Long Shadows:
contemporary anthropometric consequences of Kazakhstan's collectivization-induced famine, 1931-1933

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Kazakhstan famine: collectivization and “sedenterization”

Literature Review

- General Background of Soviet Famines in early 1930s
- Kazakh Famine in 1931 - 1933
- Kazakh Famine and Chinese Famine: A comparative perspective
- Anthropometric Measurement

General Background of Soviet Famines in early 1930s

- Dekulakization-Debaization / Collectivization

Dekulakization: Under Soviet context, the word “kulak” refers to the class of “wealthy, grasping peasant”. “Bai” referred to wealthy Kazakh nomadic herders. Dekulakization/debaization was the process intended to erase the whole class of kulaks and transform their land into collective land, and to seize and redistribute wealthy nomads’ herds. The total amount of peasants who were affected by dekulakization was roughly 6 million (Conquest, 1986).

Collectivization: the process intended to transform small-scale farming into large-scale collective farming. By 1930, “more than half of rural households had undergone some degree of collectivization, (including) more than 60 million people in all and more than 35 million adults" (Tauger, 2014).

Through dekulakization/collectivization, Soviet government had substantially improved its ability to extract agricultural surplus from peasants. In 1930, the grain requisition from government increased by 30% compared to the previous year, and the amount of requisition for 1931 was even more aggressive (Livi-Bacci, 1993, p. 745).

Following dekulakization/collectivization and excessive grain procurement, famines started to emerge. In Ukraine, the crude death rate reached 60.8 (per 1000 population) in 1933, which was more than 3 times of the normal death rate (Livi-Bacci, 1993). in Urals Region, though not among the most severely regions affected by famines, the death rate still exceeded the birth rate (Kessler, 2001).

Kazakhstan famine, 1931 - 1933

- In Kazakhstan, an estimated 1,450,000 people (equivalent to 38 percent of population) perished in the famine (Pianciola, 2001).
- Kazakhstan had traditionally been a largely nomadic economy. The majority of population in Kazakhstan were nomadic or semi-nomadic herdsmen. In the late 1920s, only 23 percent of Kazakhs were entirely sedentary (Pianciola, 2001).
- Thus, in Kazakhstan, efforts to collectivize nomads were accompanied by efforts to sedentarize them permanently. The implementation of “collectivization on the basis of sedentarization” allowed Soviet government to extract grain and meat surplus from Kazakhs (Cameron, 2016).

Kazakhstan famine, 1931 - 1933

- Moreover, northern and eastern Kazakhstan were areas where central Soviet authorities wanted to expand grain cultivation" (Pianciola, 2001). Thus, these regions were likely to have experienced higher level of collectivization and sedentarization than other regions in Kazakhstan.
- This pattern invites comparison with Kyrgyzstan, which also had a predominately nomadic population, but in which there was far less pressure to collectivize and sedenterize, and in which nomadic life-styles continued for many more years.
- It also invites comparison with ethnic Uzbeks, who tended to live nearby or in Uzbekistan, and who were historically sedentary.
- During the process of sedentarization, large numbers of peasants lost their livestock and were forced to settle in a pre-determined places, unless they fled (Cameron, 2016).
- Territorially-limited famine started in Kazakhstan as early as the spring of 1930. However, widespread dissemination of famine across the country started in 1931, and ended in 1933 (Pianciola, 2001).

Kazakh Famine and Chinese Famine: A comparative perspective

- The Chinese Great Famine In 1959-1961 is another man-made catastrophe under central-planning economies, which led to as many as 45 million of deaths (Dikotter, 2010).
- It's helpful to compare the Kazakh Famine with the Chinese famine, since they share some important common features.
- First, they both occurred under a collectivized agricultural system.

In China, Mao Zedong launched the "Great Leap Forward" movement in 1958 aimed at boosting both agricultural and industrial output. In agriculture, huge efforts were made to mobilize rural laborers and collectivize individual households' farmland into large communes for organizing large-scale agricultural projects such as irrigation (Kung & Lin, 2003).

Kazakh Famine and Chinese Famine: A comparative perspective

- Second, excessive government procurement played a crucial role in both famines.

In Kazakhstan, forced requisition of livestock, which was intended to sedentarize nomadic groups and supply meat for urban areas across Soviet Union, led to an 87% decline in total number of livestock from 1929-1934 (Pianciola, 2004).

In China, due to inflexible and progressive grain procurement policy, the regions which historically produced more grain suffered more during 1959-1961 by having higher mortality rates than less productive regions (Meng, Qian, & Yared).

