The Effect of Early Life Economic Conditions on Child Health in Post-Soviet Russia

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Abstract

The effect of the economic collapse on health has been extensively documented in Russia since the dissolution of the Soviet Union. The proportion of stunted children in Russia increased substantially in this period, but no study has investigated the mechanisms by which this economic collapse impacted child health outcomes. This paper uses an OLS regression followed by a Binder-Oaxaca decomposition to determine the specific economic factors that significantly contributed to this decrease in child heights.

JEL classification: I1**;** I14; J13

Keywords: Child Health, Post-Soviet Russia, Recession

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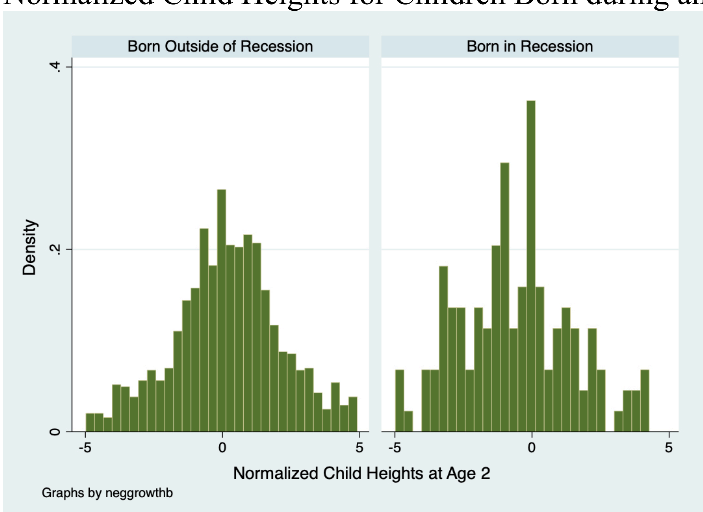
I. Introduction

When the Soviet Union dissolved in 1991, it had already been experiencing economic downturn, but once it officially fragmented, Russia, its largest constituent, experienced absolute economic turmoil. Throughout the 1990s, Russia experienced negative growth rates which had significant long-term impacts on its population. One aspect in particular that has been affected is health. In Russia, life expectancy decreased significantly, with male life expectancy decreasing by 4.0 years and female life expectancy declining by 2.3 years from the years 1991 to 1994 (Leon & Walt, 2000).

Children were also exposed to this collapse in the early 1990s, but only a few studies have explored the impact that this collapse had on the health outcomes of these children. Stunting in children below the age of six increased from 9.1% to 16.3% from 1992 to 1994 (Mroz & Popkin, 1995). The distributions of child height born during the recession and outside of the recession are presented in Figure 1.

Figure 1

Normalized Child Heights for Children Born during and outside of the Recession



Note: Heights are normalized using height-for-age Z-scores by age in month as discussed in the Data section.

Figure 1 highlights that heights for children born during the recession are lower than for children born after of the recession. However, the mechanisms contributing to this decrease in heights are poorly understood, and no study has empirically investigated these mechanisms in Post-Soviet Russia.

Height is primarily influenced by nutrition during the first 1000 days of a child's life from conception to the age of two (Victora, de Onis, Hallal, Blossner, & Shrimpton, 2010), so exposure to poor economic conditions during this formative period could lead to poorer nutrition and decreased height later in life. By using economic factors provided by the Russian Longitudinal Monitoring Survey (RLMS), this paper uses a fixed-effects OLS regression to determine the most important factors that contributed to worsening child health in Russia throughout the 1990s.

