced in the rural sample, but still shows a reduction of about 10 percentage points between 1997-2004. Besides the trends in the CHNS data, competition for jobs between urban workers and rural migrants as well as some degree of labor market integration between the public, collective, and private sectors (Dong and Bowles, 2002), suggest that rural workers were not isolated from the reforms. We therefore include both urban and rural families in our analysis. In our estimation sample, mothers are jobless in 15.8 per cent of child-wave observations and fathers in 6.5 per cent.

Figure 3
Employment rates CHNS data, 1993-2011

(a) Employment share of labor force   (b) Employment share of population
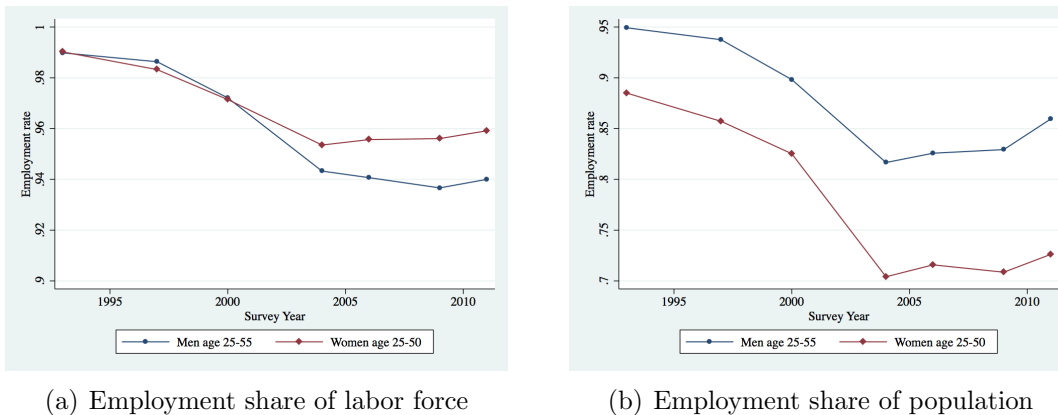
Unfortunately, household and individual income are poorly measured in the CHNS, with around 30% of observations on household income consisting of imputed values where data was missing. For individual wage income, which is available only for workers who receive a regular salary, some 10% of values are imputed.[8] For completeness, we do analyze the effects of unemployment on household income, but these estimates should be interpreted with caution. We do not analyze the effects on individual income, because earnings are not available for those who do not receive a regular salary, but among those who receive a regular

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[8]Imputations have been made by the CHNS. While the data include indicators for whether any part of income was imputed, we do not have access to the original income data. We thus use the income data including any imputations made. Values are in 2011 Yuan.

Figure 4

Rural and urban employment rate (% of population) CHNS data, 1993-2011
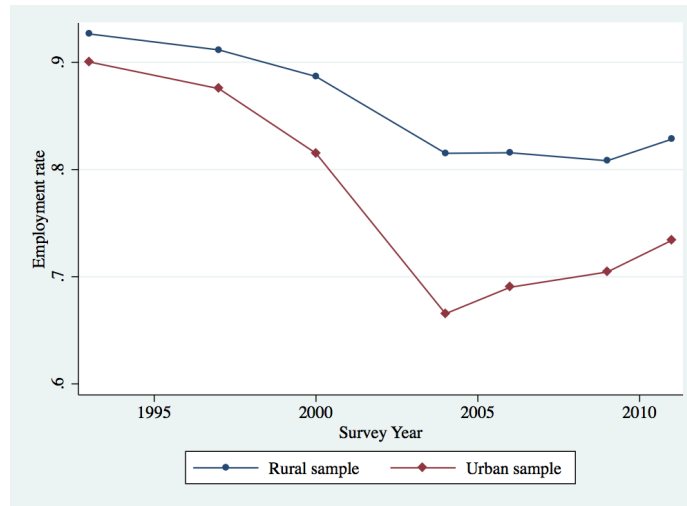
salary, fathers in our sample earn about 25% more (10,700 Yuan per month) than mothers (8,400 Yuan). We thus expect that households will experience greater income losses with paternal unemployment than with maternal unemployment.

Time use data is collected for all individuals aged 6 and older. Rather than a full time use survey, individuals report average minutes per day during the past week spent on each of four domestic activities: buying food for the household, preparing and cooking food for the household, washing and ironing clothes, and cleaning the house. Children aged 6 and older spend on average 7.4 minutes per day on domestic chores, while mothers spend 2.5 hours per day and fathers spend 25 minutes.

Though time spent on child care is also recorded, this only relates to care for children aged 6 and younger, so that our sample is too small to analyze effects of unemployment on child care. It is useful to note, however, that mothers of young children in our sample are much more likely to care for these children than fathers are, and also spend more hours per week: for children younger than age 6 in the 1997 CHNS wave, 74 per cent of mothers indicate they spend time on child care, compared to 38 percent of fathers. Conditional on providing any child care, mothers spend on average 13.9 hours per week while fathers spend 6.1 hours per week. Overall, as the time use of mother and fathers shows a strong traditional

gender division of household work, we expect to find that maternal unemployment has greater time use effects benefiting child health, while inducing less psychosocial stress than paternal unemployment, as discussed in Section 2.2.

4   Methodology

Our specification of interest is:

$$H_{ijt} = \alpha_i + \beta_1 Jobless_{ijt}^f + \beta_2 Jobless_{ijt}^m + \beta_3 X_{ijt} + \beta_4 \gamma_t + \beta_5 Y_{ijt} \gamma_t + \epsilon_{ijt} \tag{1}$$

Our dependent variable H_{ijt} is health of child i born in household j, observed in wave t (1997, 2000, or 2004). Our primary health measures of interest are height-for-age and weight-for-age z-scores. We further analyze indicators for underweight and stunting, whether the child was sick or injured during the past four weeks, and standardized systolic and diastolic blood pressure. Our explanatory variables of interest are indicators for whether the father (f) or mother (m) was jobless in wave t. We estimate child fixed effects models (α_i), to account for time-invariant characteristics at the child level such as inherent healthiness. Note we do not know exactly *when* parents lose their job, only whether they are jobless in survey wave t, so that our FE results, rather than estimating the 'instantaneous' effect of unemployment, capture the average effect of unemployment with a duration of 1 day up to 4 years (the maximum time period between consecutive survey waves) on current health.

