Land Reform and Child Health in The Kyrgyz Republic

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Abstract:

Does privatizing land improve child health and nutrition outcomes? We exploit a natural experiment in The Kyrgyz Republic following the collapse of socialism whereby the government rapidly liquidated state and collective farms containing 75 percent of agricultural land and distributed it to individuals, providing 99-year transferrable use rights. We use household surveys collected before, during, and after the reform and data on the spatial variation in the timing of privatization to identify its health and nutrition impacts. We find that children exposed to land privatization for longer periods of time accumulated significantly greater gains in height and weight, both critical measures of long-term health and nutrition. Children who benefited most from privatization were between the ages of 1 and 1.5—possibly due to protective effects of breastfeeding for children younger than a year old, and reduced vulnerability to health shocks at older ages. We find no evidence of significant gender differences in the effects of privatization.

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Abstract

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Keywords: human capital, child health, land reform, height-for-age, Central Asia, The Kyrgyz Republic
JEL classifications: I1, J1, O1

1. Introduction

Does privatizing land improve child health and nutrition outcomes? There is considerable debate about the proper role of government in land administration. While, on the one hand, market failures may justify government involvement in the management of natural resources including land, the argument for market failure and the ways in which government should be involved in land markets is unclear. Empirically, there is little evidence on how privatization of land affects the most vulnerable, including children. This is unfortunate given the sheer quantity and magnitude of land reforms currently transpiring in the developing world, many of which are significantly increasing the extent to which individuals have rights to and/or ownership over land. Children are especially sensitive to early investments made in their health, and access to major productive resources like land is thus likely to play a critical role in determining their health outcomes.

In theory, markets should provide land to the most productive individuals, thus maximizing social welfare. Indeed, a large body of work shows that productive investments in land and in farming technologies are heavily influenced by the quality of land policy and the security of land tenure (Feder et al., 1988; Besley, 1995; Carter and Olinto, 2003; Lopez and Roman, 1997; Rozelle 1996; Alston et al., 1999; Banerjee et al., 2002; Lanjouw and Levy, 2002; Field, 2005; Deininger and Ali, 2008). At the same time, government efforts to ensure equal access to land in rural areas could potentially benefit children—especially the most vulnerable and disadvantaged, whose families might otherwise not access land. For example, historical inequalities, credit constraints, and cultural norms may constitute barriers to accessing natural resources for otherwise productive individuals. Access to communal land can in such cases serve as a safety net for the poor (Jodha 1990; Burgess 1997). Further, there are costs associated with private ownership of land including those associated with physically demarcating and delineating plots, establishing and maintaining land ownership records, and enforcing land rights and resolving disputes (Feder and Feeney 1991; DeMeza and Gould 1992; Deininger and Feder 2001). This introduces theoretical ambiguity about the ultimate impacts of land privatization.

We exploit a natural experiment in The Kyrgyz Republic following the collapse of socialism to identify the effects of land privatization on child health outcomes. Starting in the early 1990s and peaking during 1994–1995, the Government of The Kyrgyz Republic rapidly liquidated 262 state farms and 190 collective farms containing 75 percent of agricultural land (excluding pastureland) and distributed it to individuals, providing 99-year transferrable use rights. We exploit spatial variation in the timing of land privatization and repeated cross-sectional Living Standards Measurement Survey (LSMS) data from The Kyrgyz Republic from 1993, 1996, 1997, and 1998 to analyze the child health impacts of privatization. Specifically, we compare children of the same age (in months) with differential exposures to land privatization due to the timing of its roll-out. Because we have four rounds of data and spatial variation in the timing of privatization, we can include not only age in months fixed effects but also region (oblast) and survey year fixed effects.

Our analysis examines the health status of children 0 – 5 years old (i.e. 0 – 60 months old). As children are especially vulnerable in their first two years of life (Shrimpton et al. 2001; Carter and Maluccio 2003), we additionally always separately consider children aged 0-24 months and 25-60 months. Our primary health outcomes are the three most commonly used anthropometric indices used for children: height-for-age z-scores (a measure of stunting and of long-term health and nutritional experience), weight-for-height z-scores (a measure of wasting), and weight-for-age z-scores (another measure of long-term health and nutritional experience) (WHO 1997).