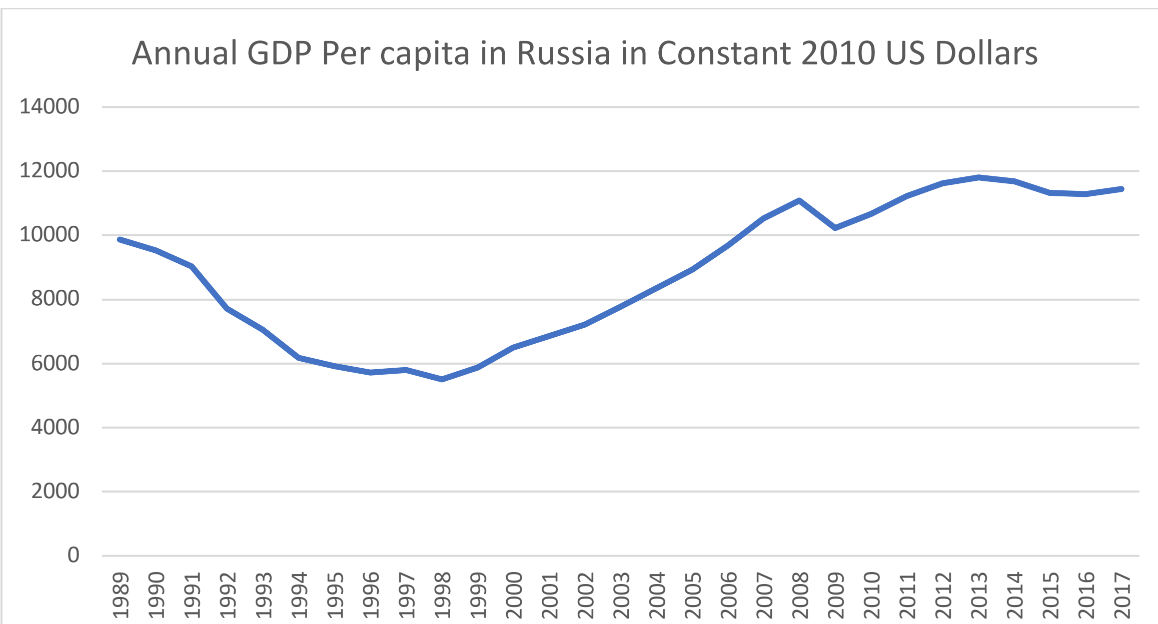
This paper continues with Section II outlining relevant literature. Then, the theoretical approach of isolating the effects of economic conditions on child height is presented in Section III. It follows with the empirical specifications for the regression in Section IV. Section V presents the data and the RLMS. This is followed by results in Section VI. The paper concludes in Section VII with avenues for future consideration and implications of this research.

II. Literature Review

When the Soviet Union dissolved in 1991, the economy of the Russian Federation collapsed. For much of the 1990s, the GDP growth rate of Russia remained negative (Figure 2), and this decline was accompanied by a trove of health consequences. One such health consequence, life expectancy, has been extensively studied. In Russian adults from 1991 to 1994, life expectancy declined 4.0 years in males and 2.3 years in females (Leon & Walt, 2000). Additionally, the prevalence of stunting in Russian children under the age of six increased from 9.1% to 16.3% from 1992 to 1994 (Mroz & Popkin, 1995), but the specific factors that contributed to this increase in stunting has not been investigated empirically.

Figure 2

GDP Per capita in Russia in Constant 2010 US Dollars



Note: Data from World Bank

Stunting is the consequence of malnutrition from prenatal conditions until two years of age (Victora et al., 2010). Even if children have access to better nutrition later in life, they do not fully catch-up to their potential heights (Fedorov & Sahn, 2005). Therefore, there is a specific developmental window during which external conditions during the first 1000 days of life can lead to stunting later in life. Stunting is a critical public health concern as it is associated with poorer cognitive development, lower school achievement, less economic productivity in adulthood, and worse maternal reproductive outcomes such as decreased survival of their children (Dewey & Begum, 2011). Poorer economic conditions have been associated with worse child health outcomes (Boyle et al., 2006), and the poor economic conditions that Russia endured in the 1990s has had a significant, detrimental impact on stunting in children whose developmental window was during this period.

Russia's economic collapse is reflected in annual real GDP per capita. As seen in Figure 2, Russia was already experiencing a decline in GDP during the waning years of the Soviet Union with about -5% growth in 1990 and 1991, but in 1992, after the Soviet Union dissolved in December of the previous year, this growth reached a low of nearly -15%. The growth remained negative for almost the entire decade, until 1999, when Russia's economy finally began to recover.

As mentioned before, the collapse of the Soviet Union had detrimental impacts on health as male life expectancy declined by 4.0 years at birth and female life expectancy declined by 2.3 years at birth on average in all of the Soviet Republics. One study surveyed the literature to explore possible explanations for why this decline occurred. Factors such as injury and violence, cardiovascular disease, and increased alcohol consumption were cited, but these factors should have no major impact on child health. However, the researchers also found that more distal factors, such whether an individual lived in an urban or rural setting and educational attainment of parents, also were associated with life expectancy (Leon & Walt, 2000). These distal explanatory variables could also impact child health outcomes and should be considered in this analysis.

