

Population Aging and Households' Saving in the Russian Federation

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Abstract

Using household data from the Russian Longitudinal Monitoring Survey, this paper assesses how aging affects saving. To overcome a systematic bias against the life-cycle hypothesis of survey data, the paper estimates how the age profile of saving changes when the micro data are corrected to account for the contribution to pensions (as additional saving) and receipt of benefits from pensions (as dissaving). With these corrections, the Russian data support the life-cycle hypothesis. A small decline in the aggregate saving rate, because of aging, can thus be

expected. However, since aggregate saving rates result from a combination of age and cohort effects, this decline may not be significant. When extrapolating the rising trends of the cohort effect, the fact that younger generations are earning and saving more than older generation at the same age, the projection shows a growing aggregate saving rate. The changes in saving of future cohorts, for example because of changes in the growth rate of the economy, can affect the aggregate saving rate even more than aging.

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Population Aging and Households' Saving in the Russian Federation¹

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1 Introduction

Russia is aging. The share of the population over 60 years old more than doubled from 7.7 percent in 1950 to 18 percent in 2010, while the share of very old people (80 or more) increased almost five-fold, from 0.6 to 2.9 percent. This process of population aging, closely reflecting regional demographic trends of falling birth rates and somewhat lengthening life spans (Bussolo, Sinnott, Koettl 2015),³ is expected to continue over the next decades, “eventually leading to a convergence in the proportion of older people in the countries of Eastern and Western Europe” (Gavrilova and Gavrilov 2009: 113).

This graying of the Russian population poses concerns in terms of a potential reduction of households’ saving. In its simplest version, the life-cycle theory (Modigliani and Brumberg, 1954) posits that, to smooth their consumption over time, people save very little or even borrow when young, save building up assets throughout their working lives, and draw down wealth (or dissave) in old age. For individuals, the age profile of the saving rate has thus a hump, or inverted U, shape. At the aggregate level, the macroeconomic saving rate is negatively influenced by aging. An increase of the share of the elderly – by raising the proportion of those who dissave in the population – is associated with a contraction in savings.

Numerous empirical studies have tested this basic prediction using both macroeconomic and microeconomic data (for a recent survey see Attanasio and Weber, 2010). This literature highlights several limitations of both macro and micro data. In particular, in a series of papers Deaton and Paxson⁴ pointed out that using households’ surveys data to infer saving behavior incurs two main problems. The first is that the life-cycle theory considers individual saving decisions; but, in most surveys, savings are measured at the household, not at the individual level. Household’ saving choices cannot be straightforwardly linked – as in the theory – to the age of an individual. The age of the head of the household is often used but since household composition changes there is not a one-to-one correspondence between the age of the head of the household and the average age of the household members. A second problem originates from how data are collected and classified in surveys. Pension benefits are normally recorded as income flows, even when a large fraction of these benefits represents drawing down of assets (Deaton 2005: 98; UN 2009: 182). In addition,

³ One of the specific features of the aging process in the Russian Federation and in other Eastern European countries is that it is mainly driven by fertility reductions. Old age mortality has not improved as much as in other parts of the world. This has led to a situation where the Russian society is aging but individuals are not.

⁴ Deaton 1997, 2005; Deaton and Paxson 2000a, 2000b, 1994.

young and middle aged workers typically do not account the contributions made by their employers to their pensions as part of their saving. The surveys' under-reporting of both dissaving at older ages and saving at younger ages generates a systematic bias against the life-cycle hypothesis.

Using the Russian Longitudinal Monitoring Survey (RLMS), this paper assesses how aging affects household saving in the case of the Russian Federation and attempts to overcome the second of the problems just mentioned. Specifically, it estimates how the age profile of saving changes when the micro data are corrected to properly account for pensions' contributions and receipts.

The results show that Russian survey data support the life cycle hypothesis, but only if the savings implications of pensions are accounted for. That is, survey data, without any adjustment for how pension contributions and benefits are treated, misleadingly show that savings rates increase with age throughout the life cycle. In particular, elderly households appear to have the highest saving rates.⁵ However, when pensions' contributions and receipts are explicitly accounted for, the RLMS data show the expected hump-shaped saving-age profile: a rise of the saving rate during middle-age working years and a decline after retirement. Similar to the findings by Munnell (1976), Edwards (1996), Dayal-Gulati and Thimann (1997), and Bosworth and Burtless (2004), this pronounced difference in life-cycle patterns suggests that public pension schemes tend to substitute for private old-age provision.

The estimated saving-age profile is then used in combination with demographic projections up to the year 2050 to gauge the potential impact of future aging on aggregate saving rates. The exercise shows a declining trend of savings rates due to aging. However, this decline may not be as disruptive to the Russian economy as sometimes assumed. This is because future saving will result from a combination of an age effect and a cohort effect. The micro data shows that younger generations (or cohorts) tend to save more than their parents at the same age, and this cohort effect counterbalances the negative age effect.

In fact, from 1998 onwards, after a sharp decline in the early transition period, the national saving rate (calculated from the survey data) begun a significant rise. This is primarily explained by a positive cohort effect, as younger Russian cohorts save a larger fraction of their income than

⁵ This result is consistent with the findings by Chamon and Prasad (2010) and Belke, Dreger and Ochmann (2012), who argue that older households tend to increase their savings due to bequest motives and due to the risk of high medical expenses in old age.

did prior generations. These higher savings rates of younger cohorts may be associated with higher rates of economic growth and increasing real per capita incomes (see Loayza et al 2000; Ang 2009). This positive cohort effect can also be tied to rising life expectancy and to the enhanced probabilities of child survival, which encourages saving for bequests.

Projections of future saving rates are thus influenced by assumptions on population aging and on the sign and magnitude of the cohort effect. If the increasing role (i.e. a positive, growing cohort effect) of younger generations will continue to 2050, a strong increase in the aggregate household saving rate is projected. However, when assuming the trend to halt, i.e. when assigning the cohort effect of the last observed cohort to all future new-born generations and when pension fund contributions and receipts are assumed to form part of the saving aggregate, the estimated run-down of assets in old-age causes the forecast of the macroeconomic saving rate to also be hump-shaped. Under this scenario, an increase in aggregate household saving rate up to approximately 2035 is projected, followed by a contraction in subsequent years.

An additional contribution of this paper consists of a systematic comparison of the historical aggregate saving rates estimated from macro (or national accounts) data and micro (RMLS based) data. This comparison highlights that household savings rates calculated from the survey data are well below those calculated from the macro data. This holds for all years considered. The trends in the micro and macro saving estimates also diverge, although the difference in the trends decreases after 2000. One reason for these differences is that household surveys tend to under-sample very rich individuals and thus underestimate total savings and their rate of change.⁶ This suggests that the richest segment of the Russian population holds a very large share of total savings. The concentration of saving is, in fact, already observed in the Russian household survey. The richest 10 percent of the sample of the survey (which does not correspond to the actual richest segment of the Russian population) holds up to 45 percent of total household savings. Saving rates are also much higher towards the top of the distribution: the richest 20 percent saves on average 12 percent of their incomes, while the middle deciles save around 4 percent, and lower deciles have negative saving rates.

⁶ The discrepancy may also originate from how foreign and domestic cash holdings are recorded (there seems to be an underreporting of these in the RMLS) and how housing and other real estate is accounted for. The differences in the rates of change of saving calculated from macro or micro data may also be explained by the fact that richer individuals may be better able to absorb shocks by varying their large wealth buffers. Indeed as shown below in Figure 1 – panel b, national accounts (macro) saving rates show a higher degree of variation than micro saving rates.

The remainder of the paper is structured as follows. Section 2 presents the data and discusses different approaches and caveats when estimating patterns in household saving from RLMS microdata. Our approach to estimating the relationship between savings and aging, and the regression results, are presented in Section 3. The regression results are then used to project future trends in the aggregate household saving rate up to 2050 under different demographic scenarios, which are presented in Section 4. Section 5 summarizes the results and concludes.

2 Data description and measurement issues

The principal data source for this case study is the second phase of the Russian Longitudinal Monitoring Survey (RLMS), the first nationally representative randomly selected household sample for Russia.⁷ Data were collected in 17 annual waves between 1994 and 2012, with the exception of 1997 and 1999, when no surveys were conducted. Our sample period features two periods of economic crises: the downturn over the transition period 1994-1996 cumulating in a domestic economic crisis in 1998, and the global economic crisis in 2008-2009.

To construct the data set for our analysis, we eliminate all observations with missing income data and keep only households in which the head is 20-80 years old. To control for outliers, observations have been pooled across households for each year, and the 1st and the 99th percentile of the per capita income, consumption and savings rate variables have been trimmed (see Appendix A.1 for detailed data and variable descriptions).⁸

2.1 Micro-macro comparison

Calculating savings from survey data can be complicated. Simply subtracting per capita household current consumption from current income in the RLMS data will not provide a reliable estimate of savings, because incomes were greatly underreported in the surveys in the early transition years until about 2003, partly due to tax evasion (Gorodnichenko *et al* 2009 and Appendix A2). However, saving can also be calculated from the accumulation account, i.e. from how the surplus (if income exceeds current expenditures) is used, or how the deficit (current

⁷ For information on the weights in RLMS data please refer to <<http://www.cpc.unc.edu/projects/rlms-hse/project/samprep>>. Adding a fourth post-stratification step, the analysis weights were rescaled using UN population data so that the sum of weights within each 5-year birth cohort matches the corresponding census proportion.

⁸ The RLMS is administered by the National Research University Higher School of Economics (HSE) and ZAO “Demoscope” together with the Carolina Population Center, University of North Carolina at Chapel Hill and the Institute of Sociology RAS.

consumption exceeds income) is financed. More specifically, household saving are calculated as the sum of the net change in financial assets⁹ minus the net change in liabilities plus the net change in real estate holdings in the last 30 days as follows:

Purchases of stocks, bonds, and other securities	
+ Current cash savings	
+ Foreign currency bought with the aim of saving	
– Sales of shares and other securities	
– Cash savings spent	
– Sales of foreign currency and valuables	
= Net change in Financial Assets (ΔFA)	
Money amount borrowed	
– Debt repayments made to creditors	
– Money lent outside the household unit	
+ Debt repayments received from creditors	
= Net change in liabilities (ΔL)	
Purchases of dacha, house, apartment, land, or garage	
+ Purchase of building materials	
– Sales of personal property	
= Net change in real estate holdings (ΔRE)	
Savings = $\Delta FA - \Delta L + \Delta RE$	

These estimates of savings from the micro data can then be used to calculate the saving rate (the ratio of saving to current incomes¹⁰) and compared with the official macro household saving rate, reported in the Russian official National Income and Products Accounts (NIPA).

The household savings rate calculated from the survey data is significantly lower than the official rate from the national income accounts, for every year from 1994 to 2012 (panel a of Figure 1). Moreover, as Panel b) indicates, the micro and macro saving estimates diverge not only in levels but also in their patterns over time, although the annual percentage point change of both

⁹ From 1994 to 1995, the question on whether (and how much) the family took money out of savings in the last 30 days was reformulated to whether (and how much) the family spent savings, sold jewelry or foreign currency savings over this time horizon. Since the value reported for 1994 is accordingly not comparable, at the aggregate level we use the average income share derived from savings or jewelry sold over later years to impute the share for 1994. For the decomposition analysis, we use savings data starting from 1995.

¹⁰ Note that current incomes are obtained as the sum of current expenditures plus saving, since current incomes directly measured from the data are not reliable.

estimates have moved closer together since the turn of the century. The discrepancy between the micro and macro estimates is particularly pronounced for the early survey years between 1994 and 1996. Likely causes of this discrepancy include the fact that household surveys do not sample the very rich segment of the population which tend to have fairly high saving rates and accumulated assets (see below section 2.3 for more details). Another reason is the underreporting of purchases of foreign or domestic currency in the RLMS, and the inclusion of housing and other forms of real estate in the calculation of savings from the RLMS. According to statistics from the Russian Statistical Committee (Goskomstat), between 1992 and 1996, 14 to 16 percent of household income was accumulated in foreign currency (Gregory *et al* 1999).