Furthermore, evidence suggest the existence of “systematic bias discriminated against the rural population in the form of excessive grain procurement… and death rates” (Kung & Lin, 2003).

The large population movements in Kazakhstan associated with the famine and weaker population registration at the time make comparisons difficult.

Anthropometric Measurement

Anthropometric measurements can be used to assess the impact of famine due to the following reason:

- Genetic factors are the primary determinants of a individual's height. However, in a large population, genetic differences tend to cancel out with each other. In this situation, variation in adult heights reflect the health status of the population (Steckel, 1995, p. 1903).
- Nutrition of early childhood plays an important role in determining adult height. According to research from NIH, adult height is heavily depending on the growth period from conception to 2 years of age (Perkins, Subramanian, Smith, & Özaltin, 2016).
- Thus, if people suffer severe malnutrition in their early childhood or embryonic period, their final adult height will be lower than their potential adult height. This allows us to measure the impact of famine using adult height.

Anthropometric Measurement

Compared to the conventional measures of economic performance such as GDP, anthropometric measurement has its own advantages:

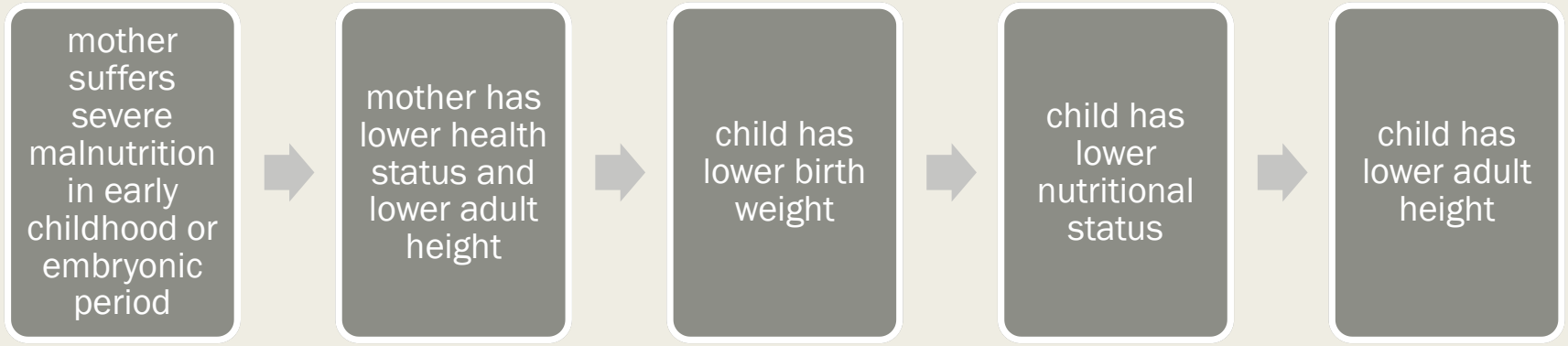
- First, Soviet official economic statistics from the in 1930s are highly suspect, especially in poorly documented, distant regions, and above all during the turmoil of a famine period. Adult height may serve as a good substitute for official statistics since it is unlikely to be systematically falsified. Newborn height is even better, though our observations will mainly be limited to adult height.
- Second, even if the official statistics are reliable, height may still provide information on people's well-being. Measures such as GDP are related to production and may be only loosely related to food intake and quality. Height is a measure of the consumption of basic necessities that incorporates demands placed on one's biological system. Ultimately, height is a function of access to resources (Steckel, 1995).

Anthropometric Measurement

- Third, estimating population losses for Kazakhstan is also problematic. Relative to Ukraine, Kazakhstan is more remote, less populous, and largely nomadic. Nomads are less easily counted than sedentary populations, especially as many fled the country. For these and other reasons, famine losses in Kazakhstan have been far less well documented.
- While there is now voluminous archival evidence of the catastrophe based on reports to government and party authorities, the numeric assessments – that roughly one-third of the population perished – are based on crude intercensal comparisons. Moreover, the original estimates of these losses are in volumes unavailable online or in libraries outside Kazakhstan, so that accessible information is limited to second-hand, fairly cursory summaries of these works.
- Given the enormity of the loss estimates – and the calamitous, panicked reports that serve as corroborating but imprecise evidence – we seek to identify additional empirical evidence of the famine, and, in particular, evidence that will suggest how extreme a disaster it was.
- We do not replicate census estimates, since any work we did in this regard would suffer from the same problems as earlier assessments. Rather, we follow an anthropometric approach, asking how adult heights were affected by the collectivization-induced famine

Anthropometric Measurement

- As it turns out, the negative effect of childhood malnutrition on adult height may persist across generations. Deaton and Dreze (2009) pointed out that "it takes time for the heights of children to catch-up with the genetic potential, given the history of undernutrition". The intergenerational effect can be explained by the following mechanism: "(1) nutritional status is highly influenced by birth-weight, and (2) birth-weight is highly correlated to mother's weight and height" (Deaton & Dreze, 2009).