The prevalence of stunting increased from 9.1% to 16.3% from 1992 to 1994 in Russian children under the age of six. Potential explanations include the government eliminating programs that provided free infant formula and other nutrient-dense foods to infants, as well as significant cutbacks in funding provided to kindergarteners (Mroz & Popkin, 1995). Other studies have also examined how height has varied in the Soviet Union since the 1980s. One study finds that although there has been an increasing trend in newborn heights since the 1980s, children born in St. Petersburg between 1994 and 1997 were shorter than children born before and after these years (Mironov, 2007). This paper also suggests other important factors that may impact the health of newborns, including maternal health, age, and socioeconomic status.

Most economic factors affect child height through decreased food availability and subsequently decreased absorbed nutrition. One study examines how food access, production, and consumption impact nutrient intake and consequently nutrient-related mortality and morbidity. In the times of the Soviet Union, food availability was heavily regulated, and there was a heavy emphasis on the consumption of livestock products leading to an excess availability and consumption of calories and protein (Lunze, Yurasova, Idrisov, Gnatienko, & Migliorini, 2015). However, during the economic downturn of the 1990s, consumption of these livestock products was nearly cut in half (Mironov, 2007). This could lead to implications of nutrient deficiencies that could contribute to stunting, especially if diets were becoming less diverse, contributing to essential micronutrient deficiencies.

The World Health Organization recommends five parameters to measures child health. They include height-for-age, weight-for-age, weight-for-length, weight-for-height, and body mass index-for-age (World Health Organization, 2006). This paper will use height-for-age as the parameter to proxy for child health outcomes because of the increase in stunting Russia experienced during the 1990s.

Because there is a developmental window of prenatal conditions and the first two year of life during which an individual's height is strongly influenced, individuals born only half a decade apart, but in drastically different economic conditions, can exhibit very different heights later in life. Since the dissolution of the Soviet Union brought economic recession to Russia, but only for a decade in the 1990s, a comparison of children born throughout the 1990s into the early 2000s can provide insight into the mechanisms by which economic conditions have affected child heights.

III. Theoretical Framework

The literature suggests that the two factors that explain virtually all of the variance in child height are genetics and absorbed nutrition (Fedorov & Sahn, 2005; Silventoinen, 2003; Weise, 2014) and thus can be modelled for an individual by the following equation:

$$H_{i,t} = f(N_{i,t}, N_{i,t-1}, \dots, N_{i,1}, N_{i,0} | G_i) \quad (1)$$

Where $H_{i,t}$ is the height of child *i* in time period *t* and $N_{i,t}$ is the absorbed nutrition of child *i* in time period *t* given a genetic endowment *G*.[1] Although absorbed nutrition in all periods of a child's life has the ability to affect his or her current height, poor nutrition during prenatal conditions and the first two years of life will lead to permanent impairment in height that cannot be fully recovered by improved nutrition in subsequent periods (Cole, 2000; Victora et al., 2010). Previous studies have explored the magnitude of this catch-up effect, and have all found it to be negative and statistically significant from 0, indicating that potential height lost due to poor nutrition in early life is unlikely to be regained (Hoddinott & Kinsey, 2001; Ruel, Rivera, Habicht, & Martorell, 1995; Adair, 1999; Fedorov & Sahn, 2005).

Height at age two is strongly associated with stunting later in life and other adverse health outcomes and is a strong proxy for later life health outcomes. Using height at age two, the catch-up effect does not have to be measured and absorbed nutrition only has to be determined in periods *t=0* to *t=2*. Equation (1) is therefore simplified to the following:

$$H_{i,t=2} = f(N_{i,2}, N_{i,1}, N_{i,0,}\, C_{i,t} | G_i) \quad (2)$$

Where the parameters are the same as in Equation (1).

[1] Time period *t* is the age of child *i,* while time period *t=0* refers to prenatal conditions. Each period corresponds to one year.

Absorbed nutrition is determined by a host of factors, including food consumption, early life illness, and maternal health (Weise, 2014). Food consumption is influenced by economic conditions especially through the channel of food availability. In recession, the most important economic factor that affects food consumption and absorbed nutrition would be household income because of how it affects the ability to purchase resources. However, household wealth is also an important factor because families with more wealth could have a greater ability to withstand shocks in household income. Additionally, regional GDP can also affect absorbed nutrition because a poor regional GDP could indicate a lack of available resources for purchase in the first place. These economic factors coupled with parental factors, such as educational attainment and age, can model absorbed nutrition as in the following equation:

$$N_{i,j,t} = f(Y_{i,j,t},, W_{i,j}, I_{i,t}, P_{i,t=0,}R_{i,r,t}) \quad (3)$$

Where $Y_{i,t}$ is the income of household *j* for child *i* in time period *t,* W_j is the wealth of household *j* for child *i*, I_i is illness experienced by child *i* in time period *t,* P_i are maternal factors such as age during pregnancy, and $R_{i,r,t}$ is the gross regional product for region *r* for child *i* in time period *t*.