Figure 1: Comparison household saving rates calculated from micro and macro data



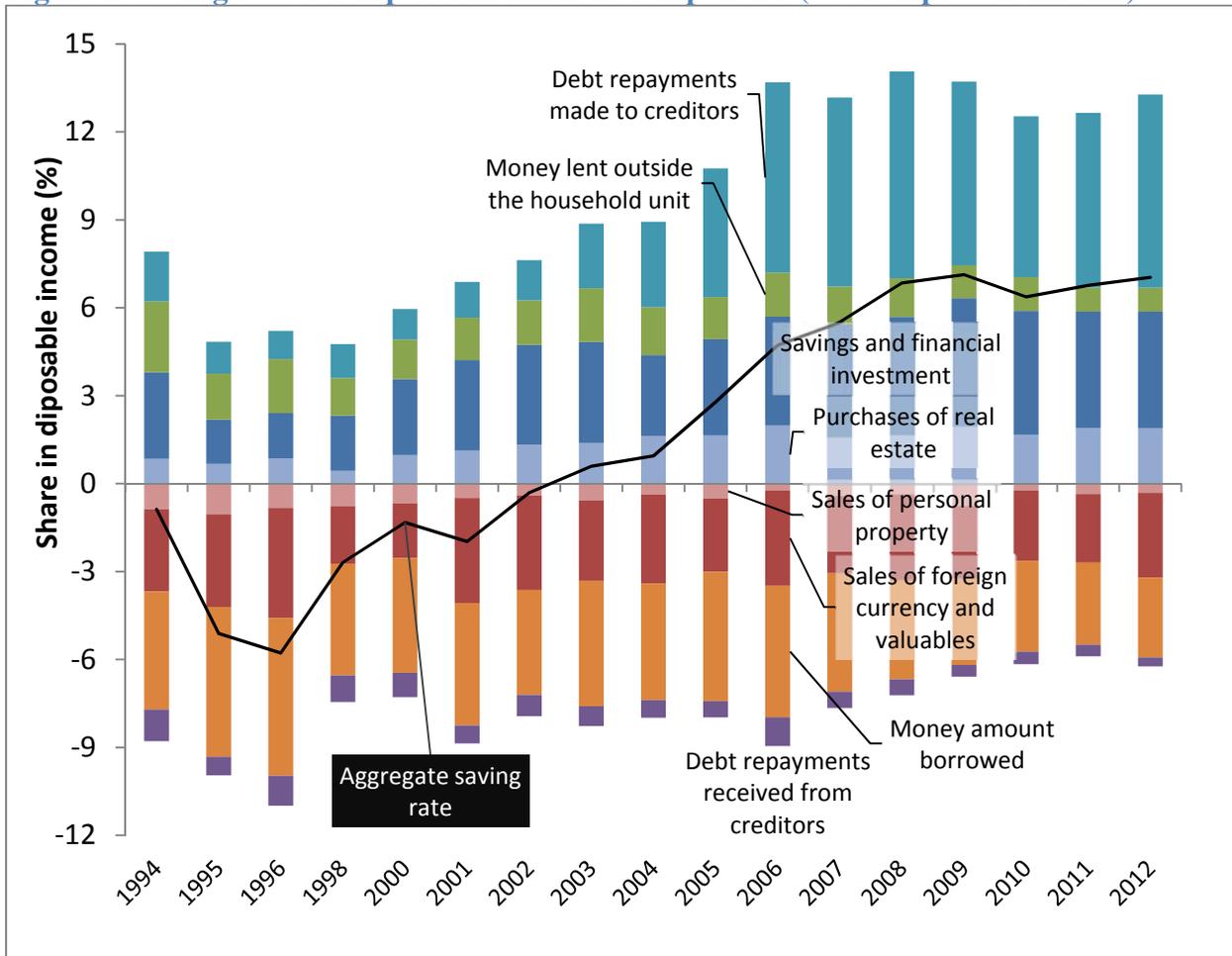
Source: World Bank calculations using RLMS household survey and ROSSTAT national accounts data.

Another potential source for the discrepancy between micro and macro estimates is the inclusion of housing and other forms of real estate in the calculation of savings from the RLMS

data. With the privatization of the housing sector, real estate holdings became a valuable asset and an important form for many Russians to accumulate and transfer wealth. However, due to the way in which the question is formulated, sales of real estate cannot be distinguished from other property sales in the survey data. Therefore, by including all sales of property as dissaving, dissavings may be overestimated while savings underestimated. Property sales, however, make up a small share of total dissaving, and no large bias is expected by accounting for them. But real estate purchases, especially after the year 2000, are much larger than property sales and not accounting for them would bias downward the saving rate calculated from the RLMS data (and increase the discrepancy with the National Accounts saving rate).

The negative household savings rate calculated from the micro data may reflect the substantial rise in borrowing by Russian households (TABLE 1 and Figure 2). This trend can be associated with the abolition of the mono-bank regime and the creation of a large number of small banks, coupled with the lack of regulation during the first years of Russia's transition from a planned to a market economy (see, e.g. Bokros *et al* 2001). From 1998 onward the increase in household liabilities flattened, and from 2005 repayments exceeded the amount of new credit taken. The observed pattern of negative household saving between 1994 and 2002, turning positive from 2003 onwards, also matches with reports of income remaining below consumption up to 2003, suggesting that this may not only be caused by income underreporting.

Figure 2: Saving rate decomposed in different components (% of disposable income)



Source: World Bank calculations using RLMS household survey data.

Although standing in sharp contrast to the national accounts data, the estimated substantial decrease in Russian household saving rates in the micro data over the early transition years (1994-1996) may be reasonable. This finding confirms the Barro-Grossman prediction of falling saving rates in reaction to the removal of rationing (Barro and Grossman 1971; see Howard 1976 for an empirical application to the Soviet Union).¹¹ It also matches the argument in Gregory *et al* (1999) that the collapse of output in the early transition period primarily reflected falling investment (rather than consumption), attributed to the abolition of the administrative-command system,

¹¹ The Barro-Grossman disequilibrium model assumes a framework in which the quantity of consumer goods available is less than consumer demand, i.e. there is excess demand generally due to government enforced price controls. In this setting, a decrease (increase) in the amount of goods available on the state and cooperative retail market leads to a decrease (increase) in labor supply, an increase (decrease) in demand on the collective farm market and other free markets and an increase (decrease) in household saving.

where savings had been provided by a state budget fed by enterprise profit taxes and turnover taxes and by a banking system that controlled enterprise depreciation and retained profits.

TABLE 1 Saving rate decomposed in different components (% of disposable income)

year	Δ fin.	$-\Delta$ credit	Δ RE	saving rate
1994	0.15	-0.99	-0.03	-0.88
1995	-1.64	-3.09	-0.38	-5.11
1996	-2.21	-3.60	0.04	-5.78
1998	-0.08	-2.28	-0.33	-2.69
2000	0.74	-2.36	0.29	-1.33
2001	-0.50	-2.13	0.64	-1.98
2002	0.18	-1.41	0.93	-0.31
2003	0.70	-0.92	0.81	0.59
2004	-0.26	-0.04	1.24	0.94
2005	0.79	0.86	1.13	2.78
2006	0.46	2.53	1.75	4.74
2007	1.20	3.11	1.20	5.51
2008	1.08	4.43	1.33	6.84
2009	1.89	4.03	1.21	7.13
2010	1.82	3.11	1.44	6.37
2011	1.64	3.59	1.54	6.76
2012	1.09	4.38	1.57	7.04

Source: World Bank calculations using RLMS household survey and ROSSTAT national accounts data.

2.2 Treatment of pension contributions and receipts

The RLMS savings data presented so far do not adequately reflect the implications of pension contributions and receipts for savings calculations.¹² By contrast, an appropriate adjustment, which captures the net change in household pension entitlements, is done for the savings calculation from the national income accounts (UN 2009: 180).¹³ The idea is that as people contribute to a pension plan throughout their working lives, the corresponding entitlements constitute the acquisition and disposal of financial assets and represent liabilities for the units ultimately responsible for paying the pensions. Thus, in the national income accounts, the change in net equity of households in pension funds is added to household savings (OECD 2011: 62). Pensions due under social

¹² See Lustig and Higgins 2013 for a detailed discussion of the treatment of pensions in analyzing savings behavior over the life cycle.

¹³ The savings ratio is usually calculated by dividing saving by disposable income. However, the entry of the change in pension entitlements in the disposable income account complicates this calculation. It is necessary to calculate total disposable income, which should be the denominator in the savings ratio calculation, by adding the adjustment for the change in pension entitlements (UN 2009: 183).

assistance and social security schemes are excluded from these calculations and treated as current transfers (UN 2009: 181f).

In household survey data, however, pensioners' households tend to report pension payments received under any scheme as part of their income, even though a substantial fraction of these receipts actually represents the drawing down of assets (Deaton 2005: 98; UN 2009: 182). At the same time, young people typically do not think of the contributions made by their employers to their pension plans as part of their saving, and thus tend to exclude these payments when asked to state their income and saving. "In consequence, the use of uncorrected household survey data is systematically biased against the life-cycle hypothesis, understating both the (youthful) saving and (elderly) dissaving components" (Deaton 2005: 98).

This bias is difficult to correct, for two main reasons. First, household survey data generally do not report the fraction of gross pre-retirement income that is used to finance accrued pension entitlements. As a closer look on the Russian pension scheme reveals (see Appendix A.3 for a description of the Russian pension system), imputing these contributions is extremely difficult due to the complexity of the pension system, which applies different rules to certain groups of pensioners and people of different birth cohorts, in part due to the numerous pension reforms. Second, classifying mandatory contributions to federal, state, and local government pension and insurance schemes as saving, and the pension benefits received from those funds after reaching retirement age as dissaving, is problematic because contributions and receipts under public pension and insurance schemes, similar to social security contributions and benefits, are mandated by government and do not reflect the outcome of household decision-making (Gale and Sabelhaus 1999: 187). On the other hand, government pension systems at least partly substitute for individual old-age provision, and thus cannot be ignored when analyzing life-cycle saving.

Following the methodology suggested by Lustig and Higgins (2013), this study presents two scenarios: i) a benchmark case in which pension receipts from any scheme are treated as social transfers, so that no adjustment is made to the survey data; and ii) an alternative in which the survey data are adjusted so that pension fund contributions and receipts enter into the savings aggregate, i.e. in which all pension receipts are considered as a rundown of post retirement wealth and hence classified as dissaving. The actual situation is probably somewhere between these two extremes.

For the second, pension adjusted, case, pension contributions are imputed by estimating the contribution rate which, if applied to all forms of labor income, would balance the pension fund, i.e. which equilibrates pension contributions and receipts.¹⁴ This method is admittedly very simplistic given the complexity of the Russian pension system; but it still provides a useful starting point. In fact, the contribution rate estimated using data for each of the years of the survey (see TABLE 2) averages 22 percent, matching almost perfectly with the official rate of insurance premium to the Pension Fund of Russia (applied to wages below the set limit value), which was fixed at 22.0 percent in 2012.¹⁵

TABLE 2: Estimated contribution rates to pension funds (% of labor income)

1994	1995	1996	1998	2000	2001	2002	2003	2004
24.19	23.83	22.08	27.29	24.81	23.37	23.07	22.24	21.03
2005	2006	2007	2008	2009	2010	2011	2012	Average
21.29	18.17	17.18	17.70	20.72	25.02	23.83	24.18	22.35

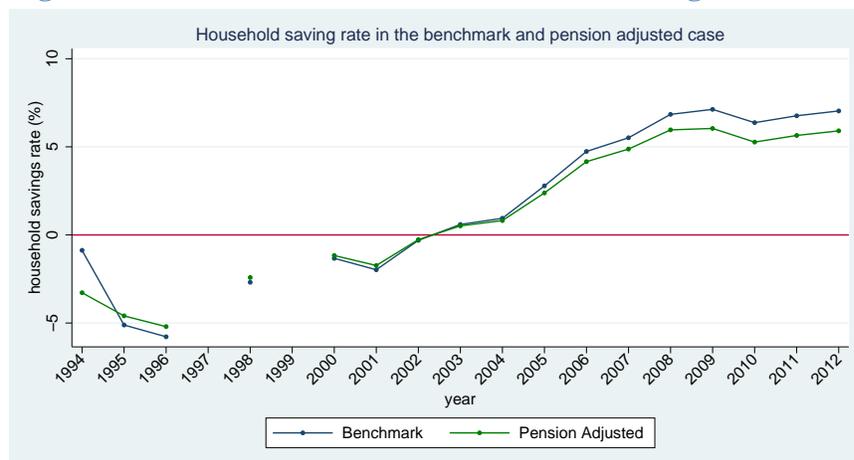
Under the pension adjusted scenario, for each household the net difference between imputed pension fund contributions and observed pension receipts is added to the savings calculations. Due to the imputation method, total pension contributions and receipts balance at the aggregate level, so that total household saving (as an amount of money) is identical under both scenarios. However, in the adjusted case, pension fund contributions enter into the calculation of gross disposable income, which explains the difference between the benchmark and pension adjusted households' savings *rates* displayed in Figure 3.

¹⁴ The option was considered to approximate the contribution rate as rate which would lead the household saving rate estimated based on RLMS data to coincide with the aggregate household saving rate reported in the national accounts. However, a comparison between the RLMS benchmark saving rate and official NIPA estimates reveals a large gap which cannot be attributed exclusively to the treatment of pensions, but must be assumed to result from other discrepancies in micro and macro measurements.