We include a vector of time varying child and parent controls X_{ijt} including age of the child, age of both parents, and number of children in the household. Survey wave fixed effects (γ_t) are included in all specifications, controlling for China-wide changes in child health. We report separate estimates that also include controls for initial household wealth and parental education, interacted with dummies for survey wave ($Y_{ijt}\gamma_t$).[9] Wealth and education can

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[9]To measure household wealth, we use an asset index based on housing conditions and ownership of vehicles

be considered productivity shifters in the production of child health, affecting the level of child health produced for given levels of material and time inputs (see Glewwe (1999); Currie (2009)). Differential trends in health according to parents' education and wealth thus capture differences in the impacts of macroeconomic changes on child health. As productivity shifters may similarly affect impacts of unemployment on child health, we also analyze heterogeneity by household socio-economic status. This is discussed in Section 6.

Identification within this framework relies on the assumption that job loss is uncorrelated with unobserved time-varying child health determinants, which may not be the case. For example, an unobserved (to the researcher) deterioration in child health could increase the likelihood of parents voluntarily quitting their job. We exploit spatial variation in the labor market impacts of the reforms to instrument parental job loss. Fathers' employment status is instrumented by the male employment rate in the household's city (urban) or county (rural) of residence; similarly, we instrument maternal employment status using the city- and county-level female employment rate.[10] This identification strategy relies on the assumption that employment shocks in the local labor market affect child health outcomes only through parental employment. Note that permanent local labor market conditions are controlled for through the child fixed effects. Similar approaches, exploiting regional labor market fluctuations, have been used in the analysis of schooling choices (Pinger, 2015) and returns to education (Carneiro, Heckman and Vytlacil, 2011), among others.[11]

We restrict our sample to children for whom height and weight are recorded and who were born in or before 1997 (the first wave we use) and no older than age 17. Above the age of 17, the percentage of children who have moved out of their parental household increases substantially. Their health indicators are not collected: we thus use the upper age limit

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and durable goods. The index is calculated using polychoric principal components analysis, as described in Ward (2014).

[10]Our estimation sample contains 48 cities and counties, and in all estimations we report standard errors clustered at the city/county level.

[11]Note that we do not control for lagged child health, as we would lose a large fraction of our estimation sample and we would need to instrument for lagged health given the inclusion of child fixed effects. However, our main interest is in the effect of parental job loss, and the potential correlation of lagged child health with job loss would be addressed through the instrumental variable estimation.

to prevent selection bias associated with the endogenous decision of children to leave their parental household. For the fixed effects estimations we need to observe each child at least twice, which gives a total of 6,288 child-wave observations. We further exclude 541 observations where the parents reach retirement age (50 years old for women; 55 years old for men) before 2004, to focus as much as possible on joblessness unrelated to retirement. The same age limits are used in construction of the instruments. Finally, we include only children with both parents reporting their work status and with both parents present in the household.[12] Our final estimation sample includes at most 4,191 child-waves.[13]

As mentioned in the introduction, the link between parental job loss and child health in China has also been analyzed by Liu and Zhao (2014), who use CHNS data for the period 1991 to 2006 and find that paternal and maternal job loss both reduce child health, but the effect of maternal job loss is statistically insignificant. An important conceptual difference with the present paper is that (Liu and Zhao, 2014) estimate the effect of recent job loss, rather than unemployment. They regress current child health on an indicator for whether the mother or father lost his or her job between the previous and current period; this indicator then switches back to zero in the next period, regardless of whether the parent is re-employed or remains unemployed. Their estimates therefore show the association between the event of *losing* a job and current child health, rather than the effect of parental unemployment. While one could potentially argue that psychosocial stress is affected mostly immediately after job loss, there is no reason to believe that parents' time use and income are affected only by *job loss*, rather than *joblessness*.

Besides this conceptual difference, there are a number of empirical issues that cast doubt on the estimation results in (Liu and Zhao, 2014). The authors estimate child fixed effects models including a lagged dependent variable, which is known to produce biased estimates (the lagged dependent variable is not instrumented). Furthermore, to address the endogeneity

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[12]Our results are robust to the inclusion of 124 children with one or both parents living outside the household but reporting their work status - results available on request.

[13]Our sample size varies for each measure of health we investigate, since we sometimes have missing values for dependent or control variables.

of parental job loss, two instrumental variables are used: an indicator variable for whether both parents worked in government or a public institution prior to job loss and an indicator variable for whether both parents worked in a state owned enterprise or collective enterprise prior to job loss. One concern with these instruments is that they are time-invariant, so that it is unclear how the instrumental variable estimation was done with the inclusion of child fixed effects. Second, before the 2004 wave, government and public institutions were not distinguished from state owned enterprises in the CHNS data on individuals' employer details. It is therefore unclear how the authors have identified whether parents worked for government and public institutions versus state owned enterprises. As the first stage results are weak, the paper's main focus is on the OLS fixed effects estimates. Finally, (Liu and Zhao, 2014) present separate estimations for maternal and paternal job loss, only controlling for presence of the other parent in the household, which is potentially endogenous. Instead, we include the employment status of both parents in each estimation, and restrict our sample to households in which both parents are present.