Hypotheses I

- If mother was born during or shortly after the critical period of the Kazakhstan collectivization famine, her children may have lower adult height.
- The negative second-generation effect on adult height should be more prominent in rural areas, since collectivization and confiscation of private herds (or unsustainable requisitions that amounted to the same thing) were rural phenomena.
- The negative second-generation effect on adult height should be more prominent in Northern and Eastern regions of Kazakhstan due to higher level of enforced sedentarization in these regions.
- Ethnic Kazakhs were at greater risk than non-nomadic Central Asians, or Central Asian populations whose herds were not seized and were not involuntarily collectivized.
- While it seems likely that ethnic Kazakhs would have suffered more than rural ethnically European populations, harsh grain requisitions make this outcome less certain.

Hypotheses II

- Ideally, we would also like to test a third-generation effect: if a maternal grandmother was born during or shortly after the critical period of the Kazakhstan collectivization famine, her grandchildren may have
  - *Lower birth height*
  - *Lower birth weight*
  - *Greater frailty at birth (lower APGAR score)*
- It is also possible that the daughters of a woman born during or shortly following the collectivization famine will be less fecund, so that she will have fewer grandchildren than her "untreated" peers.
- However, sample sizes are small and competing explanations are possible, thereby weakening the strength of third generation tests.

Diff-in-diff Model

- Main specification:

Z-score of height = β_0 + β_1 * **ethnicity indicator** + β_2 * **rural indicator** + β_3 * **region indicator** + β_4 * **famine indicator** + β_5 * (**region indicator** * **famine indicator**) + β_6 * (**rural indicator** * **famine indicator**)

- **Z-score of height** = adult height of Kazakhstan children– average adult height of reference population with the same age) / standard deviation of adult height of reference population with the same age.
- **rural indicator**: indicates whether mother's birth place was in the Northern and Eastern region of Kazakhstan.
- **region indicator**: indicates whether mother's birth place was in the rural area of Kazakhstan.
- **ethnicity indicator**: indicates whether the observation is ethnic European (i.e. Russian, Ukrainian, etc.).
- **famine indicator**: indicates whether mother was born around the critical period of famine. The nutrition level during ages 0-2 and prenatal period is crucial for height. Thus, we initially adopt 1929-1934 as the critical famine period. An alternative specification limiting the treated period to 1931-34 is also explored.

Data

- Primary Dataset: DHS 1995 dataset for Kazakhstan.

This survey includes demographic and health information of thousands of women between age of 15 - 49 in Kazakhstan.

Adult heights of children were gathered from this dataset.

There is no direct information on mother's birth place. However, DHS does include information related to children's birth place. Children's childhood place of residence (rural/urban) and *de jure* region of residence (which is categorized into 5 regions in Kazakhstan) were used as proxies of mother's birth place.

- Secondary Datasets: DHS 1996 dataset for Uzbekistan; DHS 1997 dataset for Kyrgyzstan.

Adult heights of reference population were gathered from this dataset. For each dataset, the whole population as well as its sedentary sub-population are used as reference populations.

Result and Interpretation

Z-score of height	whole UZ	sedentary UZ	whole KG	sedentary KG
ethnicity indicator	0.416*** (0.036)	0.406*** (0.035)	0.471*** (0.038)	0.472*** (0.038)
rural indicator	-0.292*** (0.034)	-0.286*** (0.034)	-0.294*** (0.036)	-0.292*** (0.036)
region indicator	-0.051 (0.043)	-0.052 (0.042)	-0.056 (0.045)	-0.057 (0.045)
famine indicator	0.527** (0.215)	0.522** (0.211)	0.585** (0.226)	0.582** (0.226)
rural indicator * famine indicator	-0.625** (0.305)	-0.618** (0.298)	-0.660** (0.320)	-0.657** (0.320)
region indicator * famine indicator	-0.768** (0.354)	-0.761** (0.347)	-0.821** (0.372)	-0.820** (0.372)
constant	-0.100** (0.033)	-0.106** (0.032)	0.138*** (0.034)	0.142*** (0.034)
R-squared	0.0831	0.0826	0.0877	0.0879
Observations	3,688	3,688	3,688	3,688