Several caveats of this simplistic way of treating contributions and receipts need to be highlighted. First, given the way that the Russian pension system is organized, not all pension receipts should be treated as dissavings (the basic pension arguably rather represents a government transfer, see Appendix 3). However, data limitations do not allow to differentiate between pension types. Second, not all workers contribute to pension plans and, in particular, self-employed and informal sector employees should be excluded. However, very few individuals reporting to be self-employed are recorded in the RLMS data, and excluding them from contribution payments does not affect the estimated contribution rates. Finally, information on formal employment contracts or share of labor revenues over total income are not available for all survey years and thus, again, cannot be used to adjust the estimation of the contribution rate. However, the hump shape of the saving-age profile – for this particular dataset – depends on the way pension receipts are treated (as either dissaving or simple income flows) rather than on how the contributions are estimated and included. In fact, a hump remains even when contributions are fully excluded (i.e. the contribution rate is zero).

¹⁵ For more information see: www.pfrf.ru

Figure 3: Sector shares (%) in total national saving



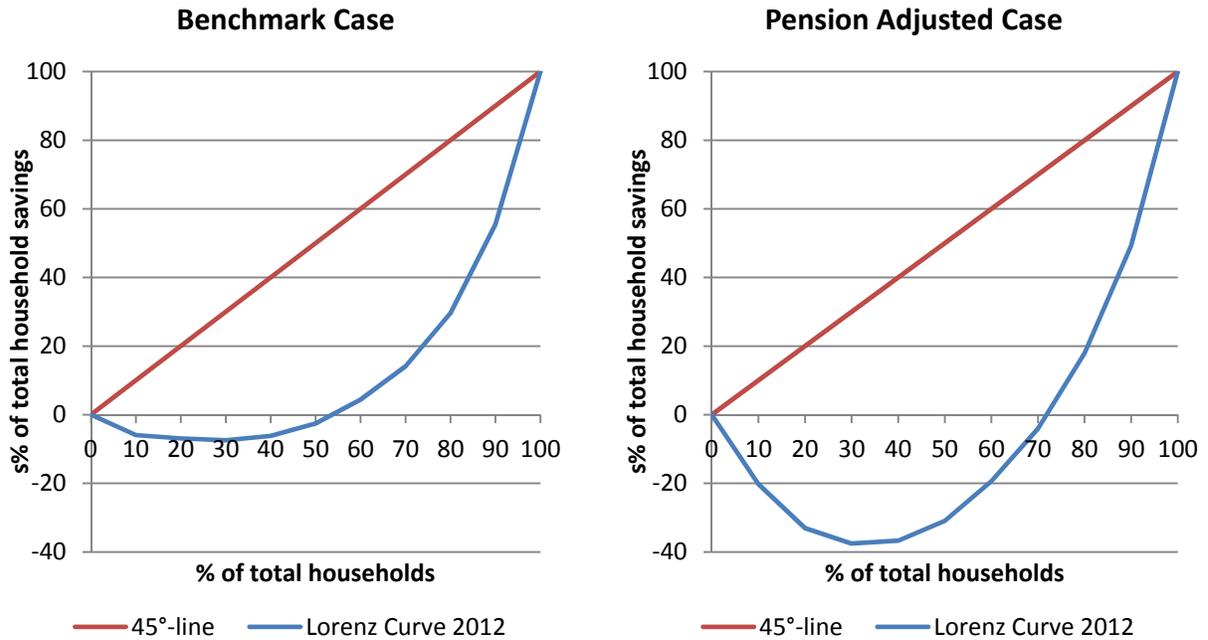
Source: World Bank calculations using ROSSTAT national accounts data.

2.3 The Concentration of Saving

Accessing administrative data, such as income taxes, could provide an accurate way to verify whether saving at the top of the distribution are very high and thus drive the discrepancy between the RMLS and the national accounts estimates of aggregate savings. However, the fact that savings (both in amounts and as a proportion of incomes) are much higher for the richer segments is already indicated by considering the (incomplete) household survey data.

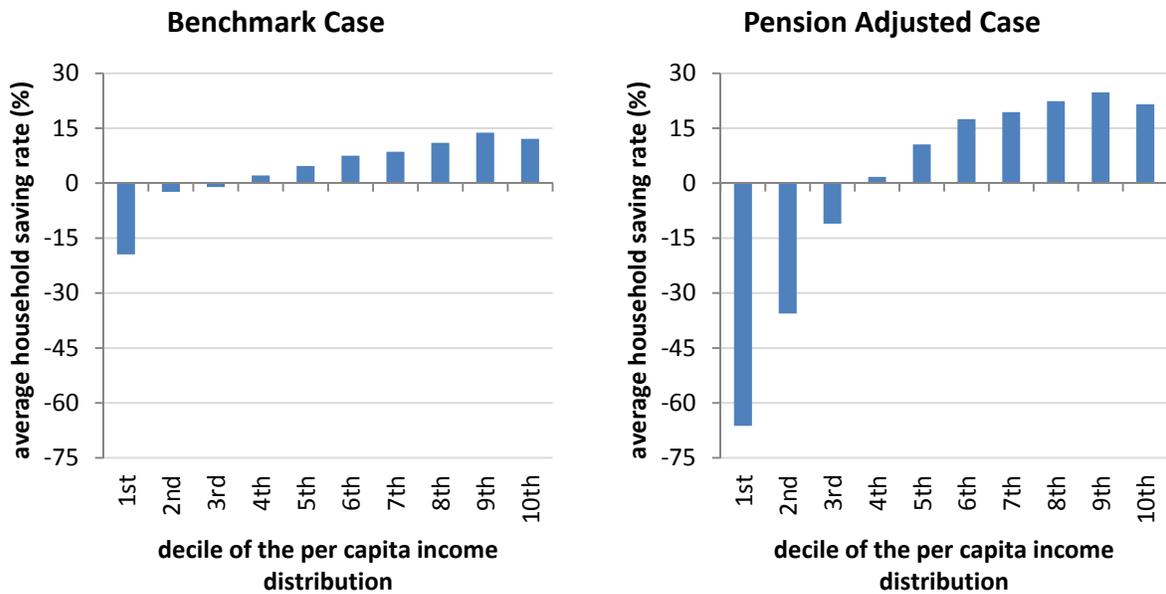
There is a high concentration of national household savings at the top of the income distribution. This was most pronounced immediately after the 1998–99 domestic economic crisis. It has been decreasing in recent years, but as Figure 4 illustrates, in 2012 the richest ten percent of all households still accounts for approximately 45 percent of total household saving in Russia. This concentration in the top quintile is not only due to higher disposable incomes of richer households, but can also be traced back to increasing saving rates along the income distribution, as shown in Figure 5. The right-hand panels of Figure 4 and Figure 5 furthermore reveal households at the lower end of the income distribution to be highly dependent on the national pension system, while households in the top quintile show positive rates of wealth accumulation even when pensions are treated as a form of dissaving.

Figure 4: Concentration of household savings, 2012



Source: World Bank calculations using RLMS household survey data.

Figure 5: Household saving rate by income decile, 2012



Source: World Bank calculations using RLMS household survey data.

3 Estimating a model of savings behavior

This paper estimates the relationship between age and saving rates using the life cycle model (a derivation of the estimation method from the life cycle model is provided in Appendix A4). After having constructed a pseudo-panel from the RLMS data, savings are estimated as a function of the age of the household head, the birth cohort to which the household head belongs, and the year in which the household was interviewed.¹⁶ The main objective of the estimation is to isolate the age effect from the cohort and time effects.¹⁷

3.1 Household savings model

Using repeated cross sections of household surveys, it is possible to track the average consumption and the average income of cohorts (defined as groups of individuals with the same year of birth) over the life cycle. Denoting individuals by ‘*i*’, cohorts by ‘*c*’ and age by ‘*a*’ and assuming that the interest rate is constant, the life cycle theory predicts that, for individual *i*, consumption at a specific age should be proportional to lifetime resources and that such proportion should depend on age, i.e.:

$$c_{i,a} = f_i(a)W_i$$

taking the average of the logs of the equation above for all individuals born within cohort *c*, gives:

$$\overline{\ln c_{c,a}} = \overline{\ln f(a)} + \overline{\ln W_c} \quad (1)$$

where the bar denotes the average.

¹⁶ Income, consumption and saving are averaged over individual households belonging to each sample ‘cell’; a ‘cell’ is defined according to the year of birth (cohort) of the household head and the year in which the interview was conducted. The evolution of the cohort averages over time is the focus of the analysis.

¹⁷ The RLMS is one of the few long-running household panels in either developed and developing countries, which enables tracking individuals and individual households over time. However, in analyzing average behavior, it can be preferable to use semi-aggregated cohort data, rather than genuine panel data (see Deaton 1997 for a more detailed discussion). As this semi-aggregated cohort data is based on the full data set, it avoids the problem of non-random attrition in panel data. Taking averages by year and birth cohort of the household head, cohort data can furthermore be used to control for unobservable fixed effect (just as with panel data) and have the advantage of reducing the effects of measurement error and enhancing the signal-to-noise ratio (Attanasio 1993: 8; Deaton 1997: 103f). Additionally, “[b]ecause there are many cohorts alive at one time, cohort data are more diverse and richer than are aggregate data, but their semi-aggregated structure provides a link between the microeconomic household-level data and the macroeconomic data from national accounts” (Deaton 1997: 101), an aspect particularly valued in the analysis of this paper.

The above equation can be estimated by regressing the average of the logarithm of consumption for cohort c observed at $c + a$ on a set of age dummies, which will capture the age effect $\overline{\ln f(a)}$, and cohort dummies, accounting for the lifetime resources $\ln W_c$:

$$\overline{\ln c} = D^a \alpha_{csp} + D^c \gamma_{csp} + u_{csp} \quad (2)$$

where $\overline{\ln c}$ is a stacked vector of log consumption levels with elements corresponding to each cohort in each year, D^a is a matrix of age dummies, and D^c is a matrix of cohort (i.e. year of birth) dummies. The coefficients α_{csp} and γ_{csp} are the age and cohort effects in consumption, and u_{csp} is the sampling (or equivalently measurement) error that comes from the fact that $\overline{\ln c_{c,a}}$ is a sample estimate of the average log consumption of all individuals born in cohort c and observed at $c + a$. Corresponding to equation (2), income is estimated according to the following equation:

$$\overline{\ln y} = D^a \alpha_{inc} + D^c \gamma_{inc} + u_{inc} \quad (3)$$

where α_{inc} and γ_{inc} are the age and cohort effects in income.

Subtracting (2) from (3) yields:

$$\begin{aligned} s_{i,a}/y_{i,a} \approx \overline{\ln y} - \overline{\ln c} &= D^a (\alpha_{inc} - \alpha_{csp}) + D^c (\gamma_{inc} - \gamma_{csp}) + (u_{inc} - u_{csp}) \\ &= D^a \alpha_{sav} + D^c \gamma_{sav} + u_{sav} \end{aligned} \quad (4)$$

In addition to the cohort and age effects taken into account so far, aggregate economic shocks and business cycle fluctuations affect income, consumption and saving in each year. In order to disentangle the age pattern from the cohort and time effects, our methodology follows the approach outlined by Deaton and Paxon (1994) and Deaton (1997) suggesting the following estimation model, which adds a time or business cycle component to the basic life-cycle framework for income:

$$\overline{\ln y}_{c,t} = D^a \alpha_{inc} + D^c \gamma_{inc} + D^t \varphi_{inc} + u_{inc} \quad (5)$$

and savings:

$$\bar{s}_{c,t}/\bar{y}_{c,t} = D^a \alpha_{sav} + D^c \gamma_{sav} + D^t \varphi_{sav} + u_{sav} \quad (6)$$

where the subscripts t refer to time (year). Cohorts are defined in five year brackets, with the youngest born between 1985 and 1989 and the oldest born between 1920 and 1924.

For the model specification, Deaton (1997) outlines various possibilities to restrict the age, cohort and time effects to follow a predefined functional form. As there is no obvious a priori pattern for the year effects, dummy variables are included. Although cohort effects are likely to be

trend-like, i.e. to be linear in c , it was decided to add cohort dummies that allow the data to choose any pattern in order to investigate possible non-linearities between cohorts born before versus cohorts born after the Soviet era. Age effects are modeled as a quintic polynomial in age in order to test the validity of the assumed hump-shaped age pattern as suggested by economic theory, yielding the following model specification:

$$\overline{LHS}_{ct} = \sum_{i=1}^5 \alpha_i \text{age}_{ct}^i + D^c \gamma + D^t \varphi + \varepsilon_{ct} \quad (7)$$

where \overline{LHS}_{ct} is a stacked vector of cohort-year observations on log incomes and the saving rate respectively, age is the age of the household head, D^c is a matrix of dummies identifying the birth cohort to which the household head belongs, and D^t is a matrix of dummies identifying the year in which the household was interviewed.¹⁸

In its current form, equation (7) cannot yet be estimated since there is a linear relationship between the age, time and cohort variables in the sense that, if once the interview year and the year a cohort was born are known, then the cohort's average age can be exactly inferred. In order to solve this problem, Deaton and Paxson (1994) assume that the year effects capture cyclical fluctuations or business-cycle effects that average to zero over the long run and are orthogonal to a time-trend, so that all deterministic changes in the dependent variable are interpreted as a combination of age and cohort effects. The specification also implies that the age profile of income and saving is the same across cohorts, except for an intercept shift. Under this assumptions, equation (7) can be estimated by regressing the cohort averages of the variable of interest on the polynomial in age, the set of cohort dummies capturing cohort-specific intercepts, and a set of T–2 year adjusted time dummies defined as follows, from $t = 3, \dots, T$

$$d_t^* = d_t - [(t - 1)d_2 - (t - 2)d_1] \quad (8)$$

where d_t is the usual year dummy, equal to 1 if the year is t and 0 otherwise (Deaton 1997: 108).¹⁹

¹⁸ An issue highlighted in the literature and in the introduction of this paper is that the age of the household head may not be a good proxy for the average age of the household; however the estimations in this paper do not correct this potential problem.