5 Results

5.1 Main Results

We first estimate the effect of paternal and maternal unemployment on child health indicators. Table 2 shows effects on child weight and height. Columns (I) and (IV) show fixed effects OLS estimation results, columns (II) and (V) fixed effects IV estimations. In all cases we include basic control variables, while columns (III) and (VI) additionally allow for differential trends according to initial household wealth and parental education.

The results show that maternal unemployment has an insignificant positive effect on weight- and height-for-age, while paternal unemployment reduces weight and height. The effects of paternal unemployment are large, reducing the age-adjusted z-scores by close to half a standard deviation, although they are imprecisely estimated. The effects are not

TABLE 2

TABLE 2

Effect of Parental Job Loss on Child Health

	Weight-for-age			Height-for-age		
	(I) FE	(II) FE-IV	(III) FE-IV	(IV) FE	(V) FE-IV	(VI) FE-IV
Mother Jobless	0.017	0.287	0.255	0.016	0.450	0.393
	(0.061)	(0.315)	(0.331)	(0.074)	(0.355)	(0.336)
Father Jobless	-0.209**	-0.676**	-0.436	-0.140	-0.718*	-0.529
	(0.084)	(0.322)	(0.379)	(0.093)	(0.372)	(0.369)
First stage - Mother Jobless						
Female employment rate		-0.741***	-0.692***		-0.741***	-0.692***
		(0.133)	(0.150)		(0.133)	(0.150)
Male employment rate		-0.097	-0.152		-0.097	-0.152
		(0.156)	(0.152)		(0.156)	(0.152)
First stage - Father Jobless						
Female employment rate		0.125	0.149		0.125	0.149
		(0.090)	(0.097)		(0.090)	(0.097)
Male employment rate		-1.024***	-1.010***		-1.024***	-1.010***
		(0.173)	(0.175)		(0.173)	(0.175)
N	4090	4090	3841	4090	4090	3841
F-stat First Stage		24.548	20.332		24.548	20.332
Basic controls	Y	Y	Y	Y	Y	Y
Additional controls	N	N	Y	N	N	Y

Notes: All estimations include child fixed effects. Standard errors clustered by city/county are in parentheses. *** significant at 1 percent level , ** significant at 5 percent level, * significant at 10 percent level.

statistically significant once we add additional controls (columns III and VI). First-stage results show that the instruments are highly significant, and the F-statistic is sufficiently high. The coefficients indicate that a percentage point decline in the local female employment rate increases the probability of a mother being jobless by about 0.7 percentage points, while a percentage point decline in the local male employment rate increases fathers' joblessness by about 1 percentage point. Furthermore, the results in Tables 2 and 3 are robust to controlling for the local average monthly wage rate (as reported by workers who are paid a regular wage or salary).[14] The average monthly wage rate in the city or county does not significantly affect health outcomes, and the coefficient estimates for parental joblessness are not affected either,

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[14]Results are available from the authors.

suggesting that local employment rate fluctuations did not affect child health through the general wage development.

TABLE 3
Effect of Parental Jobloss on Child Health

	Underweight		Stunted		Sick last 4 weeks	
	(I)	(II)	(III)	(IV)	(V)	(VI)
	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV
Mother Jobless	-0.089	-0.112	-0.204	-0.207	-0.126*	-0.142*
	(0.092)	(0.103)	(0.151)	(0.131)	(0.076)	(0.081)
Father Jobless	0.268***	0.247**	0.376**	0.348**	0.045	0.065
	(0.098)	(0.125)	(0.157)	(0.148)	(0.074)	(0.072)
First stage - Mother Jobless						
Female employment rate	-0.741***	-0.692***	-0.741***	-0.692***	-0.758***	-0.703***
	(0.133)	(0.150)	(0.133)	(0.150)	(0.138)	(0.152)
Male employment rate	-0.097	-0.152	-0.097	-0.152	-0.099	-0.157
	(0.156)	(0.152)	(0.156)	(0.152)	(0.154)	(0.150)
First stage - Father Jobless						
Female employment rate	0.125	0.149	0.125	0.149	0.132	0.142
	(0.090)	(0.097)	(0.090)	(0.097)	(0.091)	(0.098)
Male employment rate	-1.024***	-1.010***	-1.024***	-1.010***	-1.032***	-0.998***
	(0.173)	(0.175)	(0.173)	(0.175)	(0.171)	(0.172)
N	4090	3841	4090	3841	3997	3757
F-stat First Stage	24.548	20.332	24.548	20.332	24.071	20.129
Basic controls	Y	Y	Y	Y	Y	Y
Additional controls	N	Y	N	Y	N	Y

Notes: All estimations include child fixed effects and wave fixed effects. Standard errors clustered by city/county are in parentheses. *** significant at 1 percent level , ** significant at 5 percent level, * significant at 10 percent level.

Table 3 shows estimated effects on additional health measures, where we only report results of the IV estimations. In line with the results for weight and height, we find negative effects of maternal unemployment on the probability that children are underweight or stunted, though not statistically significant. Paternal unemployment significantly increases both underweight (low weight-for-age) and stunting. We further find that mothers' unemployment is associated with a 14.2 percentage point reduction in the probability that a child has been sick or injured in the last 4 weeks. The effect of fathers' unemployment on sickness

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is positive but smaller, and not statistically significant.