We find that children exposed to privatization for longer periods of time accumulated significantly greater gains in height and weight, both critical measures of long-term health and nutrition. Specifically, height-for-age z-scores and weight-for-age z-scores of children aged 0 – 5 are increasing in the number of months in which the child was exposed to land privatization. This appears to be driven predominately by children aged 0 – 24 months old; impacts on those aged 25 – 60 months old are smaller in magnitude and statistically insignificant. We find no overall impacts on weight-for-height z-scores, a measure of wasting, though we do find some reductions in wasting due to privatization for children aged 25 – 60 months old. Having privatization in effect between the ages of 1 and 1.5 seems to provide the greatest health benefits—possibly due to protective effects of breastfeeding for children younger than a year old,

and reduced vulnerability to health shocks at older ages. We find no evidence of significant gender differences in the effects of privatization.

This study makes two main contributions. First, it provides some of the first evidence to our knowledge on the implications of government vs. private management and ownership of land on the health of young children. It does so by examining not a gradual change in institutions or in tenure security—both of which may be endogenous to a multitude of other factors affecting child health—but by exploiting a natural experiment involving the rapid and near total privatization of previously government-managed land. While land privatization on the scale of post-soviet The Kyrgyz Republic is unlikely to be repeated in another context, the findings of this study have broad-reaching implications for the likely impacts of allocating land and land user rights to individuals instead of governments or communities in developing countries worldwide. Second, we contribute to a growing literature identifying the critical periods in a young child's life when they are most and least vulnerable to external shocks—in this case, the availability of private land.

The remainder of the paper is organized as follows: Section 2 provides background information on land reform and child health in The Kyrgyz Republic. Section 3 describes the empirical strategy, data, and outcomes of interest. Section 4 characterizes our main empirical results. Finally, Section 5 concludes.

2. Background

The Republic of The Kyrgyz Republic declared its independence from the Soviet Union in August 1991. In May 1993, it joined the Commonwealth of Independent States and its official name changed to the Kyrgyz Republic. It is a land-locked, low-income country in Central Asia that is only about 200 square kilometers (almost exactly the size of the U.S. state of South Dakota). It is comprised of seven regions, or *oblasts*, in additional to the independent cities of Bishkek (the capital) and Osh. In 1991, the Kyrgyz Republic had a GDP per capita of $994 (in constant 2010 USD) which quickly plummeted to $571 (in constant 2010 USD) by 1994 (World Bank 2017).

Agricultural production was the country's primary economic activity during the Soviet era and afterward. Throughout 1991—1998, the time period of our study, 63 – 64 percent of the population lived in rural areas. Agriculture's share in GDP was 37 percent in 1991 and steadily climbed to 50 percent by 1996 (though it had declined to 40 percent by 1998) (World Bank 2017). Corresponding to these trends, the share of employment working in agriculture in 1991 was 36 percent, but this steadily rose to 49 percent by 1998, and peaked at 53 percent in 2000—despite the fact that only 7 percent of the country's land is arable (World Bank 2017).

The country implemented a number of rapid, market-oriented reforms in the early 1990s including land reform policies purportedly aimed at making agriculture an engine for economic growth (FAO 2015). Starting in the early 1990s and peaking during 1994–1995, the Government of The Kyrgyz Republic rapidly liquidated 262 state farms and 190 collective farms containing 75 percent of agricultural land (excluding pastureland) and distributed it to individuals. In effect, this initiated the process of privatizing land, and we therefore refer to it as the land privatization of the 1990s. The amount provided to each farmer was based on their employment status, farming experience, and proximity to the farm. Individuals received 99-year transferrable use rights for land shares ranging from 0.1 to 1 hectares. In 1998, a constitutional amendment allowed for private land ownership, and all land use certificates were transformed into landownership certificates (USAID 2011).

The 1990s land privatization did not proceed all at once across the full country given the obvious logistical challenges of a simultaneous reform. To learn about the pattern of privatization, we included a question on the community questionnaire of the 2016 Life in Kyrgyzstan Survey (LIK) asking, "In the 1990s, a large-scaled land reform occurred in Kyrgyzstan that allocated land plots to household. When did the land reform first allocate plots of land in your community (month and year)?" The survey covered between 9 and 51 communities in each oblast. We took the median date (month and year) in each oblast and assigned this as the date of the reform; these dates are shown in Table 1. By taking the median, we hoped to avoid having unknowledgeable individuals providing outlier dates influence our assignment of the timing of privatization.