¹⁹ This specification, however, neglects any interaction between age, cohort, and years effects. In order to identify the age pattern of saving and its movements over time, the differentiation between age, cohort and time effects is essential. As pointed out by Shorrocks (1975) in discussing the age profile of individual asset holdings, the snapshot offered by a single cross-section can be quite misleading in this regard. Due to productivity growth, younger cohorts are likely to be on average better off than older cohorts in terms of aggregate life-cycle wealth. Shorrocks (1975) creates an example in which, given a sufficiently strong negative cohort effect, the illusion of a hump-shaped age profile is

The regression specified in (7) is estimated twice for both incomes and saving rates: firstly, using RMLS data without any adjustments related to pension contributions and receipts, and a second time with the adjustments.

3.2 Regression results

This section aims to address “one of the oldest challenges in the life-cycle theory hypothesis”, which is “the question of whether the data really support the fact that people save when they are young and run down their assets when they are old” (Deaton 2005: 97).

In the left panel of Figure 6 are plotted the regression results under the benchmark case scenario, in which the savings data are not adjusted for pension contributions and receipts. This panel shows the estimated age, cohort, and time effects for saving rate (left column) and for household income (right column). Note that household income here has been netted of all dis-savings, i.e. it does not include flows from sales of property and financial assets, loan repayment receipts and credits taken.

The estimation results suggest an almost linear positive age and cohort effect for the saving rate, which closely resemble earlier findings (see, e.g., Székely and Attanasio, 2000). Neither savings nor logged income show a marked hump shape, as both variables tend to increase monotonically with the age of the household head. Considering the cohort effect, more recent cohorts are found to have much higher per capita incomes and savings rates than cohorts born in earlier years.

In short, the estimations using data not adjusted for pensions reject the life cycle hypothesis. Households do not dissave in old-age, and the elderly in fact have the highest saving rates. This result is consistent with the findings of Chamon and Prasad (2010) and Belke, Dreger and Ochmann (2012), who argue that older households tend to increase their savings for two main reasons, i) the risk of high medical expenses in old-age; and ii) bequest motives.

The positive cohort effect on the household savings rates suggests that Russians in more recent periods save a larger fraction of their income than did prior generations at the same age. As indicated by Deaton and Paxson (2000), it is not possible to know for sure what factors are driving this result. Higher saving rates of younger cohorts may be associated with other trending variables,

created although individuals continue to accumulate wealth over their live cycle. A similar example can analogously be constructed for the analysis of household saving (Attanasio 1993: 8).

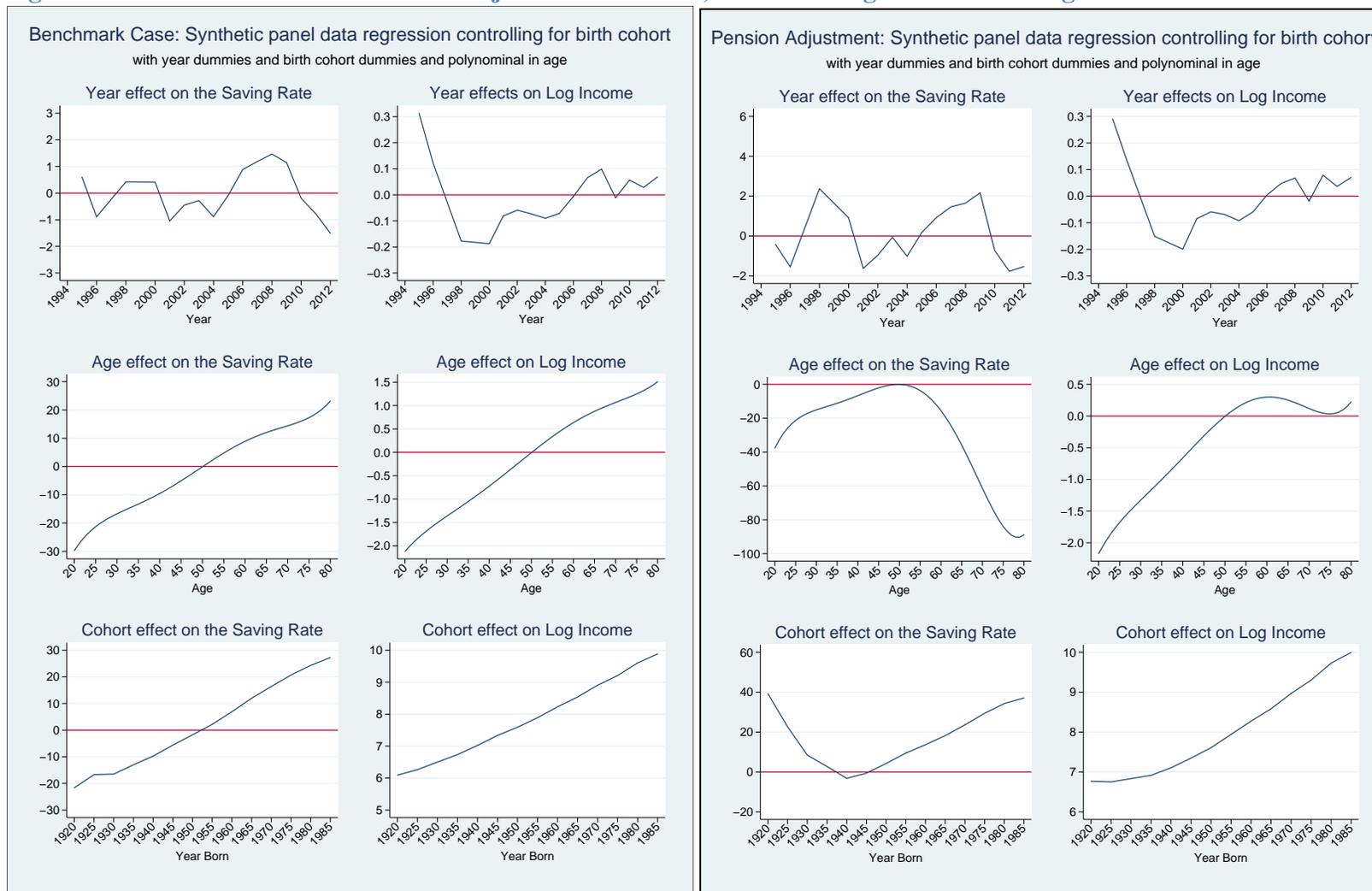
including economic growth and increasing real per capita incomes (see Deaton and Paxson 2000; Loayza et al 2000; Ang 2009). This cohort effect may also be tied to rising life expectancy, and to the enhanced probabilities of survival of their children, which increases the incentive to save in order to leave an inheritance. In this regard, Chamon and Prasad (2010), for the case of China, have found that even after controlling for broader demographic shifts, there remains a substantial time trend in household saving, which must be attributed to other economy-wide changes affecting all households.

The results here differ remarkably when adjustments are made for the treatment of pensions. In particular, the relationship between savings and age becomes roughly consistent with the life cycle model, revealing a strongly hump-shaped saving-age profile that peaks around age 50 (right panel of Figure 6). Around age 75 to 80, about 90 percent of all resources available to the household represent rundown of earlier accumulated wealth. The age profile of logged per capita income now also shows a modest hump, with a peak just around age 60 and a small decline thereafter.

The estimated cohort effect on logged per capita income under the adjusted pension approach is roughly similar to the effect estimated in the benchmark case, but shows a flatter increase among cohorts of the earlier periods and a steeper increase thereafter. The cohort effect on the savings rate varies substantially between the two saving datasets. When treating pension contributions and receipts as part of the savings aggregate, a negative cohort effect is observed for individuals born between 1920 and 1940. With the 1940-1944 birth cohort – the war generation – a trend reversal occurs. For the cohorts born after the Second World War, savings rates seem to be higher within each new generation.²⁰

²⁰ This trend reversal may be related to the socio-economic environment before and after the Second World War. On the other hand, since it is only observed in the adjusted pension case, it may rather be associated with the particularities of the transition period. The abolition of the administrative-command system increased the need for private old-age provision, which is likely to have affected the saving behavior of those generations that were still young or middle-aged at the time the old system collapsed.

Figure 6: Benchmark Case vs. Pension Adjusted Case: Time, cohort and age effect on saving



Source: World Bank calculations using RLMS household survey data.

In addition to the age and cohort profile, the effect of business cycle fluctuations on the savings rate is estimated. The time effect on logged per capita income closely reflects the macroeconomic conditions over the sampling period. A large negative shock happened around 1998, the year of Russia's largest domestic economic crisis over the observed time horizon. A negative income shock also occurred in 2009, when the global financial and economic crisis hit the Russian economy. Surprisingly the savings rate seems to increase in times of economic crises.

Similarly, Székely and Attanasio (2000) estimate a positive time effect on household saving in Peru after the main economic crisis in 1991, which is attributed to consumption falling more than income in the survey data. Under the general assumption that households aim to smooth their consumption over time, we would expect to observe the opposite relationship. The increase in the household savings rate in times of economic turmoil may possibly be associated with the rise in uncertainty motivating precautionary savings. Among other studies, Ang (2009) finds that an increase in the inflation rate appears to encourage household saving.

4 The impact of Future Demographic Changes on the aggregate savings rate

Future demographic scenarios indicate that aging will continue for the Russian population and this section addresses whether this will imply a reduction of the aggregate households' savings rate. Several assumptions are needed to assess the impact of demographic trends on saving. Most importantly these projections should be considered as accounting projections as no behavioral adjustment is accounted for. They address this question: "what would happen if nothing else but the age structure of the population changes?"

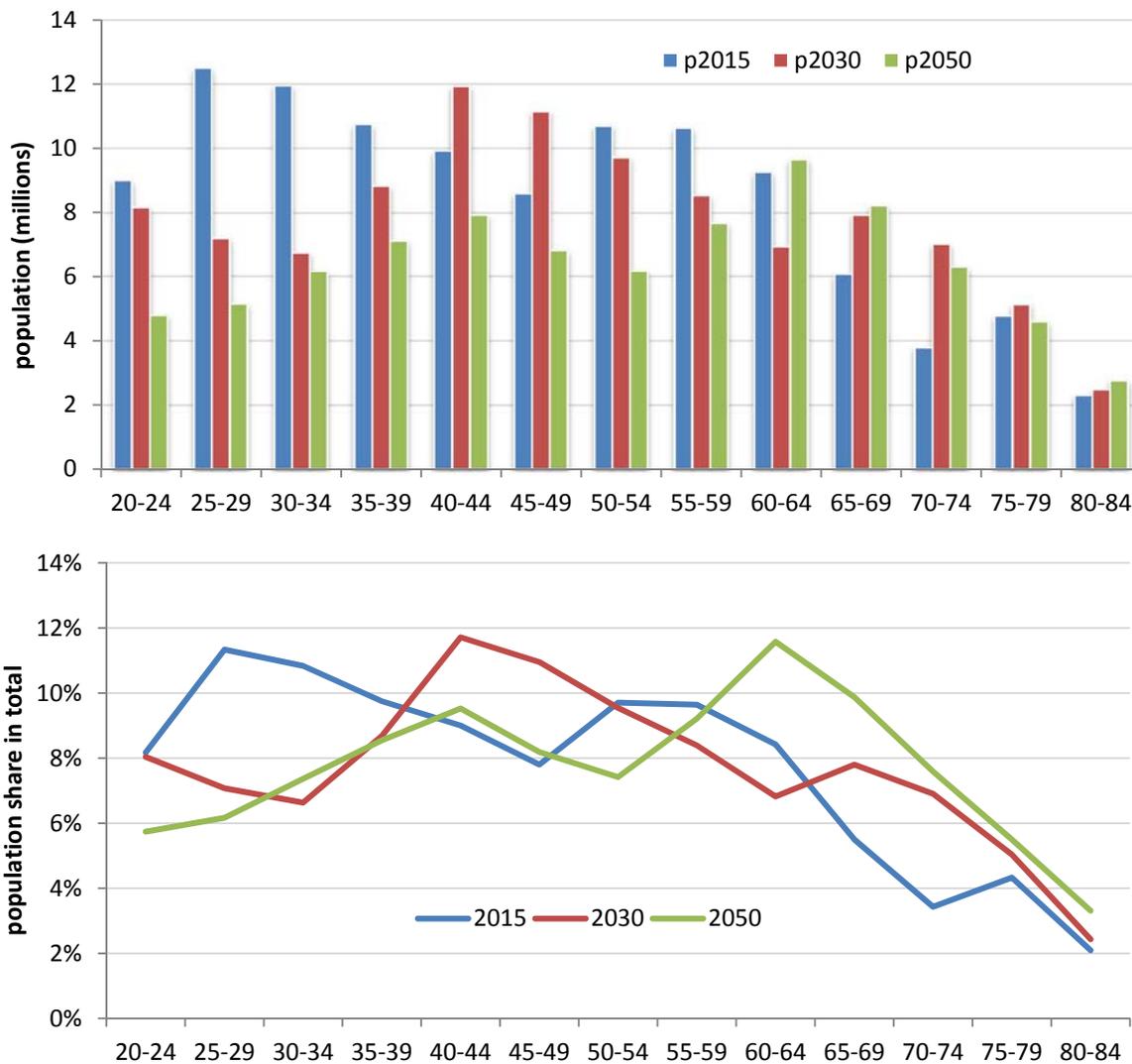
4.1 Assumptions

General equilibrium effects generated by the shift in age structure, such as a different labor to capital ratio or changes in consumption patterns, are not considered. The scenario analysis is purely based on the age and cohort coefficients estimated above. Furthermore, the coefficients are those estimated for the total population, even if saving behavior can differ for groups of people that have different permanent incomes, such as the skilled and the unskilled.²¹ As for the business