TABLE 4
Effect of Parental Job Loss on Child Blood Pressure

	Z-Systolic		Z-Diastolic		Hypertensive	
	(I)	(II)	(III)	(IV)	(V)	(VI)
	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV
Mother Jobless	-2.794***	-2.614**	-2.245***	-2.140**	-0.359**	-0.373**
	(1.044)	(1.215)	(0.855)	(0.981)	(0.150)	(0.172)
Father Jobless	2.855***	3.214***	2.020***	2.164***	0.163	0.167
	(0.938)	(0.977)	(0.706)	(0.750)	(0.157)	(0.162)
First stage - Mother Jobless						
Female employment rate	-0.671***	-0.632***	-0.677***	-0.640***	-0.677***	-0.639***
	(0.144)	(0.184)	(0.142)	(0.182)	(0.142)	(0.182)
Male employment rate	-0.156	-0.183	-0.143	-0.166	-0.144	-0.169
	(0.181)	(0.199)	(0.184)	(0.205)	(0.184)	(0.205)
First stage - Father Jobless						
Female employment rate	0.089	0.121	0.086	0.117	0.086	0.118
	(0.119)	(0.123)	(0.118)	(0.122)	(0.118)	(0.122)
Male employment rate	-1.068***	-1.071***	-1.060***	-1.061***	-1.061***	-1.063***
	(0.202)	(0.198)	(0.203)	(0.198)	(0.203)	(0.198)
N	2990	2820	2984	2814	2978	2808
F-stat First Stage	13.648	9.354	13.853	9.521	13.840	9.507
Basic controls	Y	Y	Y	Y	Y	Y
Additional controls	N	Y	N	Y	N	Y

Notes: All estimations include child fixed effects. Blood pressure estimations include only children aged 7 and older. Standard errors clustered by city/county are in parentheses. *** significant at 1 percent level , ** significant at 5 percent level, * significant at 10 percent level.

When investigating the blood pressure of children aged 7 and older (Table 4), we also find different impacts of mothers' and fathers' unemployment. Children's blood pressure declines significantly with maternal unemployment and increases significantly with paternal unemployment; the effect sizes are large and suggest that maternal (paternal) unemployment decreases (increases) children's blood pressure by more than two standard deviations of the reference distribution. Mothers' unemployment reduces the probability of a child being hypertensive by 37 percentage points while fathers' unemployment has an insignificant positive effect on hypertension. These results indicate that job loss of a parent has substantial ef-

fects on child blood pressure, potentially reflecting impacts on children's psychosocial stress. Blood pressure is generally positively associated with weight (especially with obesity), so the fact that the estimates for weight in Table 2 are of the opposite sign suggests that weight changes are not driving the blood pressure effects we finds.

In all, our main estimates suggest that paternal unemployment negatively affects the health of children, while maternal unemployment improves some dimensions of child health, notably the incidence of sickness or injuries and children's blood pressure. These results are in line with findings for the US by Schaller and Zerpa (2015), who partly rely on subjective child health as reported by parents and on medical care use.

5.2   Channels

As discussed in Section 2.2 unemployment is expected to affect child health through changes in income, time use, and parents' mental distress, each of which may differ between paternal and maternal unemployment. To investigate these channels, we estimate the following equation:

$$C_{ijt} = \alpha_i + \beta_1 Jobless_{ijt}^f + \beta_2 Jobless_{ijt}^m + \beta_3 X_{ijt} + \beta_4 \gamma_t + \beta_5 Y_{ijt} \gamma_t + \epsilon_{ijt} \qquad (2)$$

This is the same specification as equation (1), but we replace our measures of child health with our potential channels of interest. Again, all estimations include child fixed effects and we instrument joblessness with city/county level sex-specific employment rates. Following the outline of the theoretical framework, we start with analysis of income, time use, and parental stress. We then turn to a number of specific health investments in section 5.2.2.

5.2.1 Income, time use, and parental stress

Table 5 shows effects of mother and father unemployment on household income and on time use of children and parents. As described in Section 3.2, income is not measured accurately. Results are included for completeness, but note these should be interpreted with caution. The income estimates (columns I and II) suggest that fathers' unemployment has large but insignificant effects on household total and per capita income. Maternal unemployment estimates are much smaller, but also very imprecise.

TABLE 5

Effect of Parental Jobloss on Income and Time Use

	Household income		Health	Time use domestic chores		
	Total	Per capita	insurance	Child	Mother	Father
	(I)	(II)	(III)	(IV)	(V)	(VI)
	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV
Mother Jobless	-2820.920	12.510	-0.156	-41.753**	20.642	-23.029
	(9989.459)	(2385.417)	(0.299)	(18.552)	(63.409)	(25.860)
Father Jobless	-8565.024	-2601.537	-0.339	16.777	-62.450	1.067
	(8559.077)	(2181.609)	(0.293)	(18.944)	(69.395)	(34.532)
First stage - Mother Jobless						
Female employment rate	-0.703***	-0.703***	-0.673***	-0.694***	-0.692***	-0.692***
	(0.148)	(0.148)	(0.150)	(0.181)	(0.150)	(0.150)
Male employment rate	-0.123	-0.123	-0.174	-0.124	-0.152	-0.152
	(0.156)	(0.156)	(0.152)	(0.181)	(0.152)	(0.152)
First stage - Father Jobless						
Female employment rate	0.176*	0.176*	0.159	0.159	0.149	0.149
	(0.098)	(0.098)	(0.098)	(0.129)	(0.097)	(0.097)
Male employment rate	-0.963***	-0.963***	-1.041***	-1.097***	-1.010***	-1.010***
	(0.178)	(0.178)	(0.179)	(0.213)	(0.175)	(0.175)
N	3784	3784	3664	3044	3841	3841
F-stat First Stage	21.415	21.415	21.367	12.003	20.332	20.332
Basic controls	Y	Y	Y	Y	Y	Y
Additional controls	Y	Y	Y	Y	Y	Y

Notes: All estimations include child fixed effects and wave fixed effects. Estimations for child time use include only children aged 6 and older. Standard errors clustered by city/county are in parentheses. *** significant at 1 percent level , ** significant at 5 percent level, * significant at 10 percent level.

Column III in Table 5 shows the effects of unemployment on the health insurance of

children. We find that paternal and maternal unemployment both reduce the probability of health insurance. The effect of paternal unemployment is about twice as large (-0.34) compared to maternal unemployment (-0.16) but neither estimate is statistically significant.