Table 1: Date of Land Reform

Oblast	Date of reform.
Batken	Jan-96
Chui	Dec-94
Issyk-Kul	Feb-95
Jalal-Abad	Mar-94
Naryn	Sep-92
Osh	May-94
Talas	Mar-94

Notes: The date of reform is calculated by the authors from the Life in Kyrgyzstan survey conducted in 2016. The date is a median date reported by Life in Kyrgyzstan survey participants.

Following the early 1990s land reforms and accompanying tenure security, food production increased by 9 percent and crop production by 19 percent between 1992 and 1998.[1] However, the number of tractors per 100 square kilometers of arable land was effectively unchanged over the same period, rising only from 189.4 to 189.8, providing little evidence of greater mechanization. Cereal yields (kilograms per hectare) in particular declined slightly by about 10 percent during 1992 – 1998. Further, livestock production—a significant share of agricultural production value in the Kyrgyz Republic—decreased by 15 percent during 1992 – 1998. These trends reflect the fact that the vast majority of agricultural production became concentrated in small, individual farms (FAO 2015).

This period of rapid market reforms appeared to coincide with improvements in child health and nutrition in The Kyrgyz Republic. For example, between 1991 and 1998, the under-five mortality rate dropped by 17 percent (from 64.7 per 1,000 to 53.7) and the neonatal mortality rate dropped by 9 percent (from 25.5 per 1,000 live births to 23.1). While data on stunting are not available for more than one year in the 1990s, the prevalence of wasting in children under age 5 dropped by 61 percent between 1993 and 1997, from 8.5 percent to 3.3 percent. Of course, these changes occurred simultaneously with other improvements in public health, including the DPT immunization rate going from 84 percent of children aged 12-23 months in 1992 to 97 percent in 1998, and the measles immunization rate for the same population going from 94 to 98 percent over the same period. This raises the question of how land privatization itself influenced child health and nutrition outcomes.

[1] The crop production index increased from 64.7 to 76.97, the food production index increased from 78.1 to 85.1, and the livestock production declined from 108.6 to 92.6 over 1992 to 1998 (2004 – 2006 = 100).

3. Empirical Strategy

A. Data

Our main data source consists of four repeated cross-sections of Living Standards Measurement Survey (LSMS) data for the Kyrgyz Republic: 1993, 1996, 1997, and 1998. Each survey was nationally representative and carried out during the months of October – November.[2] These data are optimally suited to answer our research questions for several reasons. First, roughly the same sampling methodology, geographic coverage, and questions about our outcomes of interest and relevant control variables were asked in all four rounds, allowing us to compare otherwise similar households and children at different points in time. Second, the data are generally high quality; they are collected by the National Statistical Committee (NATSTATCOM) with technical assistance from the World Bank and are well documented, translated into English, and publicly downloadable (World Bank 1993). Finally, these data importantly span the critical period during which land privatization occurred. Specifically, as Table 1 shows, the dates of privatization range from September 1992 to January 1996 – a period of 3 years and five months. This means that privatization had not yet occurred at the time of the 1993 survey (except for Naryn oblast) but had already occurred at the time of the 1996, 1997, and 1998 surveys – providing useful observations of similar children before and after the reform.

Our analysis examines the health and nutrition status of children 0 – 5 years old (i.e. 0 – 60 months old) in addition to separately considering children aged 0-24 months and 25-60 months. We have data on these children's gender, height, whether they were measured laying down or standing, weight, and age in years for all four years. 48 percent of the children are female and 80 percent live in male-headed households. For 1996, 1997, and 1998, we further know both the year and month of birth. Date of visit is not available, but given the very short window of enumeration (October – November), we assume a November 1st date of visit (the midpoint) and compute age in months accordingly.[3] For the case of 1993 data, unfortunately, month and year of birth are not available and we must use the approximated visit timing (November) and age in

[2] The 1996 survey was split between two time periods—one in early 1996 and one in late 1996. We use the data collected during October – November 1996 in our analysis.

[33] For 1997 and 1998, we further know the day of birth, which we use in z-score calculations.

years to compute age in months.[4] Appendix Table A1 clarifies the data we have and the calculations we make. We argue that any noise in our estimates of child age in months constitutes random measurement error and should thus not bias our estimates of the effects of privatization on child health and nutrition. If anything, we would expect it to make it harder to pick up a statistically significant effect. We further show robustness of our main results to omitting 1993; in such regressions, while we do not see any children that were completely unexposed to privatization, we can compare children of the same age in months with very different exposures due to both the timing of privatization and the year of survey data considered (1996, 1997, or 1998).