²¹ This can be particularly relevant in cases where, compared with the old generations, newer generations have higher levels of education, and steeper age-income profiles. If these differences are pronounced, the aging of the population – i.e. the fact that newer generations are smaller in size – can be compensated by the fact that these new generations have a larger economic weight. The new generations higher saving rates and higher incomes may push up the

cycle fluctuations, the time effects are set to zero, so that any projected trend in saving rates is given by the combination of age and cohort effects, which we extrapolate up to 2050. Over this long time horizon, new cohorts will join the sample and some cohorts will leave it. The aggregate savings rate is defined as the savings rate of individuals between ages 20 to 80, i.e. the very old and the very young are excluded from the analysis.

Figure 7: ROSSTAT medium population forecast, 2015-2050



Source: ROSSTAT demographic projections (medium variant).

aggregate saving rate by counterbalancing the dissaving (or low saving) of the larger (in number of people) older generations. However, as shown in Appendix A5, no large differences in the savings behavior of household heads with different levels of education is observed for the Russian data.

The analysis uses official ROSSTAT population projections up to 2050. Figure 7 provides an overview of the projected demographic structure between 2015 and 2050. Under the medium population growth scenario depicted – which involves assumptions on the expected evolution of fertility, mortality, and international migration rates – the saving-relevant population (20 years and older) is expected to decline from 110.2 million in 2015 to 101.8 million in 2030 and 83.4 million in 2050. The strongest decline is expected among the young working age, the 20 to 34 year olds, whose relative population share is expected to decrease from close to one-third to under one-fifth of the considered population.

The savings rate scenarios are produced under a combination of a 2x2 combination of assumptions. Scenarios may differ depending on whether the data have been adjusted for pensions or not, and on the assumption made on the cohort effect. Future new born generations may be assigned either the cohort effect estimated for the youngest living cohort, or an increasing cohort effect that extrapolates the trend estimated from the historical data. All these forecasts essentially depend on the assumption that all deterministic trends in the savings rate (and income) originate from a combination of cohort and age effects, and that the age profile of saving (and income) is stable and the same across cohorts. More in detail, the aggregate saving rate can be thought of as the weighted average of the cohorts specific saving rates where the weights are the economic size of the cohort, as follows:

$$s_rate_t^{ag} = \frac{S_t^{ag}}{Y_t^{ag}} = \frac{\sum_c S_t^c N_t^c}{\sum_c Y_t^c N_t^c} = \sum_c \frac{S_t^c}{Y_t^c} w_t^c \quad \text{with} \quad w_t^c = \frac{Y_t^c N_t^c}{\sum_c Y_t^c N_t^c} \quad (20)$$

where $s_rate_t^{ag}$ is the aggregate savings rate, S_t^{ag} and Y_t^{ag} represent aggregate savings and incomes at time t , while S_t^c and Y_t^c are the saving and income of cohort c at time t and, finally, N_t^c is the size of cohort c at time t . The economic weight of cohort c , w_t^c , depends on the population and income size of the cohort vis-à-vis the total economy. Note that the projections of this aggregate saving rate will be influenced by three factors:

- (i) Demographic changes that affect the N 's and thus, at any specific year t , the age composition of the population;
- (ii) Saving rates of the cohorts: year by year, these rates change because a specific cohort becomes older (age effect), or because a new born cohort enters the economy, and an old one exits (cohort effect);

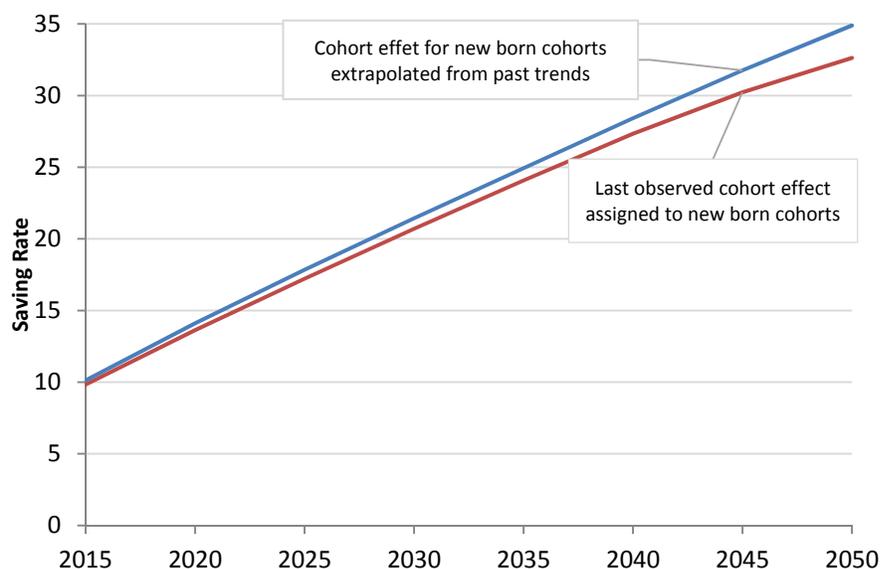
- (iii) The income weight of the cohorts: in the same way as for the saving rates of point (ii), year by year, the incomes of different cohorts vary because of age and cohort effects.

4.2 Results

The savings rate forecasts suggest, similar to the findings by Bosworth and Chodorow-Reich (2006), Belke, Dreger and Ochmann (2012), and Székely and Attanasio (2000), that the demographic effects of population aging on saving will be less disruptive than sometimes assumed.

Since in the benchmark case scenario (without adjusting for pensions) the savings rate increases monotonously with age, the savings rate forecast predicts an increasing trend in the Russian savings rate up to 2050. This result is due to the overall demographic trend toward an increasingly older society (see Figure 8).

Figure 8: Benchmark Case - Saving rate forecast under different scenarios



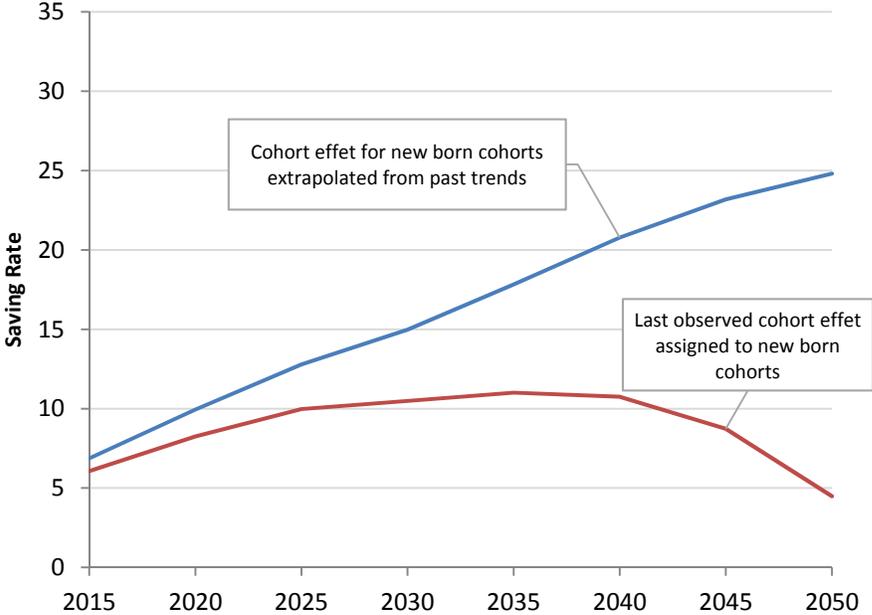
Source: World Bank calculations using RLMS household survey data and ROSSTAT demographic projections (medium variant).

While the increase in the predicted savings rate is stronger when future cohorts continue to save a larger fraction of their income than did prior generations at the same age, the savings rate

also increases with age in the scenario which assumes that future generations have the same cohort effect on savings as the most recent cohort.²²

By contrast, when adjusting aggregate savings for pension fund contributions and receipts, population aging may potentially reduce future saving rates. Given the estimated hump-shaped age-saving profile when adjusting for pensions (see age effect of saving in right panel of Figure 6), population aging will, at least in an initial phase, increase the number of middle-aged savers relative to the young who are dissaving or saving only a small income fraction. Over time, the aging process will increase the number of (low saving or dissaving) elderly vis-à-vis middle-aged savers. When holding the cohort effect of new-born generations constant, the saving rate forecast will be hump-shaped.

Figure 9: Saving rate forecast under different population growth scenarios, pension adjusted



Source: World Bank calculations using RLMS household survey data and ROSSTAT demographic projections (medium variant).

As shown in Figure 9, up to about 2030, during the initial phase of aging, aggregate saving will increase; later on, as the share of older age groups rises, the aggregate saving rate flattens and finally declines. However, this projected decline in saving cannot be taken for granted. Indeed it disappears if the observed trend with younger generations disposing of higher incomes and saving

²² Note that the two alternatives of keeping a constant cohort effect or extrapolating it apply to the saving rate as well as to the income of all new born cohorts. A growing cohort effect will thus have a ‘double’ impact, it will raise the saving rate of the new born cohorts and it will raise their income weight.

a larger fraction of these incomes is assumed to continue. As shown in the same Figure 9, when the cohort effect is assumed to continue its upward trend, an increase in the aggregate household saving rate up to 2050 is projected, although this rate is below the one of the benchmark (unadjusted data) forecast of Figure 8.

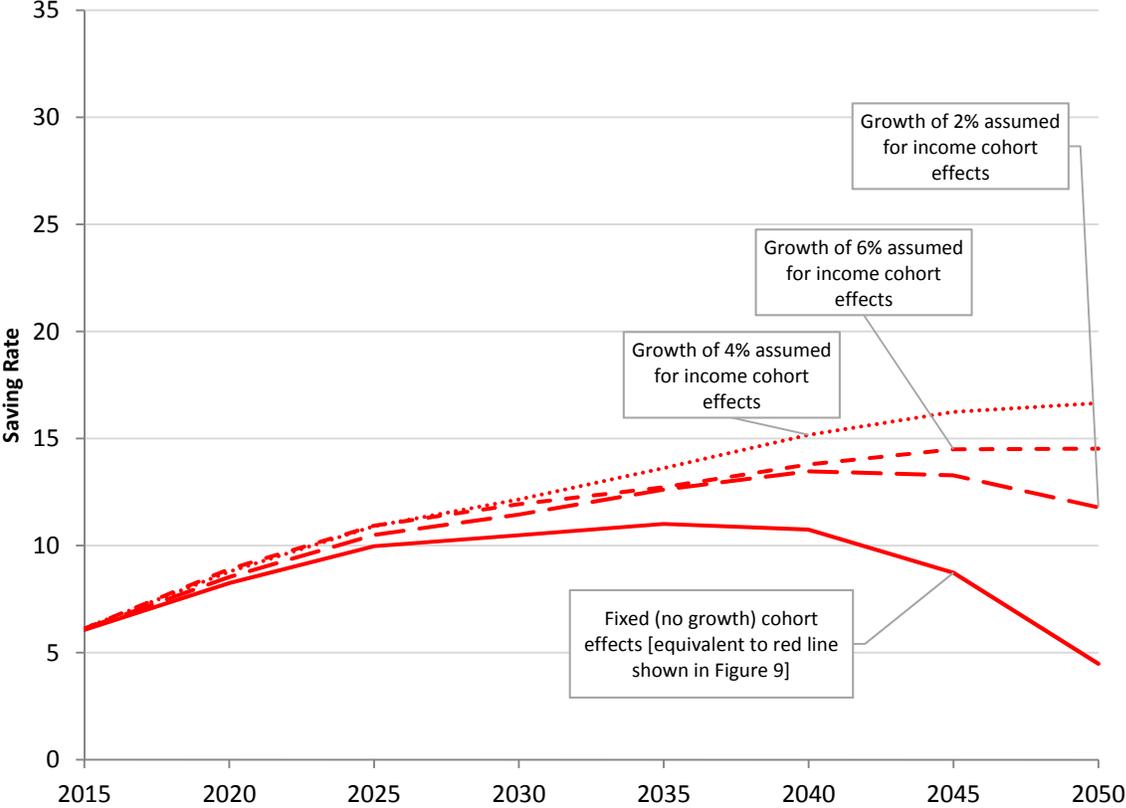
This simple accounting projection exercise highlights that the economy-wide aggregate saving rate can be seen as the weighted average of the saving rates of different groups. An increase in the economic weight of groups with high saving rate will positively influence the aggregate saving rate. In turn, the increase in the economic weight for a specific group can result from an increase in its population size (the demographic effect) or from an increase in its income (the cohort effect). The different assumptions for the cohort effect – from a fixed value to an upward trend – can be interpreted as a sensitivity analysis of how the aggregate saving rate depends on assumptions about the future growth rates of the economy. As higher rates of economic growth increase the lifetime wealth of younger cohorts relative to the older ones, higher growth has accordingly a similar effect on the aggregate national saving as an increase in the numbers of middle aged (high savers) relative to the old due to changes in demographics (Deaton and Paxson 2000b).