For time use, we use the average minutes per day spent on domestic chores (washing, cleaning, buying food, and preparing food) by the mother and father, as well as children's own time use. The time use of children is available only for children aged 6 and older, resulting in a smaller estimation sample. As results in column (IV) show, maternal unemployment reduces the time that children spend on domestic chores by 41.8 minutes per day. The estimated effect is large relative to the mean in the sample; the sample average is 7.3 minutes per day, whilst the corresponding figure conditional on doing any domestic chores is 40.7 minutes with a standard deviation of 45.9. However, we do not find significant changes in the time that parents spend on domestic chores (columns V and VI). Maternal unemployment is associated with increased time of mothers and reduced time of fathers in domestic chores, and paternal unemployment is associated with a large reduction in mothers' time on domestic chores, but the estimates are again very imprecise. If we restrict the estimation sample for parents' time use to include only the parents of children aged 6 and older (those included in column IV) we find similar results; maternal unemployment frees up children's time but there are no significant effects on time use of mothers or fathers themselves.

In order to investigate whether parental stress could be a channel through which child health is affected, Table 6 shows effects on mother and father blood pressure levels. We find an increase of mothers' systolic blood pressure following fathers' unemployment and a decline in mothers' diastolic blood pressure following her own unemployment. The effects are equal to about half a standard deviation (parents' blood pressure measures are not standardized). Fathers' blood pressure also increases with paternal unemployment and declines with maternal unemployment, but the effects are smaller and not statistically significant.

In all, bearing in mind measurement issues with respect to income and the limited scope of time use data, the evidence is fairly weak but nonetheless suggests that all three channels

TABLE 6
Effect of Parental Jobloss on Parental Blood Pressure

	Mother Blood Pressure				Father Blood Pressure			
	Systolic		Diastolic		Systolic		Diastolic	
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV
Mother Jobless	-4.511	-3.027	-4.184*	-4.991*	0.252	0.269	-2.635	-1.410
	(4.458)	(4.776)	(2.231)	(2.752)	(4.935)	(4.027)	(3.252)	(4.399)
Father Jobless	10.162*	7.189**	4.186	4.997	4.508	4.734	2.459	2.129
	(5.315)	(3.474)	(5.057)	(6.086)	(5.594)	(5.682)	(2.441)	(4.197)
First stage - Mother Jobless								
Female employment rate	-0.743***	-0.688***	-0.743***	-0.688***	-0.813***	-0.746***	-0.813***	-0.746***
	(0.118)	(0.118)	(0.118)	(0.118)	(0.125)	(0.124)	(0.125)	(0.124)
Male employment rate	-0.101	-0.129	-0.101	-0.129	0.137	0.107	0.137	0.107
	(0.154)	(0.142)	(0.154)	(0.142)	(0.172)	(0.174)	(0.172)	(0.174)
First stage - Father Jobless								
Female employment rate	0.118	0.144	0.118	0.144	0.139	0.156	0.139	0.156
	(0.085)	(0.089)	(0.085)	(0.089)	(0.081)	(0.087)	(0.081)	(0.087)
Male employment rate	-1.014***	-0.998***	-1.014***	-0.998***	-0.990***	-0.953***	-0.990***	-0.953***
	(0.205)	(0.206)	(0.205)	(0.206)	(0.200)	(0.207)	(0.200)	(0.207)
N	3729	3496	3729	3496	3181	2965	3181	2965
F-stat First Stage	20.870	21.852	20.870	21.852	23.122	21.336	23.122	21.336
Basic controls	Y	Y	Y	Y	Y	Y	Y	Y
Additional controls	N	Y	N	Y	N	Y	N	Y

Notes: All estimations include child fixed effects. Standard errors clustered by city/county are in parentheses. *** significant at 1 percent level , ** significant at 5 percent level, * significant at 10 percent level.

play a role in the differential health effects of paternal and maternal unemployment. We find greater time use changes and reduced blood pressure of mothers in response to maternal unemployment, while paternal unemployment has no impacts on time use and increases mothers' blood pressure.

5.2.2 Health investments

Income and time use are considered key channels linking parental unemployment to child health, as they determine the resources available to parents for investing in child health. We now turn to an analysis of the available indicators of these health investments, which are immunizations received, general health services received, and children's diets.

Table 7 shows the effect of unemployment on receiving any immunizations during the past 12 months (for children younger than 12) and on receiving preventive health care services during the past four weeks.[15] We find that maternal unemployment increases the probability of receiving immunization by almost 20 percentage points (close to half a standard deviation) and paternal unemployment has a small negative effect, but estimates are not statistically significant. We do find significant effects on the probability of receiving preventive health services, which declines with maternal unemployment and increases with paternal unemployment. As discussed in section 3.1, it is difficult to interpret these findings, as preventive services (mostly general health and child health examinations) may reflect preventive investments as well as investments in diagnosis and treatment. Given the effects of unemployment on children's health and sickness during the past four weeks (in Table 3), the estimates for health services are more likely to reflect a response to changes in health. Conversely, changes in the use of general health examinations are unlikely to account for the effects of unemployment on child health, while our results indicate that changes in immunizations may play some role.

Results for children's macronutrient intake and dietary diversity are reported in Table

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[15]About 10% of immunizations was covered by health insurance, according to the CHNS data. Estimates for immunization and health services are very similar if we control for health insurance coverage.