Equation (3) can be substituted into Equation (2) and the following equation can be derived:

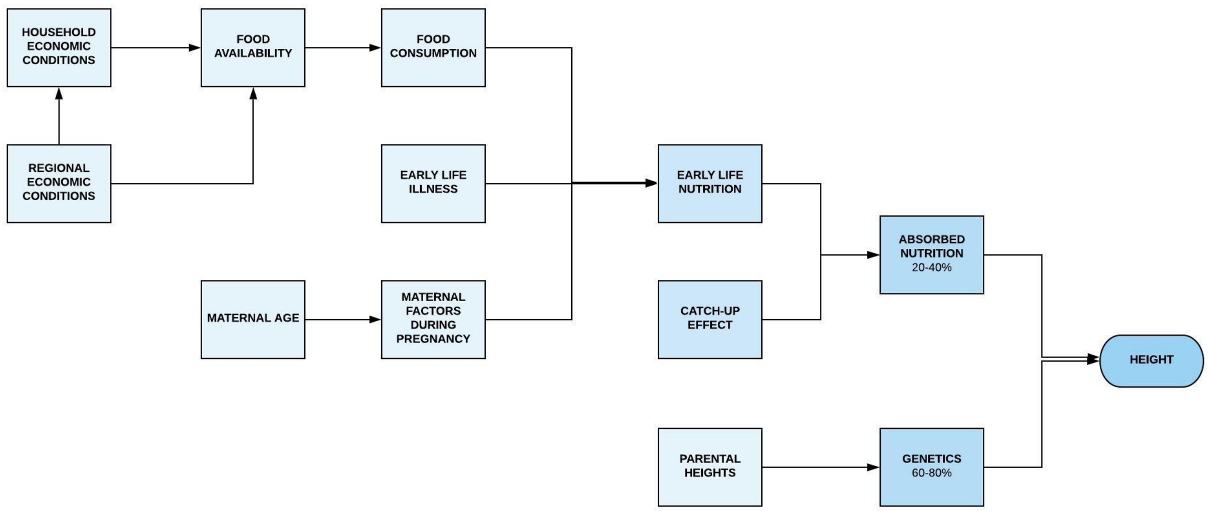
$$H_{i,j,t} = f(Y_{i,2}, Y_{i,1}, Y_{i,0}, I_{i,2}, I_{i,1}, I_{i,0}, W_j, P_{i,t=0,}R_{i,r,t}|G_i) \quad (4)$$

Where the parameters are the same as defined for Equation (2) and Equation (3).

A graphical representation of this model is presented in Figure 3. This model can be used to determine the impact of early life economic conditions on heights of children at age two, and because deficiencies in height at age two are rarely recovered in subsequent periods and lower height is associated with poorer health outcomes, this model can proxy for poorer health outcomes later in life.

Figure 3

Theoretical Framework



IV. Empirical Specifications

A fixed-effects OLS regression is used to determine the impact of economic conditions on child health. This section will specify the variables used in this analysis. The outcome variable of interests is height-for-age Z-score at age two, while the explanatory variables are household and regional economic indicators. There are a number of additional factors that can affect child height, and they need to be controlled in order to isolate the effect of economic conditions. The equation estimated is the following:

$$Z_{i,a,g} = \beta_0 + \beta_1 * HHincome_{i,j,t} + \beta_3 * HHwagearrears_{i,j,t} + \beta_3 * borninrecession_{i,t} + \beta_4 * borninrecession_{i,t} * HHincome_{i,j,t} + \chi + \mu + \gamma + \delta + \varepsilon_{i,j,t} \quad (5)$$

Height-for-age Z-scores, $Z_{i,a,g}$, are used to standardize all heights of children to WHO growth standards. Although children in this analysis are all of age two, this standardization can control for gender, age in months, and can exclude outliers in the data.

Monthly household income during a child's developmental window is used to capture exposure to economic effects and economic wellbeing. Because there is significant correlation between household income for child i in consecutive periods, only household income at age two is considered to avoid collinearity issues. $HHwagearrears_{i,j,t}$ is also included as an explanatory variable to determines if wage deferments in the household during the year of birth of child i have affected later life height. Additionally, a dummy for if child i is born during a recession year is included as is the interaction between being born in a recession year and household income to determine the marginal effect of income when a child is born during the recession.