An additional simulation – using the pension adjusted data – was performed to show the effect of economic growth on the aggregate saving rate. In this scenario, the cohort effects of the saving rate are assumed constant for the new-born, while the cohort effects on incomes are pegged to different projections of economic growth. In the central projection, the economic growth rate is set close to its historic value close to 4%. This rate is used to extrapolate the income cohort effect for the projection period. The resulting path for the aggregate saving rate is then compared to that of the pension adjusted scenario with fixed cohort effects and no economic growth (equivalent to the red line in Figure 9), as well as to two alternative scenarios with the income cohort effects growing at 2 percent (0.5 times the historic rate) and 6 percent (1.5 times the historic rate) respectively (see Figure 10).

Higher growth rates in per capita incomes increase the lifetime wealth of the young relative to the old. Figure 10 shows the saving rate projections under the assumption of medium population growth, with each line calculated at a different rate of economic growth across cohorts. Note that higher rates of economic growth do not influence aggregate saving rates in a linear way. This is because higher growth rates increase in the economic weight of new born cohorts relative to elderly

dis-savers (effect 1), but also relative to those in prime working age who have the highest saving rates (effect 2). As shown in Figure 10, when raising the rate of economic growth from zero to two percent or from two to four percent, the first effect dominates and higher growth rates are associated with higher aggregate saving rate for the whole projection period. However, when the growth rate increases further, the second effect becomes more important. Accordingly, setting per capita income growth to 6 percent results in a slightly lower aggregate saving rate.

Figure 10: Saving Rate Forecast, Different Income Growth Scenarios



Source: RLMS household survey data and Rosstat demographic projections (medium variant).

4.3 Caveats

As highlighted by Székely and Attanasio (2000), these forecasts should be treated with extreme caution for two main reasons. First, to study individual life-cycle behavior, we would ideally like to follow individuals in their decision-making over time. However, information on consumption expenditure and saving is reported at the household, rather than the individual, level. We therefore track cohorts of households defined by the age of the household head, rather than by the age of individuals. In the presence of multigenerational households, this approach has the

disadvantage of combining data for people at different lifecycle stages (see Deaton and Paxson 2000). Moreover, as noted by Székely and Attanasio (2000), family composition tends to change not only between cohorts but also within each cohort over the life-cycle. This implies that even though we are tracing the same type of household in the repeated cross sections available, the composition of the group is changing, blurring our inferences about the behavior of cohorts as they age (Székely and Attanasio, 2000: 20). In consequence, there is a potential bias in the saving-age pattern estimated based on the age of the household head, since saving decisions in multigenerational households also depend on the age of the other household members.

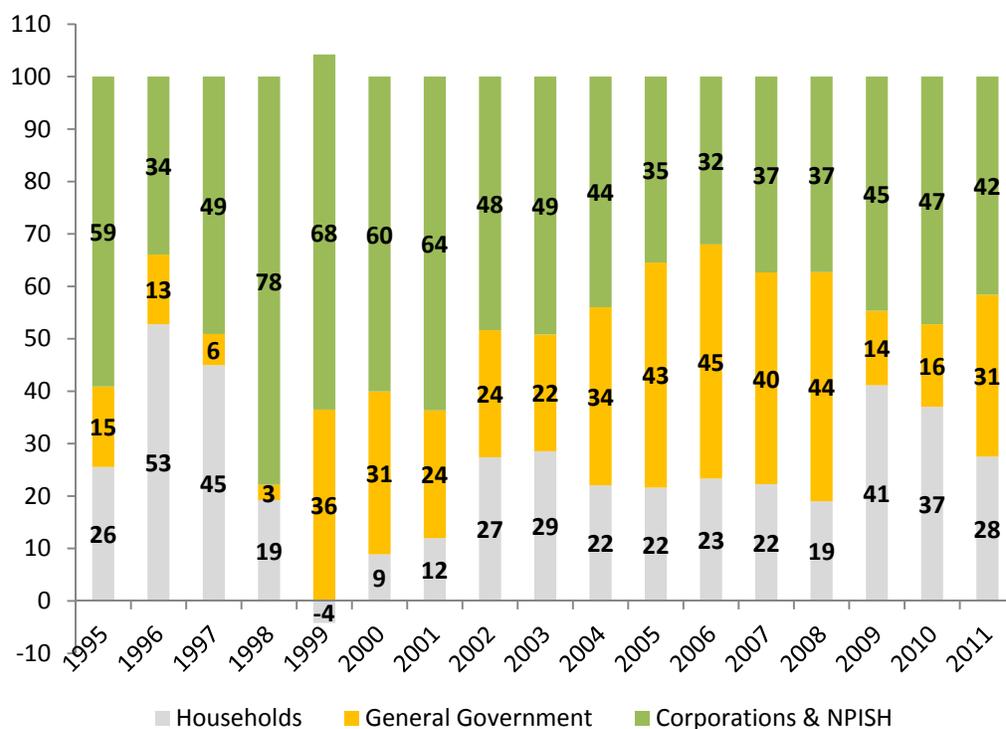
Second, the estimated profiles are based on the behavior observed in a given economic environment over a restricted time period. In other words, all effects are estimated for households facing given earnings and demographic profiles as well as a given set of institutions, including the pension system with fixed arrangements for old age. The forecasts are produced under the very strong assumption that the age profile estimated for this specific setting remains stable over time. Moreover, the current specification does not account for any interaction between age, cohort, and years effects.

However, the graying of the population in Russia is likely to challenge the long-term sustainability of the current pension system, increasing the need for private old-age provision and hence affecting future life-cycle decision making. As emphasized by Deaton and Paxson (2000), due to the standardization of the year effects, any change in aggregate saving is attributed to changes in relative population and relative resource weights over an unchanging age profile of saving. This methodology strongly relies on the validity of the life cycle hypothesis, and all parameters are estimated conditional on its truth. However, reconsidering their own previous work, Deaton and Paxson (2000) conclude that not all time trends in saving ratios can be fully explained within the life cycle framework. Specifically, the estimated cohort effects could be driven by other trending variables, including economic growth, whose impact cannot be further disentangled.

Moreover, the data issues mentioned in Section 2.1 impede comparability of micro- and macroeconomic measures, and forecasted saving rates are likely not to coincide with the actual aggregate household saving rate observed at the macro level. Similar to the previous work by Székely and Attanasio (2000), the projections presented here therefore do not aim to reproduce the level of aggregate savings rates nor to efficiently forecast their evolution, but rather present the implications of expected demographic shifts given the estimated age profiles.

One last limitation is that the exercise in this paper provides projections only for the household sector. This analysis does not allow for any conclusions about how other sectors of the Russian economy will adjust to demographic trends, or how their saving behavior is going to evolve. As Figure 11 suggests, our analysis of household saving behavior can hence only explain, at best, around one third of the change in total aggregate saving in Russia.

Figure 11: Sector shares (%) in total national saving



Source: World Bank calculations using ROSSTAT national accounts data. Note: “Non-profit institutions serving households (NPISHs) are legal entities that are principally engaged in the production of non-market services for households or the community at large and whose main resources are voluntary contributions.” (UN 2009: 17). These include, e.g., charities, trade unions, religious organizations, and the majority of universities.

5 Conclusions

The main research objective was to determine whether saving rates measured from household surveys for the Russian Federation conform to the life-cycle theory and thus whether this country will experience a contraction in its household savings rate as its society grows older. The estimation and simulation results suggest that the demographic effects of population aging on saving will likely be less disruptive than sometimes assumed. The future trend in the savings rate significantly depends on two main factors.

First, the hump shape profile of the saving rate, with low saving at the beginning and end of the life-cycle, depends heavily on how pension contributions, but especially receipts, are treated. As argued earlier by Deaton (2005), standard household survey data generate saving-age profiles that are systematically biased against the life-cycle hypothesis. By ignoring pension contributions, the accumulation of assets during working life is underestimated. Similarly, by considering pension receipts as transfer payments that form part of household income, dissaving in old-age is also understated. This paper clearly shows the consequences of these underestimations. When using unadjusted data, savings rates increase with age, with older individuals saving more than young or middle aged. However, when pension contributions and receipts are accounted for, the expected hump shaped age effect is found. Correspondingly, when using pension adjusted data, aggregate saving rates are influenced by the age composition of the population, and aging exerts a negative pressure on aggregate saving rates.

The second factor influencing projection for aggregate saving rate is the cohort effect. The survey data presents strong cohort effects: younger generations earn more and save a larger fraction of these earnings than did prior cohorts at the same age. This pattern can be explained by economic growth, which leads to a rise in life-time resources, and also by an increase in life expectancy. When extrapolating the positive trend in household saving rates to future cohorts, a strong increase in the aggregate household saving rates is observed up to 2050 counterbalancing the negative impact of the aging of the population. However, whether this trend will indeed continue for new-born generation is not certain.

Perhaps not surprisingly, the future rate of aggregate household savings will thus depend not only on the age composition of the population – the pure demographic effect – but also on the savings behavior of new born cohorts, which, in turn, will depend on the overall economic situation and on the evolution of their life-expectancy. Another important influence on future savings will be the institutional context, including how the future health and pension systems affect the way in which households provide for old age. The ongoing demographic trends are likely to increase pressures towards reducing the generosity of the pension system, forcing households to increasingly dissave in old age. This possible development may threaten Russia's future household saving rate.

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Appendix

A.1 Data description and definition of key economic variables

The Russia Longitudinal Monitoring Survey (RLMS) includes detailed information on measures of income, consumption, and household demographics designed to monitor the effects of national reforms on the health and economic welfare of households and individuals in Russia.

In the second phase of the RLMS starting in 1994, a multi-stage probability sample was employed, making the RLMS the first nationally representative random sample for Russia (albeit a highly clustered one). Overall, interviews were completed in 84 percent²³ of the original national probability sample of n=4718 dwelling units, and questionnaires were obtained from over 97 percent of the people listed on the household rosters, which represents a relatively high response rate.

The key variables of interest for our analysis are household income and expenditure and its individual components. The reported, nominal variable values have been converted to real values using inflation coefficients, and categorized medians have been used to impute missing values for each expenditure item that was purchased by the household, but where the amount of the purchase was not stated. Similarly, missing income information has been imputed for certain non-labor income subcategories, irregular receipts, and household production.²⁴

Composition of household income

Total household income is the combined income of all household members (after taxes) received in the last 30 days from all jobs and other regular sources, including salary from all places of work received in money or in kind, agricultural income and income from own production, rental income and income from assets sales (including personal property, livestock, jewelry and currency

²³ Interview completion rates outside St. Petersburg, Moscow City, and Moscow Oblast range from 84.8% in the combined Central/Central Black Earth region to 92.6% in Western Siberia. Rates in the highly urban Moscow/St. Petersburg region are much lower. For more information refer to <<http://www.cpc.unc.edu/projects/rlms>>.

²⁴ “For each expenditure item, it is known whether or not a household purchased the item, as well as the amount of the purchase. [...] When a household purchased the item but did not report the amount of the purchase, the missing amounts are imputed by regressing the log of expenditure on the complete interaction between year dummies and federal district dummies, controlling for the size of the household, number of children (18 years old or younger), and number of elderly members (60+). The procedure is described in Gorodnichenko, Sabirianova Peter, and Stolyarov (2008a). The subcategories with the largest number of missing values include utilities (2.1% of the sample), gasoline and motor oil (1.6%), transportation services (1.5%), and contributions to non-relatives (1.4%). Missing values for other subcategories are trivial. [...] As with expenditures, missing income amounts for the subcategories of non-labor income, irregular receipts, and household production are imputed using the regression approach. Overall, imputations are minimal.” (Gorodnichenko et al 2009: 7f.).

sales) and other non-labor income from pensions, stipends, unemployment benefits, interests and dividends, alimonies, child care benefits and net private transfers.