TABLE 7

Effect of Parental Jobloss on Child Health Care Received

	Immunization		Health Services	
	(I)	(II)	(III)	(IV)
	FE-IV	FE-IV	FE-IV	FE-IV
Mother Jobless	0.332	0.198	-0.187**	-0.192**
	(0.261)	(0.347)	(0.084)	(0.091)
Father Jobless	-0.132	-0.018	0.250	0.373*
	(0.327)	(0.524)	(0.197)	(0.221)
First stage - Mother Jobless				
Female employment rate	-0.794***	-0.737***	-0.790***	-0.719***
	(0.246)	(0.248)	(0.140)	(0.154)
Male employment rate	-0.023	-0.135	-0.033	-0.116
	(0.300)	(0.301)	(0.150)	(0.143)
First stage - Father Jobless				
Female employment rate	0.095	0.038	0.125	0.133
	(0.103)	(0.109)	(0.089)	(0.095)
Male employment rate	-0.933***	-0.768***	-1.032***	-1.006***
	(0.172)	(0.176)	(0.175)	(0.178)
N	1316	1218	3810	3580
F-stat First Stage	6.785	6.056	23.001	18.248
Basic controls	Y	Y	Y	Y
Additional controls	N	Y	N	Y

Notes: All estimations include child fixed effects and wave fixed effects. Immunization estimations include only children aged 11 and younger. Standard errors clustered by city/county are in parentheses. *** significant at 1 percent level , ** significant at 5 percent level, * significant at 10 percent level.

8. Maternal unemployment has no effect on children's macronutrient intake and the effect on total calorie intake is negative but not statistically significant. We do find that maternal unemployment significantly increases children's dietary diversity score, but only in the specification without initial parental education and wealth controls. Paternal unemployment, on the other hand, significantly reduces children's intake of fat by almost 1.3 standard deviations (as reported in Table 1), and reduces their dietary diversity score. A declining share of energy from dietary fat may lead to insufficient fat intake for children's growth needs. Chunming (2000) reports that, based on a survey conducted in China in 1991, stunting among boys younger than six was linked with a low intake of protein and fat. Yet there seems to be no

TABLE 8
Effect of Parental Job Loss on Child Diets

	Carbohydrates		Fats		Proteins		Calories		Dietary Diversity	
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)
	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV	FE-IV
Mother Jobless	-0.044	-0.083	-0.032	-0.166	0.051	-0.035	-0.156	-0.243	0.659*	0.582
	(0.220)	(0.247)	(0.427)	(0.401)	(0.182)	(0.194)	(0.210)	(0.219)	(0.399)	(0.452)
Father Jobless	-0.105	-0.107	-1.072***	-0.874**	-0.326	-0.212	-0.307	-0.211	-1.101**	-0.787
	(0.371)	(0.427)	(0.396)	(0.415)	(0.288)	(0.311)	(0.299)	(0.333)	(0.496)	(0.527)
First stage - Mother Jobless										
Female empl. rate	-0.735***	-0.672***	-0.745***	-0.678***	-0.741***	-0.675***	-0.738***	-0.676***	-0.733***	-0.670***
	(0.131)	(0.145)	(0.132)	(0.147)	(0.130)	(0.145)	(0.130)	(0.144)	(0.131)	(0.146)
Male empl. rate	-0.148	-0.227	-0.140	-0.217	-0.141	-0.220	-0.148	-0.227	-0.150	-0.228
	(0.148)	(0.136)	(0.149)	(0.136)	(0.144)	(0.133)	(0.148)	(0.136)	(0.149)	(0.136)
First stage - Father Jobless										
Female empl. rate	0.118	0.147	0.106	0.141	0.114	0.147	0.117	0.147	0.118	0.148
	(0.092)	(0.097)	(0.095)	(0.100)	(0.092)	(0.098)	(0.092)	(0.097)	(0.092)	(0.097)
Male empl. rate	-1.034***	-1.018***	-1.013***	-1.000***	-1.033***	-1.023***	-1.036***	-1.021***	-1.033***	-1.019***
	(0.182)	(0.181)	(0.180)	(0.180)	(0.174)	(0.175)	(0.182)	(0.181)	(0.182)	(0.181)
N	3826	3595	3782	3553	3803	3576	3812	3581	3832	3601
F-stat First Stage	25.845	21.872	25.726	21.756	26.087	21.956	26.326	22.199	25.430	21.685
Basic controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Additional controls	N	Y	N	Y	N	Y	N	Y	N	Y

Notes: All estimations include child fixed effects. Standard errors clustered by city/county are in parentheses. Carbohydrates, fats, and proteins are measured in log grams, calories in log kcal. *** significant at 1 percent level , ** significant at 5 percent level, * significant at 10 percent level.

conclusive evidence on the effect of low fat intake on growth. Our results suggest that it plays a role in the negative child health effects of paternal unemployment.

6 Heterogeneity

In this section we explore whether the health effects of parental job loss differ by households' socio-economic status, and analyze heterogeneity by children's sex and age group.

6.1 Socio-economic status of the parents

Our estimations so far controlled for the initial level of household wealth and parental education, each interacted with year dummies, in order to capture productivity shifters in child health production. As explained in Section 4, these may also affect the impact of unemployment on child health. In the basic theoretical framework of child health production, one would expect that negative income effects and positive substitution effects of unemployment are greater when parents have higher child health productivity. On the other hand, more wealthy households may be better able to mitigate the negative income effects. Time use shifts of more educated mothers may also be greater, for example because more educated mothers are more likely to work longer hours and to use market-based child care if they do work (Schaller and Zerpa, 2015).

To assess whether children are differentially affected depending on the socio-economic status (SES) of their household, we split the sample according to the education level of the father. Low-SES households are those where the father has completed less than middle school education.[16] Comparing children in low-SES and high-SES households (Table 9), we find that all estimates are very similar, with two exceptions. First, maternal unemployment reduces stunting significantly only in high-SES households (column IV). This is difficult to explain,

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[16]Middle school was the median level of education for mothers and fathers in 1997. Results are very similar when we classify households by their asset index value or either parent's years of education, but in some cases have weaker first stage identification.