- The coefficients of ethnicity indicator and rural indicator are exactly what we expected, since ethnic Europeans tend to have higher adult height due to genetic differences, and people from the rural area tend to have lower nutritional status than their urban counterparts.
- The coefficient of famine indicator is positive, however, in order to get the aggregate effect of famine on the sub-population of interest, we need to combine it with the coefficients of two interaction terms.

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- The coefficients of two interaction terms are both negative and significant at 5 % level.
- A combined negative effect of famine indicator and its interaction with rural indicator, equals -0.10 standard deviations in specification (1).
- A combined negative effect of famine indicator and its interaction with region indicator, equals -0.24 standard deviations in specification (1).

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- The two combined negative effects suggest that mothers being born in the rural area & Northern and Eastern regions of Kazakhstan during the critical period of famine (1929-1934) rendered a negative effect on the height of their daughters, with magnitude of 0.1 and 0.24 standard deviation respectively.
- The results are fairly consistent across different reference populations.

Results and Interpretation

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- These results strongly support the cataclysmic results from comparing census data and from the panicked reports sent by officials to CPSU (party) and regional authorities.
- The positive famine period coefficient suggests that punitive conditions were imposed on the countryside but not the towns.

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- An alternative specification exploring the difference in magnitude of famine's effect between ethnic Europeans and non-Europeans is included in Appendices 1.3. No significant relationship is found.
- Thus, small-sample evidence suggests that rural Kazakhs and Russians both suffered from collectivization.
- Splitting the period suggests that if anything, being born earlier (1929-30) had a stronger effect than being born later (1931-34).

Limitations

- Selection vs. Scarring

Deaton (2007) proposed the analytic framework of selection vs. scarring, which represents two opposite effect of early age malnutrition on adult height.

Selection: low-nutritional environment increases the survival cutoff, so children with weaker physical conditions do not survive. The selection of children with high potential adult height may increase the average height of the population.

Scarring: Children who survive experience a reduction in final adult height due to malnutrition in their childhood, which works in the opposite direction to selection.

Most Studies find that scarring predominates over selection. However, selection may be stronger than scarring at high levels of mortality and low levels of income (Bozzoli, Deaton & Quintana-Domeque, 2009).

Given the large negative effects here, scarring clearly dominates – and note that our estimates are biased downward because of adverse survivor selection bias in the treated population,

Limitations

- Small Sample Size

While the DHS datasets for Kazakhstan include more than 3,500 observations, it only includes 41 respondents whose own mothers were born during 1929 – 1934. Due to an insufficient sample size, low statistical power prevents us from adding highly nuanced variables.

- Migration during the famine

Due to data availability, we are forced to make several assumptions to link daughters' residential information with their mothers. However, during the famine in 1931-1933, a large number of Kazakhs (up to 1.5 million people) fled from rural area to cities or surrounding regions including China, the RSFSR (mainly Siberia and the Urals), and other Central Asian countries (Pianciola, 2001, p. 242). The large-scale out-migration of Kazakhs during this period may strengthen or weaken selection effects.

In addition, there was in-migration of ethnic Russians to Kazakhstan around the period of the famine. They might have been abnormally tall and healthy, thereby creating a selection effect biasing our results upward (though it seems unlikely to dominate the downward-biasing scarring effects.

Third-generation effect

- It is also important to test whether there exists a third-generation effect of famine.
- So far, we have checked the birthweight of grandchildren whose grandmother was born in 1929-1934 in DHS. However, we found only 2 observations and, obviously, no inferences based on that are possible.
- In addition, we also checked the total number of children born to DHS respondents whose own mother was born in 1929-1934. The mean for Kazakhstani women is lower but sample sizes are small.

Country	Number of observations	Mean	Standard Deviation	Min	Max
Kazakhstan	9	1.56	0.88	0	3
Uzbekistan	5	1.6	0.55	1	2
Kyrgyzstan	12	2.83	1.75	1	7

Third-generation effect

- Note that our sample size is very small. In addition, whether to give birth is also driven by nonbiological factors (preferences, marriage patterns, financial constraints). It is possible that these varied systematically for treated and untreated cohorts. Thus, it is unclear whether or not a third-generation effect exists.