Among control variables, we have consistent data over time on several characteristics of the household head: their age, gender, marital status, and ethnicity (Russian, Kyrgyz, Uzbek, and "other"). We also know the oblast in which a household is located. In initial exploration of the mechanisms which might be driving our results, we further include a control for the number of hectares of land "available to the household." We show that the main results still hold, consistent with the fact that land is private (including what this implies for tenure security, ability to use it as collateral, etc) being the driving factor behind child health improvements, as opposed to households simply having more land to farm. Table 2 summarizes these controls variables for each round of data and for the sample overall.

[4] We do so by assuming that May (i.e. 6 months before the survey date of November) is the month of birth. A simple examine illustrates why: assume a child is 3 years old at the time of the November 1993 survey. We know that her age in months must be between 36 and 47 (if it were 35, she would be 2 years old, and if it were 48, she would be 4 years old). We thus assume that she is 42 months old in November 1993 (since (36+47)/2 = 42 when rounded to the nearest integer), implying that she turned 3 in May 1993 (her birth month).

Table 2: Summary Statistics

Variable name	All surveys		Survey 1993		Survey 1996		Survey 1997		Survey 1998	
	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Height for age z-score	3,335	-1.36	652	-0.34	632	-1.34	919	-1.80	1,132	-1.60
Weight-for-age Z-score	3,823	0.03	712	0.60	725	0.06	1,065	-0.23	1,321	-0.09
Weight-for-length/height	3,072	0.83	663	0.71	573	1.12	840	0.76	996	0.81
BMI-for-age Z-score	3,031	0.96	653	0.95	552	1.20	842	0.94	984	0.86
exposed (btw age 0 and age 60 mos.)	4,060	19.74	824	0.12	763	15.63	1,115	24.44	1,358	30.08
Urban dummy	4,136	0.00	824	0.00	777	0.00	1,146	0.00	1,389	0.00
Child's age in months	4,136	32.74	824	16.75	777	32.20	1,146	32.77	1,389	34.06
Child is female	4,136	0.48	824	0.50	777	0.49	1,146	0.47	1,389	0.49
birth month	3312	6.32	na	na	777	6.56	1146	6.34	1389	6.17
birth year	4,136	1994.0	1,991	1.4	777	1993.7	1,146	1994.7	1,389	1995.6
Mos. exposed btw 0-6 mos. of age	4,136	2.47	824	0.25	777	1.61	1,146	2.95	1,389	3.98
Mos. exposed btw 7 & 12 mos. of age	4,136	2.58	824	0.00	777	1.68	1,146	3.12	1,389	4.16
Mos. exposed btw 13 & 18 mos. of age	4,136	2.61	824	0.22	777	1.66	1,146	3.17	1,389	4.23
Mos. exposed btw 19 & 24 mos. of age	4,136	2.58	824	0.00	777	1.82	1,146	3.16	1,389	4.06
Mos. exposed btw 25 & 30 mos. of age	4,136	2.47	824	0.21	777	1.89	1,146	3.12	1,389	3.71
Mos. exposed btw 31 & 36 mos. of age	4,136	2.20	824	0.00	777	1.84	1,146	2.89	1,389	3.14
Mos. exposed btw 37 & 42 mos. of age	4,136	1.86	824	0.25	777	1.78	1,146	2.39	1,389	2.55
Mos. exposed btw 43 & 48 mos. of age	4,136	1.39	824	0.00	777	1.54	1,146	1.65	1,389	1.91
Mos. exposed btw 49 & 54 mos. of age	4,136	0.92	824	0.17	777	1.13	1,146	1.02	1,389	1.26
Mos. exposed btw 55 & 60 mos. of age	4,136	0.30	824	0.00	777	0.40	1,146	0.32	1,389	0.42
Mos. exposed btw 24 & 60 mos.	4,136	9.14	824	0.36	777	8.58	1,146	11.39	1,389	12.98
Mos. exposed btw age 0 & 60 mos.	4,136	19.38	824	0.48	777	15.35	1,146	23.78	1,389	29.41
age of hh head	4,113	46.30	824	15.76	771	44.93	1,136	47.81	1,382	47.28
HH head is female	4,117	0.20	824	0.48	772	0.15	1,139	0.16	1,382	0.16
HH head is married	4,117	0.81	824	0.36	772	0.82	1,139	0.80	1,382	0.80
HH head - Kyrgyz	4,118	0.83	824	0.44	777	0.79	1,137	0.94	1,380	0.83
HH head - Russian	4,118	0.03	824	0.17	777	0.04	1,137	0.02	1,380	0.03
HH head - Uzbek	4,118	0.07	824	0.33	777	0.10	1,137	0.01	1,380	0.09