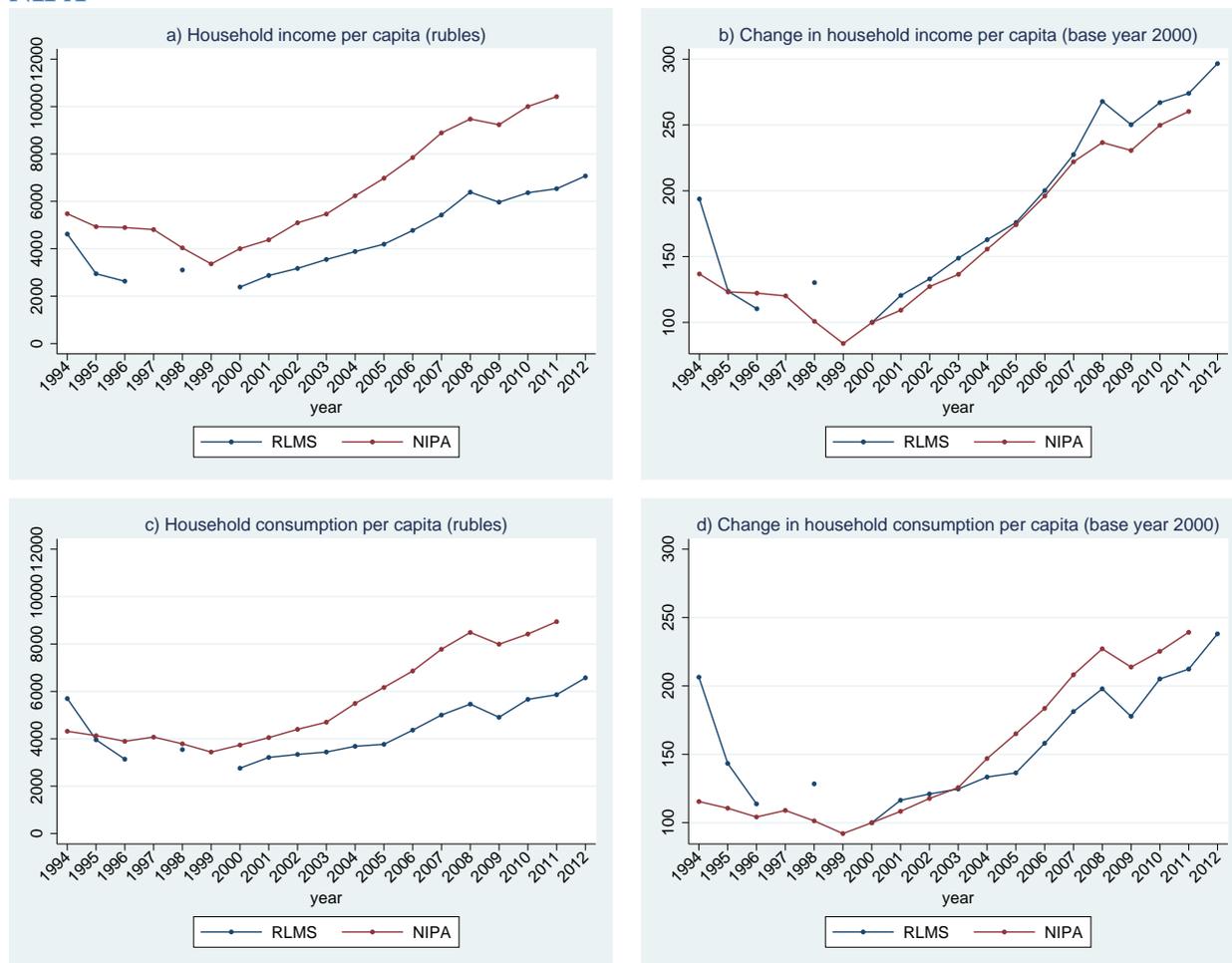
Composition of household expenditure

The RLMS questionnaire contains detailed information on separate expenditure items purchased in the last 30 days (unless indicated otherwise). Expenditure for final consumption includes foods and beverages, tobacco products, clothing and footwear, personal hygiene products, consumer durables and luxuries, including purchases of electronic devices and motor vehicles (automobile/motorcycle), gasoline and other fuel expenses, rents and utilities, and service expenses (compare Gorodnichenko et al 2009 for a more detailed variable list). Additionally, households are requested to report purchases of real estate and building material, expenditures for stocks, bonds, or other investment paper, alimony payments and other private transfers, repayment of loans or private debt as well as rubles saved in the last 30 days.

A.2 Micro-macro comparison of key economic variables

A comparison of per capita consumption and income information between RLMS and Russian official National Income and Products Accounts (NIPA) is provided in Figure 12. Unsurprisingly, average per capita disposable income and consumption calculated using RLMS data generally underestimate national account aggregates, since very rich households tend to be underrepresented in household surveys. Nevertheless, in line with Gorodnichenko *et al* 2009 and Gorodnichenko *et al* 2010 (who use a similar approach in comparing RLMS and NIPA consumption measures over the 10-year period from 1994 to 2004), we find that differences between the RLMS and NIPA data in the early sampling period are greater for income than for consumer expenditures (between 1994 and 2003, reported disposable income per capita is up to 40 percent lower in RLMS than the official figures, while reported per capita consumption is between 6 and 26 percent lower in the RLMS). This difference can be attributed to features of the Russian transition, such as underreporting of incomes for reasons of tax evasion (Gorodnichenko *et al* 2009).

Figure 12: Household per capita income and consumption comparison between RLMS and NIPA



Source: World Bank calculations using RLMS household survey and ROSSTAT national accounts data and UN population estimates.

Notes: Both RLMS and NIPA measures of household disposable income are after taxes and transfers given. Per capita values from aggregated NIPA data are calculated using UN population estimates. Measures are deflated using the annual average Consumer Price Index (base year 2005).

As in Gorodnichenko *et al* 2010, beginning in 2003 consumption expenditures grow more slowly in RLMS than in NIPA. This difference in trends could indicate a growing gap between the RLMS sample and unobserved households at the top-end of the income distribution, but at the same time the growth rates of the RLMS and NIPA income series are surprisingly close (see Figure 12). “Part of the gap [in the growth rates of consumption expenditures] may also arise due to an upward trend in consumption of goods that RLMS data does not consistently track, such as internet and cell phone services. However, new consumption categories are not enough to account for the post-2003 growth gap: new goods added to RLMS over the years constitute at most 5 percent of

aggregate expenditures. Finally, a small portion of the gap (up to 1.6 percent of aggregate expenditures per capita) can be explained by the replacement of one of the wealthiest oil-based regions in the North by the middle income region in Siberia in the 2003 RLMS sample (this was the only episode of regional sample replacement during the 1994–2005 period)” (Gorodnichenko *et al* 2010: 213).

A.3 Key components of the Russian pension system

The Russian retirement scheme for workers is essentially a state pension financed on a pay-as-you-go (PAYG) basis. Thus, the main part of the system is unfunded, in the sense that today’s pension benefits are paid directly from current workers' contributions and taxes. The provision of pensions can accordingly be seen as a redistributive process among households. However, the pension reform in 2002 introduced a major change in the system. Prior to 2002, pensions were provided through a defined benefit (DB) arrangement based on the length of work and the pensionable wages in the last two years of this work record (Eich *et al* 2012; OECD 2013). The reform transferred this single, publicly managed distributive system into a multi-pillar one, including i) a basic pension, ii) an insurance benefit based on a notional defined contribution account and iii) a mandatory funded defined contribution (DC) (see TABLE 3).

The basic pension is aimed at providing a minimum standard of living, to address the problem of old-age poverty (Hauner 2008). It constitutes a flat rate payment granted to all those in retirement age (60 for men/ 55 for women) with at least five years of contributory service. Since most elderly fall into this category, coverage is almost complete (Eich *et al* 2012). Although supposedly uniform, certain groups of pensioners – including those aged 80 or above, those who are invalid with limited work capacity, those caring for a dependent family member or those who spent at least 15 years working in Arctic areas – receive higher pension benefits. With a benefit amount of 3170 rubles per month (as of 2010), the basic pension was equivalent to about 12 percent of the average wage (Eich *et al* 2012). At the beginning of 2010, the basic pension was incorporated into the notional account PAYG system.

TABLE 3 Key parameters of the Russian pension system

Pension Parameter	I. Basic pension (part of PAYG)	II. Notional defined contribution scheme (part of PAYG)	III. Mandatory funded defined contribution scheme
Retirement age	60 for men/ 55 for women with minimum of 5 years contribution, but many provisions for even earlier retirement		
Benefits	RUB 2,963 (USD 96)/month if no dependents, RUB 5,926 (USD 196) if three or more dependents in 2012. Higher benefits for those older 79, disabled, caregivers and those who live or have worked in Arctic areas.	At retirement, the amount standing to the individual's account (incl.contributions and interest returns) is annuitized using a factor based on life expectancy (set universally at 228 months (19 years) in 2013).	Lifetime annuity based on individual contributions and interest returns earned.
Interest rate on contributions	-	Contributions to individual accounts are not invested in financial assets, but earn a "notional" return set by law. Currently the return is the average wage growth, but limited to the growth rate of PFR income, expressed per pensioner.	Workers can choose once a year: (1) to have their contributions invested and administered in one of the privately run funds (2) to keep their funds in the PFR and managed by Vnesheconombank (VEB) which is appointed as the state asset management company, or (3) to keep their funds in the PFR and managed by a private asset manager.
Indexation post-retirement	Indexed annually to average wages, but limited to the annual growth of the Pension Fund of the Russian Federation's (PFR) income, expressed per pensioner.		Paid as scheduled withdrawal.
Contribution rates in 2013	Basic part since 2010 merged into PAYG (until 2009 6% of salary).	22% of salary if born 1966 or earlier, 16% if born 1967 or later; both up to a ceiling set at about 165% of annual average wage (RUB 568,000 (USD 18,773) in 2013). Those with annual income above this ceiling pay an additional 10% of salary.	None if born 1966 or earlier, 6% of salary if born 1967 or later.

Source: Updated version of Eich et al 2012: 4, Table1 using OECD 2013: 87f.

Note: The currency exchange rate used is the national currency units per US-Dollar (monthly average) extracted from the OECD Main Economic Indicators (MEI) database.

The Notional Defined Contribution (NDC) scheme is the labor insurance component of the Russian pension system. The NDC model, which was pioneered by Sweden in the 1990s, retains

PAYG state financing, while resembling a privately-funded DC plan. Workers continue to pay for today's pensioners, but their contributions are also credited to notional individual accounts by the Pension Fund of Russia (PFR), which (by law) earn a "notional" return based on a discretionary average between the growth in wages and consumer prices (that may not exceed the annual growth rate of pension contributions to the PFR). The benefit at retirement is an annuity calculated by dividing the notional capital that has been accumulated in the account by a factor based on the average life expectancy (in months) at the age of retirement (228 as of 2013, equal to 19 years of benefit times 12 months according to Eich *et al* 2012). Hence, while the basic pension is independent of contributions and represents a social transfer, pension receipts under the NDC scheme are based on the contributions that each worker individually accumulates throughout her or his working life, and could thus be interpreted as savings.²⁵ However, the rate of these contributions or "savings" is governmentally fixed and enforced. As of 2013, those born before 1967 contributed 22 percent of wages to this part of the pension system, while the contribution rate for those born after 1967 was set at 16 percent of wages up to a ceiling of RUB 568 000 (\$18 773) annually (OECD 2013).

The third part of the labor pension is a mandatory, funded DC system. Under this scheme, individuals contribute to pension fund accounts which are invested by public or private asset managers. Workers can choose between three investment options. Under the default option currently chosen by about 85 percent of all contributors, the contributions are kept in the RPF and administered by a state financial institution. Alternatively, the contributions can be kept in the RPF but be administered by a private asset manager or be invested and administered in one of the private pension funds. Upon retirement, insured individuals receive both the contributions and the interest earned on those contributions in form of a life time annuity (Eich *et al* 2012). The funded DC system hence works similar to a regular savings account for old-age provision, again with the important difference that contributions are mandatory and currently fixed at a contribution rate of 6 percent of wages. Limiting the importance of this component, in 2012 a law was passed to reduce the contribution rate to two percent by 2015.

²⁵ "The basic pension provides a flat benefit which is financed by the portion of the uniform social tax that is paid by employers to the federal budget and then transferred to the budget of the Pension Fund of the Russian Federation (PFR). Since 2010 it has been financed through insurance contributions for the mandatory pension insurance" (OECD 2013: 87).