TABLE 9
Effect of Parental Jobloss on Child Health, by Father's Education

	Weight-for-age (I) FE-IV	Height-for-age (II) FE-IV	Underweight (III) FE-IV	Stunted (IV) FE-IV	Sick 4 weeks (V) FE-IV	Z-Systolic (VI) FE-IV	Z-Diastolic (VII) FE-IV
Panel A: Low education							
Mother Jobless	0.430	0.596	-0.048	-0.041	-0.118	-2.443***	-2.122***
	(0.360)	(0.397)	(0.097)	(0.192)	(0.088)	(0.683)	(0.662)
Father Jobless	-0.462	-0.767	0.243*	0.475***	0.147*	2.709***	1.875**
	(0.430)	(0.523)	(0.137)	(0.156)	(0.086)	(0.746)	(0.735)
N	1084	1084	1084	1084	1056	790	790
F-stat First Stage	9.406	9.406	9.406	9.406	9.189	8.612	8.610
Panel B: High education							
Mother Jobless	0.132	0.319	-0.070	-0.294**	-0.139	-3.046*	-2.357*
	(0.405)	(0.447)	(0.146)	(0.143)	(0.098)	(1.755)	(1.313)
Father Jobless	-0.637	-0.591	0.219	0.381**	0.028	2.920*	2.110**
	(0.438)	(0.442)	(0.152)	(0.168)	(0.093)	(1.516)	(1.004)
N	3004	3004	3004	3004	2939	2200	2194
F-stat First Stage	23.387	23.387	23.387	23.387	22.729	12.110	12.495
Basic controls	Y	Y	Y	Y	Y	Y	Y
Additional controls	N	N	N	N	N	N	N

Notes: All estimations include child fixed effects and wave fixed effects. Blood pressure estimations (columns VI and VII) include only children aged 6 and older. Standard errors clustered by city/county are in parentheses. *** significant at 1 percent level , ** significant at 5 percent level, * significant at 10 percent level.

as average height-for-age is higher for high-SES children and maternal unemployment does not increase height-for-age more in the high-SES sample. Second, paternal unemployment increases the incidence of sickness only in low-SES households (column V). This may be due to worse overall health of low-SES children, so that a given negative shock is more likely to translate into a higher incidence of sickness. In all, however, we find that children in both types of households are negative affected by parental unemployment and positively by maternal unemployment.

6.2   Boys and girls

China, like India, is well known for the phenomenon of missing women, reflecting a culturally rooted son preference (Das Gupta, 2008). While skewed population sex ratios are perhaps the most visible result of son preference, it also affects parental investments in child health, as recently documented for India (Barcellos, Carvalho and Lleras-Muney, 2014). In separate estimations for boys and girls (Table 10), we find that the effects of maternal and paternal unemployment on height-for-age, underweight, stunting, and the incidence of sickness are stronger for girls than boys. Most estimates are statistically insignificant, but the pattern is consistent across outcomes in that paternal (maternal) unemployment reduces (improves) health more strongly for girls. The exception is blood pressure, for which the estimates are highly significant but do not show a clear pattern of heterogeneity between boys and girls.

6.3   Age groups

The vulnerability of children's health to changes in parental health investment is likely to depend on children's age. One simple reason is that for younger children, a parental unemployment spell in the data will account for a larger fraction of their lives, hence health outcomes reflecting cumulative health investments - such as height - should be affected more strongly. Furthermore, the period from pregnancy until two years of age (the first 1000 days) is considered critical for shaping long term health (Black et al., 2013), when inadequate

TABLE 10

Effect of Parental Jobloss on Health of Boys and Girls

	Weight-for-age (I) FE-IV	Height-for-age (II) FE-IV	Underweight (III) FE-IV	Stunted (IV) FE-IV	Sick 4 weeks (V) FE-IV	Z-Systolic (VI) FE-IV	Z-Diastolic (VII) FE-IV
Panel A: Boys							
Mother Jobless	0.266	0.257	0.021	-0.146	-0.083	-2.887**	-2.636**
	(0.414)	(0.421)	(0.132)	(0.191)	(0.093)	(1.421)	(1.116)
Father Jobless	-0.407	-0.245	0.199	0.203	0.003	3.144***	2.494***
	(0.459)	(0.511)	(0.132)	(0.184)	(0.089)	(1.139)	(0.842)
N	2088	2088	2088	2088	2053	1510	1510
F-stat First Stage	18.790	18.790	18.790	18.790	17.048	6.844	6.981
Panel B: Girls							
Mother Jobless	0.146	0.508	-0.278*	-0.276	-0.219	-2.416**	-1.849*
	(0.426)	(0.459)	(0.168)	(0.192)	(0.148)	(1.208)	(1.014)
Father Jobless	-0.289	-0.854	0.352*	0.532**	0.207	3.594***	1.998**
	(0.545)	(0.546)	(0.202)	(0.217)	(0.148)	(1.329)	(0.948)
N	1753	1753	1753	1753	1704	1310	1304
F-stat First Stage	10.662	10.662	10.662	10.662	10.182	10.143	10.124
Basic controls	Y	Y	Y	Y	Y	Y	Y
Additional controls	Y	Y	Y	Y	Y	Y	Y

Notes: All estimations include child fixed effects and wave fixed effects. Blood pressure estimations (columns VI and VII) include only children aged 6 and older. Standard errors clustered by city/county are in parentheses. *** significant at 1 percent level , ** significant at 5 percent level, * significant at 10 percent level.

nutrition and infectious diseases can lead to stunting (WHO, 2014b). At the same time, adolescence (age 10 to 19) is gaining attention as a last window of opportunity for repairing consequences of malnutrition in early childhood, being an active growth phase and a period of important physical changes (see, for example, Melaku et al. (2015)). The CHNS data does not allow a focus on the first two years of life, due to the limited sample size and the length of the period between survey waves, but to distinguish between early childhood and adolescence, we split the sample into children aged 0-6 in 1997 and children aged 7 and older in 1997.