HH head ethnic: other	4,118	0.06	824	0.31	777	0.08	1,137	0.04	1,380	0.05
HH has land available	4,114	0.90	822	0.73	777	0.90	1,143	0.99	1,372	0.92
Hectares of land available	4,109	1.47	817	0.18	777	3.54	1,143	1.37	1,372	1.16
Born before 1995	4,114	0.48	822	0.73	777	0.60	1,143	0.47	1,372	0.26

Notes: All children in the sample are age 60 months or younger. Rural sample. Note that the birth month for 1993 is missing due to the design of the survey. We assume that all children are born in May of the respective year of their birth. Since the survey was conducted in November 1991, this assumption leads to the assignment of age in months for each child that is based on May birth. Thus, a child born in 1993 will be assigned an age of 6 months.

B. Outcomes

Our primary health outcomes are the three most commonly used anthropometric indices used for children: height-for-age z-scores (a measure of stunting and of long-term health and nutritional experience), weight-for-height z-scores (a measure of wasting), and weight-for-age z-scores (another measure of long-term health and nutritional experience) (WHO 1997). We compute these using the 2006 WHO child growth standards and the Stata program zscore06 (Leroy 2011). Table 2 summarizes these outcome variables.

C. Empirical specification

To estimate the effects of privatization on child health and nutrition outcomes, our main specification examines the effect of a variable indicating the number of months of exposure to privatization. The more months of a child's life spent while privatization was in place, the larger is this variable. For all children interviewed in 1993—with the exception of children in Naryn oblast, where privatization occurred in late 1992—exposure is 0. Given that older children will naturally be exposed for more months purely due to their age, we importantly include fixed effects for child age in months in all specification (60 dummies in total, for the child being age 0 months through age 59 months). These capture all factors related to a child's age that should affect both health and nutrition outcomes in addition to months of exposure. Our main empirical specification, which we estimate using ordinary least squares (OLS), is as follows:

$$Y_{iahjt} = \beta_0 + \beta_1 P_{iahjt} + \beta_2 X_{hjt} + \delta_a + \alpha_j + \gamma_t + \varepsilon_{iahjt} \quad (1)$$

where Y_{ihjt} is a health and nutrition outcome variable for child *i* whose age in months is *a* from household *h* living in oblast *j* in year *t*. P_{ihjt} is a variable capturing the number of months of a child's life they have been exposed to land privatization; its range is from 0 to the child's age in months (i.e. from no exposure to exposure for the child's entire life). δ_a are child age in months fixed effects, α_j are oblast fixed effects, and γ_t are survey year fixed effects. X_{hjt} are household head controls including age, gender, a dummy for being married, and ethnicity (Russian, Kyrgyz, Uzbek, and "other" as the base group). *t* is either 1993, 1996, 1997, or 1998 according to the survey round from which the observation comes. To account for correlation within birth year

cohorts, we cluster standard errors at the birth year level. This specification is similar to that used by Hidrobo (2014) to study the effects of Ecuador's 1999 economic crisis on child health.

Effectively, our econometric specification means that we compare children of the same age (in months) with differential exposures to land privatization due to the timing of its roll-out. The fact that we have four rounds of data, both before and after the reform, in addition to spatial variation in the timing of privatization are what allow us to include not only age in months fixed effects but also region (oblast) and survey year fixed effects.