χ is a set of Household factors to proxy for household wealth to determine if wealth can protect against shocks in household income. Ideally, a wealth index could be constructed using a process such as principal component analysis, but there was not significant correlation between important household assets.[2] This is likely because assets that could contribute to wealth in 1994, such as a computer, are almost universally owned after 2010, and therefore a household wealth index function would be different for different time periods, making comparisons between periods difficult. The household assets in this analysis include having a washer, whether a family lives in a dorm and whether a family rents or owns their place of residence.

Ideally, monthly gross regional product per capita (GRP) for each period from prenatal conditions to the age of two could be included in this analysis. However, because GRP is correlated with household income (r =.341), so a region fixed-effect, μ, is included instead to control for any inherent differences between sampling locations.

Important controls include parental factors, γ, such as height, educational attainment, and maternal age. Household availability of nutrient dense food products is also important. For children in this analysis, household availability of dairy products, δ, is also included. Availability of meat products was also considered, but children under the age of two are not often fed meat.

[2] See Appendix B for correlation coefficients of Household factors.

V. Data

The data source for this analysis is the Russian Longitudinal Monitoring Survey (RLMS). This is a household-based survey developed to assess the impact of Russian reforms on the economic well-being of households and individuals. This survey is nationally representative of Russia through the use of 38 unique primary sampling units and has been conducted annually from 1994 to 2017 with the exception of 1997 and 1999. This analysis makes use of the longitudinal individual, household, and child level data it provides.

The 1994-2015 individual panel data set includes over 500 health and economic variables for 52,950 unique individuals. For the children of interest in this analysis, this data provides reported heights and household information. Because the unique identifiers of parents are not provided for children, parents were determined to be adults living in the household during the same year of data collection who reported having children. At worst, these are a close relative or primary guardian. The heights and educational status of both parents were matched to each child. Additionally, maternal age was also matched to each child.

The individual panel data set was then merged with the 1994-2015 household panel so that household level assets and income were also available for each child. Additionally, the household panel provides information on the availability of dairy products within the household, and these were also matched to each child.

From 1994 to 2004 child heights were measured, as opposed to being reported by a parent or guardian. A t-test was used to compared measured to reported heights for children, and reported heights are about two centimeters lower than measured heights for both boys and girls. This indicates that mixing the two measures of height could bias the results, but using only reported heights increases power by increasing the sample size of the regression by including children past 2004.

Height-for-age Z-scores were computed in the Stata package *zanthro*. Because the RLMS provides child birth months, height-for-age Z-scores were calculated using age in months for a more precise measurement. These height-for-age Z-scores also control for gender.

The regional economic data is provided by *Regiony Rossii* compiled by the Russia/NIS Statistical Publications. In Russia, the real GDP per capita declined sharply throughout the 1990s but begins to recover in 1999 (Figure 2). *Regiony Rossii* provides annual gross regional product for each of Russia's oblasts and republics from 1995-2015. These data are matched to the RLMS data by primary sampling unit of the individual. This data is then matched to each child by birth month to determine monthly prenatal, first year, and second year gross regional product. For example, a child born in January 1997 will have their monthly prenatal exposure determined to be the one-ninth the gross regional product of 1996.

VI. Results

Results for the impact of household economic factors on height can be found in Table 1. The results are presented in two columns to first observe the impact of income controlling for parental factors and then to observe the impact of the household factors and the interactions between being born in recession and household factors.

Table 1.

Regression Results

VARIABLES	(1) Height-for-Age	(2) Height-for-Age
lnincome	0.178***	0.234***
	(0.0456)	(0.0735)
Born in Recession dummy	-0.439**	1.115
	(0.199)	(1.064)
Recession*lnincome		-0.272**
		(0.107)
householdarrear		0.0403
		(0.162)
motherheight	0.0472***	0.0439***
	(0.00884)	(0.00947)
fatherheight	0.0225***	0.0237***
	(0.00791)	(0.00889)
motherage	0.00269	-0.0663
	(0.0531)	(0.0588)
$motherage^2$	0.000186	0.00115
	(0.000802)	(0.000884)
washer		-0.0194
		(0.175)
dorm		-0.458
		(0.409)
rented		0.164
		(0.181)
motherprimaryeduc		-0.146
		(0.213)
mothersecondaryeduc		-0.0389
		(0.139)
fatherprimaryeduc		-0.136
		(0.181)
fathersecondaryeduc		0.0385
		(0.139)
milk		0.0234
		(0.0198)
Recession*milk		0.0504
		(0.0572)
Recession*washer		0.935
		(0.707)
Constant	-13.56***	-12.68***
	(1.962)	(2.249)
Observations	1,260	1,074
R-squared	0.064	0.074
Number of psu	38	38