We find (Table 11) that paternal unemployment reduces the weight- and height-for-age z-scores and increases underweight of young children significantly, while the effects on older children are much smaller and not statistically significant. Yet at the same time, the effects on stunting – negative for maternal job loss and positive for paternal job loss – are stronger for older children. In our sample, older children have a significantly lower mean height-for-age score (-1.04 compared to -.78 for young children, in 1997), and the distribution has more mass around the stunting cutoff of -2. This can explain why a small effect on height-for-age can still significantly change the probability of stunting.

The reduction in sickness and injuries (column V) due to maternal job loss is found only for younger children, which is in line with the idea that for younger children, maternal child care can replace child care outside of the household, reducing the exposure of children to infections and the probability of incurring injuries (Schaller and Zerpa, 2015). Note that blood pressure was measured only for children aged 6 and older and therefore we cannot analyze effects on the blood pressure of young kids. For the other health outcomes, however, the general picture is that the impacts of parental job loss are stronger for younger children.

TABLE 11
Effect of Parental Jobloss on Child Health, by Age Group

	Weight-for-age (I) FE-IV	Height-for-age (II) FE-IV	Underweight (III) FE-IV	Stunted (IV) FE-IV	Sick 4 weeks (V) FE-IV
Panel A: Young children (aged 0-6 in 1997)					
Mother Jobless	0.325	0.513	-0.243	0.037	-0.256*
	(0.431)	(0.449)	(0.157)	(0.151)	(0.151)
Father Jobless	-1.336*	-1.844**	0.533**	0.273	0.106
	(0.790)	(0.761)	(0.258)	(0.283)	(0.264)
N	1326	1326	1326	1326	1302
F-stat First Stage	9.508	9.508	9.508	9.508	9.654
Panel B: Older children (aged 7 and older in 1997)					
Mother Jobless	0.334	0.355	-0.078	-0.411**	-0.020
	(0.470)	(0.415)	(0.170)	(0.190)	(0.080)
Father Jobless	-0.234	-0.049	0.185	0.398**	-0.002
	(0.402)	(0.313)	(0.158)	(0.177)	(0.070)
N	2515	2515	2515	2515	2455
F-stat First Stage	8.891	8.891	8.891	8.891	8.405
Basic controls	Y	Y	Y	Y	Y
Additional controls	Y	Y	Y	Y	Y

Notes: All estimations include child fixed effects and wave fixed effects. Standard errors clustered by city/county are in parentheses. *** significant at 1 percent level , ** significant at 5 percent level, * significant at 10 percent level.

7 Conclusions

This paper analyzes the causal effect of paternal and maternal unemployment on the health of children aged 0-17 in China, during a period of economic reforms that resulted in massive lay-offs and declining employment rates. We find that paternal unemployment has negative effects on child health, leading to a significant rise in underweight and stunting, and increasing children's blood pressure. Maternal unemployment, on the other hand, has no significant effect on children's height and weight, but reduces the incidence of sickness and injuries as well as children's blood pressure. Young children appear to be affected more by parental unemployment than older children and there is some evidence that girls are affected more strongly than boys, while we find no clear differences between children in households

of low and high socio-economic status.

Our results are in line with recent evidence on the child health impacts of parental unemployment in the US (Schaller and Zerpa, 2015) and with evidence on the role of maternal employment in explaining the cyclicality of infant health in a number of countries (e.g. Bhalotra (2010); Miller and Urdinola (2010)). Analyzing the main channels through which unemployment affects child health (income, time use, and parents' psychosocial stress), our results indicate that each of the channels may contribute to the differential child health impacts of maternal versus paternal unemployment. Although there are measurement issues with the data on income and time use, the results show that particularly the effects on children's time use and mothers' blood pressure are in line with beneficial child health impacts of maternal unemployment and negative health impacts of paternal unemployment.

In terms of specific health investments, our findings show differences between paternal and maternal unemployment effects on immunizations that are in line with the effects on child health, though estimates are statistically insignificant. A new finding is that maternal (paternal) unemployment increases (reduces) children's dietary diversity, which is a measure of the nutrient adequacy of diets. Furthermore, we find that paternal unemployment significantly reduces children's fat intake. To the best of our knowledge, this is the first evidence on the causal effect of parental unemployment on the nutrient intake and dietary quality of children aged 0-17, and it suggests that besides child care and health care, child health may be affected through changes in diets and nutrition.

In all, despite some issues with the quality of the data, the picture that appears across all of our estimations is consistent, and shows that mothers' and fathers' unemployment have opposite impacts on child health. The evidence is in support of the idea that traditional gender roles play a role in these differences (Rege, Telle and Votruba, 2011; Kalil and Ziol-Guest, 2008): working women in our sample earn less then men and women spend substantially more time on domestic chores and on child care, so that losing their job should result in a relatively smaller income loss while increasing maternal time investments in children.

Since the reforms of State Owned Enterprises in China in the late 1990s led to stronger reductions in female employment than male employment, our results suggest that some dimensions of child health may have improved, with the benefits of maternal unemployment dominating. Still, many children suffered from negative health effects of paternal job loss, and the aggregate changes in height-for-age and weight-for-age would be negative. As China's government has recently announced an expected 1.8 million lay-offs in the coal and steel industry[17], further reforms in the near future are likely to affect male employment more heavily and thus may have more negative child health effects on aggregate. A strong social safety net program, to compensate for income losses and support worker reallocation to other sectors, would be an important policy to mitigate these impacts. Child feeding programs may be effective in particular to mitigate nutritional impacts more directly (see Giles and Satriawan (2015)). Our results suggest such policies should especially target families with young children.

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[17]See Yao, Kevin and Meng Meng. 2016. "China expects to lay off 1.8 million workers in coal, steel sectors." Reuters, February 26. Retrieved from http://www.reuters.com/article/us-china-economy-employment-idUSKCN0W205X.

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