- DHS also offers alternative measures of nutritional status in childhood for grandchildren, such as height-for-age, weight-for-height, and weight-for-age. We plan to utilize these measures to continue testing the existence of third-generation effect in a subsequent revision .

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Appendices

1. Alternative specifications

(1) Divide KZ famine into 2 periods: 1929-1930, 1931-1934. (Using sedentary population of UZ DHS as reference population)

Z-score of height	1929-1930	1931-1934
ethnicity indicator	0.409*** (0.035)	0.409*** (0.035)
rural indicator	-0.289*** (0.034)	-0.291*** (0.034)
region indicator	-0.056 (0.042)	-0.062 (0.042)
famine indicator	0.856* (0.312)	0.249 (0.285)
rural indicator * famine indicator	-0.643 (0.447)	-0.542 (0.403)
region indicator * famine indicator	-1.070** (0.480)	-0.524 (0.520)
constant	-0.105*** (0.032)	-0.101** (0.032)
R-squared	0.0825	0.0807
Observations	3,688	3,688

(2)Including interactions of three indicators

Variables (Outcome) (Explanatory)	Z-score of height
ethnicity indicator	0.405*** (0.035)
rural indicator	-0.290*** (0.034)
region indicator	-0.052 (0.042)
famine indicator	0.247 (0.159)
rural indicator * region indicator * famine indicator	-1.349*** (0.416)
constant	-0.103*** (0.032)
R-squared	0.0826
Observations	3,688

(3) Including interaction term of ethnicity indicator and famine indicator.

Variables (Outcome) (Explanatory)	Z-score of height
ethnicity indicator	0.40*** (0.035)
rural indicator	-0.29*** (0.034)
region indicator	-0.05 (0.042)
famine indicator	0.23 (0.315)
rural indicator * famine indicator	-0.39 (0.351)
region indicator * famine indicator	-0.78** (0.347)
ethnicity indicator * famine indicator	0.43 (0.348)
Constant	-0.10** (0.032)
R-squared	0.0830
Observations	3,688

Notes:

1. **All the above specifications use sedentary population of UZ DHS as reference population.**
2. **Small sample size may make coefficients unstable when adding lots of terms.**

Appendices

2. Descriptive Statistics

(1). Ethnic composition of Kazakhstan DHS 1995

Ethnicity	Frequency	Percent
Kazakh	1,937	51.37
Russian	1,178	31.24
Ukrainian	120	3.18
German	116	3.08
Korean	33	0.88
Azerbaijani	17	0.45
Byelorussian	28	0.74
Dungan	43	1.14
Kurd	16	0.42
Moldavian	13	0.34
Tatar	68	1.80
Uzbek	28	0.74
Uyghur	75	1.99
Chechen, Ingush	17	0.45
Polish	8	0.21
Other	74	1.96
Total	3,771	100.00

(2). Region composition of Kazakhstan DHS 1995

Region	Frequency	Percent
Abroad	18	0.48
Almaty	610	16.18
South	919	24.37
West	827	21.93
Central	713	18.91
North and East	684	18.14
Total	3,771	100.00

Note:
North and East Region includes the following Oblasts: Kostanaiskaya, North Kazakhstan, Kokchetauskaya, Pavlodarskaya, Akmolinskaya, Karagandinskaya, East Kazakhstan.

Appendices

2. Descriptive Statistics

(3) Ethnic composition of Uzbekistan DHS 1996

Ethnicity	Frequency	Percent
Uzbek	3,347	75.81
Russian	285	6.46
Kazak	256	5.80
Tadzhik	118	2.67
Korean	43	0.97
Iranian	16	0.36
Karakalpak	158	3.58
Turkmen	28	0.63
Tartar	106	2.40
Ukrainian	13	0.29
Other	45	1.02
Total	4,415	100.00

(4) Ethnic composition of Kyrgyzstan DHS 1997

Ethnicity	Frequency	Percent
Kyrgyz	2,560	66.53
Russian	493	12.81
Kazakh	72	1.87
Uzbek	439	11.41
Korean	23	0.60
Dungan	32	0.83
Uyghur	78	2.03
Tatar	31	0.81
Ukrainian	33	0.86
German	22	0.57
Other	65	1.69
Total	3,848	100.00

Notes:
(1) Sedentary Uzbekistan reference population excludes Kazakh and Turkmen ethnic groups.
(2) Sedentary Kyrgyzstan reference population excludes Kazakh and Uyghur ethnic groups.