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results indicate that household income is a statistically significant predictor of height at age two ($p<.01$) when only controlling for parental height and maternal age. The effect remains statistically significant when household wealth variables, parental education, and dairy availability is added and the interaction between being born in recession and income are introduced in column (2). Being born in a recession year is not significant for either regression, likely because the effect of being born in a regression is better explained by other economic explanatory variables in the regression. Household arrears do not seem to matter significantly either, likely because families at risk of wage deferments that affect resource availability already have low incomes, and the effect is already explained by the income variable.

The effects in column (1) are expected as household income improves absorbed nutrition through increased food availability and quality, while parental heights can control for the genetic endowment of children.

Column (2) presents the results when interacting income with being born in a recession year as well an interaction between the wealth variables and being born in a recession year. The results find that for children not born in a recession year, a 1% increase in income is associated with .00234 increased in height-for-age Z-scores at age two ($p<.01$). However, for children born in recession years, a 1% increase in income is associated with a .00038 decreased in height-for-age Z-scores at age two ($p<.05$). This result likely indicates that household with higher incomes were actually affected more by the economic recession as evidenced by the decreased heights of their children. One explanation for this effect could be that households that earn more income are more likely to be located in urbanized centers, which inherently have lower access to fresh produce, meat, and dairy products due to a scarcity of land. This could decrease availability of high-quality foods, and on average, these higher income households have less access to these foods. Even though there is a region fixed-effect to control for potential differences between regions, it is unable to control for differences within regions, and the level of urbanization within each region could vary.

Wealth was also considered in the regression in column (2) due to its potential of mitigating the effect of poor economic conditions on child health. However, none of the included wealth variables are significantly associated with improved child heights. There are a number of possible explanations for this result.

First, wealth could be distributed unequally between regions and the region fixed-effect could be controlling for latent wealth factors. Also, in this period, Russia was transitioning from a planned to a free market economy, so private ownership and wealth were still developing concepts in Russian society at the beginning of this analysis. Thus, most individuals had very little personal wealth to mitigate the effects of poor economic conditions. When wealth was distributed from public to private ownership throughout the 1990s, it was done so unequally with households in more urban regions and oligarchs receiving disproportionately more wealth (Novokmet, Piketty, & Zucman, 2017). This would make wealth only accessible to a few individuals, and the effect in this analysis could be captured in the region fixed-effect and income variables.

Another potential explanation is that wealth does not have a mitigating effect in the first place. Recession could decrease the availability of resources to a point that even the wealthiest households are unable to obtain necessities. This is supported by the finding that children in households with higher income are affected disproportionately by the recession.

A regression without the region fixed-effect can clarify if wealth was being captured by regional differences or if wealth simply does not matter. A regression without the region fixed-effect is presented in column (3) in Table 2. In its place, regional GRP is included to control for regional availability of resources. Columns (1) and (2) are the same as in Table 1 and are included for comparison.

Table 2.

Regression Results with no Region Fixed-Effect

VARIABLES	(1) Height-for Age	(2) Height-for Age	(3) Height-for Age
lnincome	0.178***	0.234***	0.197*
	(0.0456)	(0.0735)	(0.103)
Born in Recession dummy	-0.439**	1.115	1.100
	(0.199)	(1.064)	(1.221)
Recession*lnincome		-0.272**	-0.210
		(0.107)	(0.129)
householdarrear		0.0403	0.198
		(0.162)	(0.188)
motherheight	0.0472***	0.0439***	0.0460***
	(0.00884)	(0.00947)	(0.0133)
fatherheight	0.0225***	0.0237***	0.0238**
	(0.00791)	(0.00889)	(0.0119)
motherage	0.00269	-0.0663	-0.0241
	(0.0531)	(0.0588)	(0.0813)
$motherage^2$	0.000186	0.00115	0.000429
	(0.000802)	(0.000884)	(0.00124)
washer		-0.0194	0.227
		(0.175)	(0.221)
dorm		-0.458	-0.133
		(0.409)	(0.425)
rented		0.164	0.0526
		(0.181)	(0.252)
motherprimaryeduc		-0.146	0.279
		(0.213)	(0.304)
mothersecondaryeduc		-0.0389	0.000141
		(0.139)	(0.192)
fatherprimaryeduc		-0.136	-0.612**
		(0.181)	(0.262)
fathersecondaryeduc		0.0385	-0.160
		(0.139)	(0.182)
milk		0.0234	0.00194
		(0.0198)	(0.0294)
Recession*milk		0.0504	0.0686
		(0.0572)	(0.0604)
Recession*washer		0.935	0.369
		(0.707)	(0.694)
lnyear2GRP			0.274*
			(0.158)
Constant	-13.56***	-12.68***	-16.06***
	(1.962)	(2.249)	(3.149)
Observations	1,260	1,074	569
R-squared	0.064	0.074	0.106
Region Fixed-Effect	Yes	Yes	No