Given that there exist sensitive periods in a child's life, following Hidrobo (2014), we also estimate a specification that allows exposure to privatization to enter more flexibly. Specifically, instead of assuming a linear relationship between exposure and child health and nutrition outcomes, we break up exposure into five distinct, critical periods: age 0-6 months old, 7-12 months old, 13-18 months old, 19-24 months old, and 25-60 months old. We consider smaller periods (only 6 months in duration) when a child is under age two and thus their health is especially vulnerable to shocks, but lump age two up until a child's fifth birthday into a single category. Our second equation is as follows:

$$Y_{iahjt} = \beta_0 + \beta_1 P_{iahjt}^{0t6} + \beta_2 P_{iahjt}^{7t12} + \beta_3 P_{iahjt}^{13t18} + \beta_4 P_{iahjt}^{19t24} + \beta_5 P_{iahjt}^{25t60} + \beta_6 X_{hjt} + \delta_a + \alpha_j + \gamma_t + \varepsilon_{iahjt} \quad (2)$$

Where P_{iahjt}^{atb} is the number of months a child was exposed to land privatization between the ages of *a* and *b* months old. The coefficients on the exposure variables thus represent the effect of an additional month of exposure to privatization on child health and nutrition outcomes during the corresponding period in the child's development.

4. Results

Table 3 presents OLS results from estimation equation (1), where our outcomes are our three measures of child health and nutrition: the child's height-for-age z-score (columns 1 – 3, a measure of stunting and of long-term health and nutritional experience), weight-for-height z-

score (columns 4 – 6, a measure of wasting), and weight-for-age z-score (columns 7 – 9, another measure of long-term health and nutritional experience) (WHO 1997). We find that greater exposure to land privatization leads children to be both taller and heavier, increasing both measures of a child's long-term health and nutritional experience. It does not, however, affect the prevalence of wasting (low weight-for-height z-score). Further, these effects appear to be predominately driven by young children under age two; effects on children aged 25 – 60 months are smaller by an order of magnitude and furthermore statistically insignificant. This suggests long term positive effects of land privatization for young children.

Table 3: Main child health and nutrition outcome regressions

Dependent variable:	Panel A: Height-for-age Z-score			Panel B: Weight-for-height Z-score			Panel C: Weight-for-age Z-score		
	All	0-24m	25-60m	All	0-24m	25-60m	All	0-24m	25-60m
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Exposed	0.041***	0.167***	0.018	0.011	-0.019	0.019*	0.035***	0.109***	0.01
	(0.01)	(0.04)	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)	(0.03)	(0.01)
Female	0.199*	0.506**	0.067	-0.076	0	-0.084	0.068	0.248*	0.012
	(0.10)	(0.21)	(0.07)	(0.06)	(0.13)	(0.06)	(0.08)	(0.11)	(0.08)
N	3261	1022	2239	3005	992	2013	3799	1240	2559
R squared	0.13	0.21	0.08	0.04	0.04	0.05	0.08	0.14	0.05

Source: LSMS 1993, 1996, 1997 and 1998 data (World Bank). The date of land reform (to calculate months a child was "exposed" to reform) is based on 2016 Life in Kyrgyzstan survey (which provided the month and year).
Notes: These are OLS regressions. The sample includes children aged 0-60 months old at the time of the survey. The regressions are estimated for children who live in rural areas. "Exposed" is the number of months a child was alive during the land reform. All regressions include survey year fixed effects, oblast fixed effects, child age in months fixed effects, and controls for household head: age, gender, a dummy for being married; and ethnicity (Russian, Kyrgyz, Uzbek, with "other" being a reference group.) Standard errors are clustered at the year of child birth level and appear in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

We next turned to our analysis of critical periods to learn more about when in a child's life exposure to privatization has the greatest returns to health (Table 4). What we find is that it is not very early childhood—specifically, the period between 0 and 12 months—in which a child benefits most from exposure to land privatization. A null effect could be consistent with breastfeeding insulating such young children from health shocks and thus preventing them from being either harmed or benefited by exposure to land privatization. However, if anything, these very young children are harmed by exposure. This could be do to fewer parental investments of other kinds in young children following privatization—such as if parents are working longer

hours or making investments that reduce children's consumption today (including reduced breastfeeding due to more parental work). However, once children get slightly older (possibly past breastfeeding age) and yet remain quite young, we see substantial improvements in height-for-age z-scores in 13 – 18 month olds. These effects wear off and are not present among 19 – 24 month olds. Finally, while we see small benefits of exposure to land reform for 25 – 60 month olds, these are far smaller in magnitude when compared to the benefits for 13 – 18 month olds. Overall, this suggest broad benefits for young children aged 0 – 5, but they are largest among children in the middle of the age distribution.