TABLE 4 Pension Spending and Characteristics of the Russian Pension System, 2000 to 2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Pension Spending (percent of GDP)											
Basic pension	n.a.	n.a.	1.9	1.8	1.6	1.4	1.6	1.4	1.8	2.2	2.7
Insurance pension	n.a.	n.a.	4.0	3.9	3.5	3.6	3.0	2.9	3.0	4.1	5.2
Allowances	n.a.	n.a.	0.2	0.2	0.3	0.8	0.9	0.9	0.8	1.1	1.0
Total	4.5	5.5	6.1	5.9	5.5	5.9	5.5	5.2	5.5	7.4	8.9
Replacement rate (percent of average wage)											
Basic pension	n.a.	n.a.	10.3	9.5	8.9	7.7	9.0	7.6	9.0	9.6	12.2
Insurance pension	n.a.	n.a.	21.3	20.3	19.5	19.9	16.7	15.3	15.3	18.2	23.5
Allowances	n.a.	n.a.	1.3	1.1	1.8	4.5	4.9	4.6	4.3	5.0	4.5
Total	32.3	n.a.	32.9	30.8	30.2	32.2	30.5	27.5	28.6	32.9	40.2
Demographics											
Pensioners (million)	38.4	38.6	38.4	38.2	38.2	38.3	38.3	38.5	38.6	39.1	39.7
Ratio of pensioners to total population ^a	26	26	26	26	27	27	27	27	27	28	28
Ratio of population 65+ to population 15-65	18	18	18	19	19	19	19	19	18	18	18
Percent of pensioners under the retirement age	28	30	30	30	31	31	31	30	29	29	28
Percent of pensioners working ^b	16	n.a.	n.a.	n.a.	n.a.	22	n.a.	26	28	30	31

Note: The pension system offers monthly allowances to certain categories of citizens, including veterans, the disabled, and persons affected by radiation exposure.

Source: Eich et al 2012: 7, Table2 based on ROSSTAT, UN, and IMF staff calculations with additions by the authors:

^a Authors' own calculation based on Pensioners (million) and Total Population as provided by United Nations Population Division.

^b OECD 2013: 91, Table 2 based on Federal State Statistics Service.

The basic pension and the insurance pension constitute the main components of pension spending in Russia, with the insurance component accounting for the largest share (see TABLE 4). How pension contributions and receipts under the NDC scheme are treated is thus highly relevant in the Russian case.

In addition to the public labor pension system, private non-state pension funds (NPFs) can be used to accumulate retirement savings on a voluntary basis, where the contributions can be paid

by either employees or their employers. Traditionally, NPFs were mainly established by large firms in certain key industries, including the mining, energy and utilities sectors. With the pension reform in 2002, the use of NPFs has become more common in other industries; voluntary funded pensions covered about 6.8 million individuals as of December 2012 (OECD 2013). “In 2010, Russia also introduced a system of co-financing or matching additional contributions from the state to the mandatory funded pension system. The program is financed by investment income from the National Welfare Fund which is a sovereign wealth fund established in 2001 with oil proceeds. As of the beginning of 2013 over 10 million requests to participate had been received, of which approximately 2.5 million had been granted at the end of 2012. The state subsidy can therefore be an important tool to promote higher retirement savings and therefore improve future adequacy of retirement income given that the scheme is carried out for a long enough period of time” (OECD 2013: 89).

A.3. The basic life-cycle model of saving

The model

The basic life-cycle model of saving assumes no uncertainty and postulates that consumption follows an age-profile determined by (age-specific) preferences and real interest rates, while the level of the profile depends on lifetime resources.

Life time resources for individual i , W_i , are modeled as the sum of inherited resources A_i^0 and the discounted present value of the flow of future earnings:

$$W_i = A_i^0 + \sum_{a=0}^L y_{i,a}^l (1+r)^{-a} \quad (1)$$

where L is the length of life, r is the constant interest rate, a is age and $y_{i,a}^l$ are the labor earnings of individual i at age a .

Consumption at age a will be a proportion of life cycle resources that depends only on age preferences and the constant real interest rate (which can then be eliminated):

$$c_{i,a} = f_i(a)W_i \quad (2)$$

In their original model, Modigliani and Brumberg (1954) assume the shape of the earnings-age profile to be independent of the growth rate of the economy, i.e. economic growth affects the lifetime resources and the distance between the income profiles of different cohorts, but not the age profile.

Given the Modigliani specification, labor income (earnings) can thus be written as proportional to lifetime resources:

$$y_{i,a}^l = g_i(a)W_i \quad (3)$$

The shape of g_i is set by the age profile of earnings and is scaled so that equation (3) holds.

Additionally, inheritance can be rewritten as proportional to lifetime resources:

$$A_i^0 = \alpha_i^0 W_i \quad (4)$$

Using these three elements, the lifetime budget constraint, which requires the present value of consumption to be equal to the sum of available resources determined by earnings and assets (inheritance), can be written as:

$$\alpha_i^0 + \sum_{a=0}^L (1+r)^{-a} [g_i(a) - f_i(a)] = 0 \quad (5)$$

which is independent from the scale factor W_i provided that α_i^0 is independent of W_i .

Assets evolve over the lifecycle in order to allow equations (2) and (3) to hold simultaneously; for individual i assets evolve from age $a - 1$ to a as follows:

$$A_{i,a} = (1+r)(A_{i,a-1} + y_{i,a}^l - c_{i,a}) \quad (6)$$

This can also be rewritten as the accumulation of assets from age $a = 0$ to age a as:

$$A_{i,a} = (1+r)^a A_i^0 + \sum_{k=0}^a (1+r)^k (y_{i,k}^l - c_{i,k}) \quad (7)$$

Total income $y_{i,a}$ is the sum of asset income, $rA_{i,a}$, and labor income (earnings) and this can be written as:

$$y_{i,a} = h_i(a)W_i \quad (8)$$

where the scale factor $h_i(a)$ is given by equations (7), (4) and (3) as:

$$h_i(a) = g_i(a) + r(1+r)^a \alpha_i^0 + r \sum_{k=0}^a (1+r)^k [g_i(a) - f_i(a)] \quad (9)$$

Savings, $s_{i,a}$, is the difference between total income and consumption. Note that the difference between the logs of total income and logs of total consumption represents (approximately) the saving rate, as:

$$s_{i,a}/y_{i,a} \approx \ln y_{i,a} - \ln c_{i,a} = \ln h_i(a) - \ln f_i(a) \quad (10)$$

The saving rate depends on age, the interest rate and on idiosyncratic variation in tastes, but not on lifetime resources, nor on the growth of lifetime resources. Using repeated cross sections of

household surveys, it is possible to track the average consumption and the average income of cohorts (defined as groups of individuals with the same year of birth) over the life cycle (see the main text for the estimation details).

A.5 Differences in savings patterns among educational groups

The estimated saving-age patterns and cohort effects do not greatly vary across household heads with secondary education, advanced secondary education, and tertiary education.²⁶ In particular, heads with secondary and advanced secondary education appear to be very similar in their life-cycle behavior. Figure 13 plots the differences in age and cohort effects of tertiary educated household heads compared to those with secondary or advanced secondary education. A positive value indicates that the tertiary educated save a higher fraction of their income, while a value below zero indicates that those with lower levels of education have a higher saving rate.

The savings rate of those with higher education tends to be lower or equal to that of lower educated households in early stages of the life-cycle (top left panel of Figure 13), either because of the former's higher educational expenses or the latter's higher economic uncertainty and weaker financial family support, which encourages higher precautionary savings. Cagetti (2003) argues that wealth accumulation is driven mostly by precautionary motives at the beginning of the life cycle, whereas savings for retirement purposes become significant only closer to retirement. After age 50, the savings rate of those with secondary or advanced secondary education is remarkably lower than that of the higher educated. This difference is particularly pronounced when pension contributions and receipts are included in the saving aggregate, suggesting that the tertiary educated save a larger fraction of their income to provide for old age. However, the difference remains large even after retirement, possibly due to stronger bequest motives among the tertiary educated.

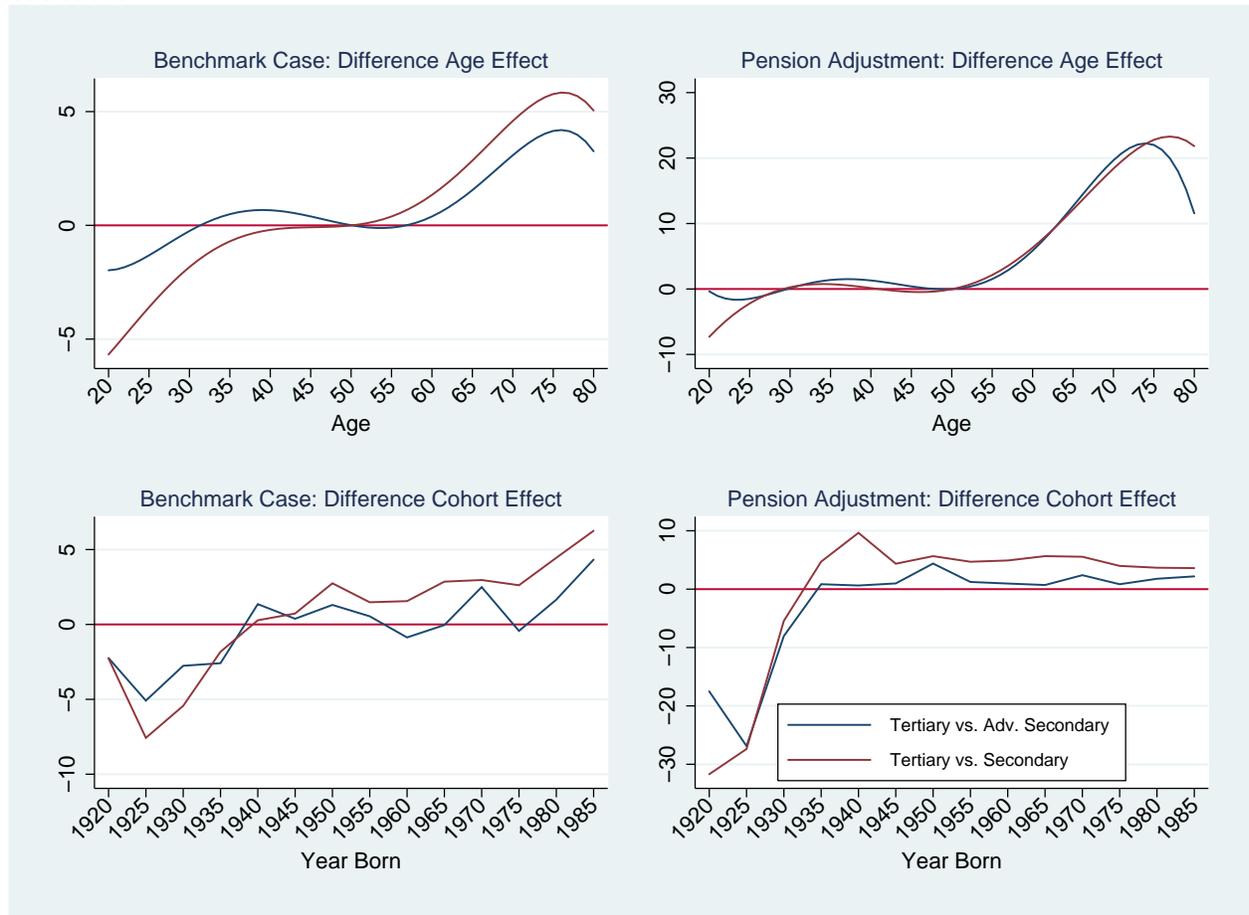
Regarding the difference in cohort effects, we find that for those born before 1935, those with lower levels of education showed a stronger inter-generational increase in savings. However,

²⁶ These educational groups are defined as follows: i) *Secondary Education* includes all individuals with incomplete or complete secondary education as highest degree. Due to the high average level of education in Russia, we do not introduce a separate category for those with no schooling or completed primary education as highest degree; ii) *Advanced Secondary Education*, is equivalent to a minimum of 10 years of schooling, plus some additional education received at a vocational training school, technical community college, medical, music, pedagogical, or art training school with or without diploma or up to two years of higher education; iii) *Tertiary Education* is equivalent to three years of higher education at minimum and includes .

for the later generations the cohort effect is highest among the tertiary educated. Since the education level remains relatively constant after age 25, it can be used as a proxy to control for differences in life-time (or permanent) income within each cohort (see Székely and Attanasio, 2000).

When estimating the regression model separately for household heads with secondary, advanced secondary and tertiary education respectively, the most pronounced difference is in the time effects, which are larger and stronger for the higher educated. The incomes of heads with advanced secondary or tertiary education were hit harder by the 1998 economic crisis, and those with tertiary education benefitted the most from the economic growth prior to the 2008/2009 global economic crisis

Figure 13: Difference in age and cohort effect on saving between lower and higher educated



Source: World Bank calculations using RLMS household survey data.