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

These results also indicate that wealth indicators are not a significant predictor of child heights. However, the potential correlation between wealth and income needs to be addressed to definitively conclude that wealth cannot protect against the effect of poor economic conditions on health outcomes. The other findings are similar to the regression in column (2), but the interaction between being born in the recession and household income is no longer significant, while regional income is a significant predictor of child heights (p<.1). This supports the previous explanation that regional GRP, a proxy for availability of resources, is a stronger predictor of child heights than household wealth.

Robustness Check

The low R-squared of .074 indicates that very little variation in child height is explain by variation in the included explanatory variables. A Binder-Oaxaca decomposition was conducted to determine how much of the difference in height between children born during the recession and after the recession was explained by significant components in the above regressions. Results are presented in Table 3.

Table 3

Binder-Oaxaca decomposition of Height-for-Age

VARIABLES	(1) Overall Height-for-Age	(2) explained	(3) unexplained
Born after Recession	-0.0371		
	(0.0756)		
Born during Recession	-0.611***		
	(0.185)		
difference	0.574***		
	(0.200)		
explained	0.338***		
	(0.0943)		
unexplained	0.235		
	(0.211)		
lnincome2		0.0651	1.933*
		(0.0427)	(0.999)
dorm		0.0125	0.0570
		(0.0151)	(0.0605)
milk		0.0191	0.0409
		(0.0182)	(0.132)
lnyear2GRP		0.241***	-1.646
		(0.0861)	(4.193)
Constant			-0.150
			(4.069)
Observations	798	798	798

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results of the Binder-Oaxaca decomposition suggest that there is a significant difference in height-for-age Z-scores between children born during the recession and children born after the recession. Children born during the recession have an average height-for-age that is .574 standard deviations lower than children born after the recession ($p<.01$). This decomposition also finds that about .338 of this .574 difference, or over half, is explained by the four variables included in the decomposition ($p<.01$).

The most significant effect is for gross regional product, which explains over 40% of the total difference by itself ($p<.01$). However, household income, living in a dorm, which could be a proxy for class and wealth, and access to dairy explained very little of this difference. This result supports the earlier assertion that availability of resources is a strong predictor of child health.

This decomposition also indicates that about 40% of the difference in height is not explained by the included variables, but this is not statistically significant compared to the portion of the difference that is explained. The most likely reason for this unexplained difference is that there are some omitted variables such as information on child illness, health care quality, government programs that subsidize child nutrition, or even maternal stressor during pregnancy due to economic hardship (Mulder et al., 2002).

Limitations

One potential limitation of this analysis is the inability to control for child illness early in life. Early life illness can decrease absorbed nutrition and height. However, illness is partially dependent on health care quality and whether a household can afford doctors and medicine. These aspects of illness can be partially controlled by household income and the regional fixed-effect, but whether a child is inherently more likely to be sick is not considered due to data limitations. One variable that was considered was frequency of visits to the doctors for a child. However, this could be endogenously determined in this model because children who are shorter and stunted are also more likely to be inherently ill (Dewey & Begum, 2011).

Additionally, because there was already an increasing trend in child heights in Russia during this period (Mironov, 2007). and the recovery period is after the recession period, the difference in heights between the two periods could be potentially explained by this increasing trend. This trend could be a component of the unexplained difference in the Oaxaca decomposition. Including children born before the recession in the reference group could control this trend, but the RLMS only began collecting data during the recession.

VII. Conclusions

The analysis presented in this paper suggest that most of the decrease in child heights in Russia experienced throughout the 1990s can be explained by household and regional economic factors. Particularly, household income and gross regional product are significant predictors of height both during and after the recession.

The effect of income is positive for children born after the recession, but the effect of income is negative for children born during the recession, potentially because children living in households with higher income were disproportionately affected by the recession when compared to children living in households with lower incomes. Additionally, household wage deferments do not appear to have a significant effect on child height, likely because households for which wage deferments would have a detrimental impact on child health already have low incomes.