Table 4: Effect of exposure to land privatization on child height-for-age Z-scores, considering critical periods

	All	0-24m	25-60m
	(1)	(2)	(3)
Months exposed between 0-6 months of age	-0.041*	-0.082	-0.034
	(0.02)	(0.08)	(0.03)
Months exposed between 7 & 12 months of age	0.016	-0.190*	-0.03
	(0.05)	(0.09)	(0.06)
Months exposed between 13 & 18 months of age	0.120**	0.584***	0.057
	(0.05)	(0.15)	(0.06)
Months exposed between 19 & 24 months of age	-0.041	-0.255	-0.016
	(0.03)	(0.13)	(0.05)
Months exposed between 25 and 60 months of age	0.028*		0.025***
	(0.01)		(0.01)
Female	0.196*	0.492*	0.069
	(0.09)	(0.21)	(0.06)
N	3315	1025	2290
R squared	0.12	0.22	0.08

Source: LSMS 1993, 1996, 1997 and 1998 data (World Bank). The date of land reform (to calculate months a child was "exposed" to reform) is based on 2016 Life in Kyrgyzstan survey (which provided the month and year).
Notes: These are OLS regressions. The sample includes children aged 0-60 months old at the time of the survey. The regressions are estimated for children who live in rural areas. "Exposed" is the number of months a child was alive during the land reform. All regressions include survey year fixed effects, oblast fixed effects, child age in months fixed effects, and controls for household head: age, gender, a dummy for being married; and ethnicity (Russian, Kyrgyz, Uzbek, with "other" being a reference group.) Standard errors are clustered at the year of child birth level and appear in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

We next examined if these effects varied by gender (Table 5). Girls are often more physically healthy and resilient than are boys. Thus, one might hypothesize that the benefits of land reform would accrue more to boys. However, we find no evidence that the effects of our exposure variable vary by gender.

Table 5: Effect of exposure to land privatization on child height-for-age Z-scores, by gender

	All	0-24m	25-60m
	(1)	(2)	(3)
Exposed	0.043***	0.172***	0.015
	(0.01)	(0.04)	(0.01)
Exposed × Female	-0.003	-0.012	0.006
	(0.01)	(0.02)	(0.01)
Female	0.266*	0.634**	-0.109
	(0.15)	(0.29)	(0.19)
N	3261	1022	2239
R squared	0.13	0.22	0.08

Source: LSMS 1993, 1996, 1997 and 1998 data (World Bank). The date of land reform (to calculate months a child was "exposed" to reform) is based on 2016 Life in Kyrgyzstan survey (which provided the month and year).
Notes: These are OLS regressions. The sample includes children aged 0-60 months old at the time of the survey. The regressions are estimated for children who live in rural areas. "Exposed" is the number of months a child was alive during the land reform. All regressions include survey year fixed effects, oblast fixed effects, child age in months fixed effects, and controls for household head: age, gender, a dummy for being married; and ethnicity (Russian, Kyrgyz, Uzbek, with "other" being a reference group.) Standard errors are clustered at the year of child birth level and appear in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 6: Effect of exposure to land privatization on child height-for-age Z-scores, with land availability controls

	All	0-24m	25-60m
	(1)	(2)	(3)
Exposed	0.043***	0.171***	0.018
	(0.01)	(0.04)	(0.01)
Female	0.187**	0.480***	0.061
	(0.08)	(0.16)	(0.09)
HH has land available	-0.484***	-0.696**	-0.378**
	(0.15)	(0.33)	(0.16)
Hectares of land available	0.013***	0.008	0.016***
	(0.00)	(0.01)	(0.00)
N	3241	1016	2225
R squared	0.13	0.22	0.09

To explore the mechanisms which might be driving our results, we next tried including controls for both whether the household has land available to them to use and the number of hectares of land available (Table 6). We find that our main results on height-for-age z-scores still hold; in fact, the coefficient on our exposure variable is now slightly larger in magnitude (0.043 compared to 0.041) and still statistically significant. That our results still hold is consistent with

not access to land, but rather the characteristics of land, driving our results. That is, tenure security, the ability to use land as collateral, and all else that comes with having private land seems to explain the health improvements, rather than the mere fact of having access to land, or the amount of land one has access to.