Wealth indicators also do not appear to have a significant effect on child height. However, gross regional product is significant. Households with higher wealth could potentially withstand poorer economic conditions, but because of the significance of GRP in predicting child heights, overall availability of resources appears to be more associated with improved child heights than household wealth. Future research should explore the effect of wealth in free market economies and in different recessions to determine if it has any impact on child health.

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Appendix

Appendix A
Summary Statistics of Included Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Height-for-Age	1,529	.1177035	1.98195	-4.9842	4.911779
lnincome	1,783	9.940428	1.373358	3.912023	16.30042
Born in Reccession	1,884	0.0997877	0.2997963	0	1
Recession*lnincome	1,783	0.8379256	2.791403	0	16.30042
hharrears	1,577	0.2016487	0.4013585	0	1
motherheight	1,835	163.504	6.402391	142	185
fatherheight	1,628	176.1015	7.232609	132	200
motherage	1,884	29.51964	8.035314	16	49
motherage2	1,884	935.9411	533.0564	256	2401
washer	1,882	0.7996812	0.4003453	0	1
dorm	1,884	0.0254777	0.1576128	0	1
rented	1,884	0.1257962	0.3317076	0	1
motherprim~y	1,883	0.1242698	0.3299767	0	1
motherseco~y	1,883	0.3345725	0.4719661	0	1
fatherprim~y	1,637	0.1789859	0.3834577	0	1
fatherseco~y	1,637	0.4086744	0.4917391	0	1
milk	1,876	3.292964	3.439134	0	21
Recession*milk	1,876	0.2446695	1.454684	0	21
Recession*washer	1,882	0.0860786	0.2805547	0	1

Appendix B
Correlation Matrix of Regression Variables

	lnincome	Born in Recession	n~lnin~2	hharrears	motherheight	fatherheight	motherage	motherage2	washer
lnincome	1								
Born in Reccession	-0.1158	1							
Recession*lnincome	0.0943	0.9519	1						
hharrears	-0.2322	0.2841	0.2495	1					
motherheight	0.1269	-0.0567	-0.0473	-0.0302	1				
fatherheight	0.0711	-0.0596	-0.0589	-0.039	0.1862	1			
motherage	0.1971	-0.0066	0.0083	0.0035	-0.0446	-0.0191	1		
motherage2	0.1844	0.008	0.0218	0.0133	-0.0519	-0.0287	0.9911	1	
washer	0.1433	0.0398	0.0534	0.0002	0.1157	0.1046	0.0038	-0.0086	1
dorm	-0.0325	0.0157	0.0237	0.0585	-0.0483	0.0192	-0.0412	-0.0367	-0.0853
rented	-0.0788	-0.0213	-0.0277	-0.0075	-0.0024	0.0811	-0.1966	-0.1824	-0.1088
motherprim~y	-0.0591	-0.0369	-0.0315	0.0449	-0.0905	-0.0914	-0.071	-0.0576	-0.1726
motherseco~y	-0.0803	0.0947	0.0898	0.0398	-0.0601	-0.1264	0.0065	0.0342	-0.0522
fatherprim~y	-0.0547	-0.0494	-0.0583	0.0092	-0.054	-0.0913	-0.0314	-0.0232	-0.1936
fatherseco~y	-0.0994	0.1024	0.1041	0.0961	-0.1117	-0.1377	0.0338	0.0408	-0.0454
milk	0.261	-0.0579	-0.0252	-0.0783	0.0667	0.0362	0.112	0.0996	0.0801
Recession*milk	0.0876	0.5461	0.589	0.1036	-0.0067	-0.019	0.0338	0.0414	0.0153
Recession*washer	-0.0599	0.9304	0.9076	0.2777	-0.0401	-0.0189	0.0051	0.0184	0.1321

	dorm	rented	Mother primary	Mother secondary	Father primary	Father secondary	milk	Recession* milk	Recession* washer
dorm	1								
rented	-0.0544	1							
motherprim~y	-0.0272	0.063	1						
motherseco~y	0.0029	0.0088	-0.22	1					
fatherprim~y	0.0437	0.0488	0.1889	0.0613	1				
fatherseco~y	0.024	-0.026	0.0314	0.1918	-0.3606	1			
milk	-0.0037	-0.0481	-0.0089	-0.0324	-0.0007	-0.0822	1		
Recession*milk	0.0036	0.0161	-0.0271	0.0412	-0.0484	0.0499	0.2718	1	
Recession*washer	0.0013	-0.0417	-0.0357	0.0901	-0.0658	0.0941	-0.0578	0.499	1