5. Conclusion

Overall, our paper suggests that privatizing land holds great potential for long-term child health—especially that of very young children (under age 2). More research is needed on the precise mechanisms driving these impacts, but our initial analysis suggests that it may not be simply the availability of land to cultivate that is driving the results. Even among individuals with similar land availability, we see significant effects of land privatization on child health and nutrition outcomes. If privatizing land indeed lends tenure security and ability to use land as collateral, this may have implications for the investments households make and the risks they take. Future research should consider these attitudes and investments are impacted following privatization.

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Appendix Tables

Appendix Table A1: Calculation of child's age in months.

Survey year	Month survey conducted	Date of survey administration assumed for child age calculation	Child age in years availability	Year of birth avail.	Month of birth avail.	Day of birth avail.	Age in months calculation
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1993	Oct-Nov	1-Nov-93	YES	based on age in years	NO	NO	Assume that May (i.e. 6 months before the survey date of November) is the month of birth for all children (given a year) and calculate age in months
1996	Oct-Nov	1-Nov-96	YES	YES	YES	NO	survey date - birth date
1997	Oct-Nov	1-Nov-97	YES	YES	YES	YES	survey date - birth date
1998	Oct-Nov	1-Nov-98	YES	YES	YES	YES	survey date - birth date

Appendix Table 2: Main child health and nutrition outcome regressions without 1993 data

Dependent variable:	Panel A: Height-for-age Z-score			Panel B: Weight-for-height Z-score			Panel C: Weight-for-age Z-score		
	All	0-24m	25-60m	All	0-24m	25-60m	All	0-24m	25-60m
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Exposed	0.025*	-0.37	0.009	0.011	-0.032	0.02	0.023**	0.109	0.004
	(0.01)	(0.23)	(0.02)	(0.01)	(0.42)	(0.01)	(0.01)	(0.06)	(0.01)
Female	0.252*	0.560*	0.121	-0.081	-0.025	-0.098	0.084	0.201	0.052
	(0.12)	(0.26)	(0.07)	(0.07)	(0.18)	(0.06)	(0.09)	(0.11)	(0.08)
N	2609	822	1787	2342	748	1594	3062	1007	2055
R squared	0.07	0.10	0.06	0.05	0.05	0.06	0.05	0.07	0.06

Source: LSMS 1993, 1996, 1997 and 1998 data (World Bank). The date of land reform (to calculate months a child was "exposed" to reform) is based on 2016 Life in Kyrgyzstan survey (which provided the month and year).
Notes: These are OLS regressions. The sample includes children aged 0-60 months old at the time of the survey. The regressions are estimated for children who live in rural areas. "Exposed" is the number of months a child was alive during the land reform. All regressions include survey year fixed effects, oblast fixed effects, child age in months fixed effects, and controls for household head: age, gender, a dummy for being married; and ethnicity (Russian, Kyrgyz, Uzbek, with "other" being a reference group.) Standard errors are clustered at the year of child birth level and appear in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Appendix Table 3: Effect of exposure to land privatization on child height-for-age Z-scores, with modifications to reform date (+/- one year)

	Panel A: Move reform timing one year forward (allow delayed effects)			Panel B: Move reform timing one year backward (allow anticipatory effects)		
	All	0-24m	25-60m	All	0-24m	25-60m
	(1)	(2)	(3)	(4)	(5)	(6)
Exposed	0.028***	0.066	0.005	0.039***	0.071**	0.034***
	(0.01)	(0.07)	(0.02)	(0.00)	(0.03)	(0.00)
Female	0.198*	0.472*	0.068	0.195*	0.476*	0.063
	(0.09)	(0.22)	(0.06)	(0.10)	(0.22)	(0.06)
N	3251	1011	2240	3259	997	2262
R squared	0.12	0.21	0.08	0.10	0.14	0.08

Source: LSMS 1993, 1996, 1997 and 1998 data (World Bank). The date of land reform (to calculate months a child was "exposed" to reform) is based on 2016 Life in Kyrgyzstan survey (which provided the month and year).
Notes: These are OLS regressions. The sample includes children aged 0-60 months old at the time of the survey. The regressions are estimated for children who live in rural areas. “Exposed” is the number of months a child was alive during the land reform. All regressions include survey year fixed effects, oblast fixed effects, child age in months fixed effects, and controls for household head: age, gender, a dummy for being married; and ethnicity (Russian, Kyrgyz, Uzbek, with "other" being a reference group.) Standard errors are clustered at the year of child birth level and appear in parentheses. * p<0.10, ** p<0.05, *** p<0.01.