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RUSSIA'S FISCAL GAP

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This paper is dedicated to the memory of Yegor Gaidar, who founded the Gaidar Institute and for whom fiscal sustainability and responsibility was of paramount importance. The views expressed herein are those of the author and do not necessarily reflect the views of the National Bureau of Economic Research.

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Russia's Fiscal Gap
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ABSTRACT

Every country faces what economists call an intertemporal (across time) budget constraint, which requires that its government's future expenditures, including the servicing of its outstanding official debt, be covered by its government's future receipts when measured in present value. The difference between the present value of a country's future expenditures and its future receipts is called its fiscal gap.

This study estimates Russia's 2013 fiscal gap at 890 trillion rubles or $28 trillion. This longterm budget shortfall is 8.4 percent of the present value of projected GDP. Consequently, eliminating Russia's fiscal gap on a smooth basis requires fiscal tightening by 8.4 percent of each future year's projected GDP.

One means of doing this is to immediately and permanently raise all Russian taxes by 29 percent. Another is to immediately and permanently cut all spending, apart from servicing outstanding debt, by 22.4 percent.

How can a country with vast energy resources and foreign reserves and other financial assets that exceed its official debt still have very major fiscal problems? The answer is that the Russia's energy resources are finite, whereas its expenditure needs are not. Moreover, Russia is aging and facing massive obligations from its pension system and other age related expenditures.

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Introduction -- Fiscal Sustainability Matters

A country's fiscal sustainability matters. It matters to its growth path, to its future tax rates, to its saving behavior, to its net domestic investment, to its labor supply, to its inflation rate, to its employment, to its wages, to its returns on capital, to the integrity of its financial markets, to the viability of its political institutions – indeed, it matters to virtually any question one might pose about a country's future.

Fiscal sustainability also raises ethical questions. If a country is spending more than it can cover with its current and future taxes, will the unpaid bills be left for today's and tomorrow's children? More precisely, will current adults, particularly retirees, escape the requisite fiscal adjustment because the adjustment starts when they are at the ends of their lives or, indeed, after they die?

But understanding what's a generationally fair means to achieve fiscal sustainability first requires knowing what overall adjustment is needed and how delaying the adjustment will increase its requisite size. A country's *fiscal gap* – the difference between the present value of its future expenditures and its future receipts – answers this question. It measures the degree to which a country's projected fiscal policy fails to satisfy what economists call its intertemporal budget constraint.

No household can continually spend more than it makes. At some point, those who are financing the excess of the household's expenditures over its receipts will declare "game over." The same is true of governments. Eventually they need to change their spending or their revenues or both to satisfy their intertemporal budgets. The longer the delay in adjusting policy, the bigger and more painful the adjustment will be and the greater will be the burden on young and future generations who are left behind to pay the bills.

The requirement that, along its economic transition path, a country's taxes cover its expenditures when measured in present value (discounted as of today) is a feature of all neoclassical economic growth models. Indeed, every dynamic growth model constructed by economists incorporates this long-term budget constraint, either explicitly or implicitly.

But while the fiscal authorities fictively dwelling within mathematical economic models realize they have to behave, real word policymakers often fail to get this message before it's too late. Countries whose prevailing policies produce fiscal gaps are running policies that are unsustainable. And the size of the country's fiscal gap indicates the degree to which taxes need to be raised, spending needs to be cut, or a combination of tax hikes and spending cuts need to be imposed, either immediately or starting at a future date, to achieve a sustainable course of policy; i.e., to eliminate the fiscal gap as currently measured.

Fiscal gap accounting may sound like the analysis of a zero-sum game in which one generation can gain only if another loses. That's not necessarily the case. There are investments, be they in education, research, infrastructure, technology, and communications, whose costs are more than offset by future welfare improvements or future revenues thanks to their positive impact on the economy. But fiscal gap accounting provides a framework for governments to soberly evaluate whether an investment will actually pay for itself through time or, instead, represent an added burden that current and future generations must bear. But even if that extra burden is positive, the benefits from the investment, e.g., in the arts and sports, may justify the costs.

An example of an investment that could pay for itself is the development of clean energy sources financed by borrowing from current older generations. If future generations are asked to repay this borrowing, but the investment provides sufficient welfare improvements to those future generations, in terms of abating climate change as well as better health outcomes, future generations may, on balance, end up better off.

Although this study constitutes the first fiscal gap analysis for Russia, prior studies discussing problems with conventional fiscal accounting and measuring the sizes of fiscal gaps in developed countries date back more than two decades. They include Auerbach, Gokhale, and Kotlikoff (1991), Gokhale and Raffelhüschen (1999), Gokhale and Smetters (2003), Auerbach, Gale, and Orszag (2003), Auerbach, Gale, and Orszag (2004), Kotlikoff and Green (2009), Evans, Kotlikoff, and Phillips (2012), and Kotlikoff and Burns (2012).

The emergence of this literature reflects the economics profession's growing understanding that conventional fiscal sustainability measures, specifically official debt and deficits, are not well grounded in economic theory. Instead, what is measured with these statistics is what the government in questions chooses to label an official as opposed to an unofficial or implicit debt, i.e., what shows up on the government's books as an official liability is whole a function of what the government does and doesn't decide to put on its books. This fiscal labeling game – making arbitrary choices to call particular receipts that are surrendered to the government in exchange for future repayments "official borrowing" and other such receipts "taxes and promises of future transfer payments" has been played to get effect. The developed world now has a mountain of implicit debt towering over a small hill of official debt. This is no less true for Russia than any other developed country.

Indeed, our findings for Russia may surprise many readers. Despite having positive net financial wealth (i.e., it foreign reserves and other financial assets exceeds its official government debt), Russia has a very major fiscal gap. The 2013 value is 889.674 trillion rubles or $27.6 trillion. This present value long-term budget shortfall is 8.4 percent of the present value of Russia's projected GDP. Consequently, eliminating Russia's fiscal gap on a smooth basis requires fiscal tightening *in all future years* by 8.4 percent of each future year's projected GDP.

How can a country with positive net wealth have small or, in the case of Russia, even negative net official debt and still have very major fiscal problems? The answer is that official debt measures are, economically speaking, entirely arbitrary. What obligations governments do and do not put on the books and, correspondingly, what governments report as their official debts is a matter of preference, not economic theory. Indeed, as formally shown by Green and Kotlikoff (2009), governments have complete leeway in deciding which receipts to call "borrowing" and which receipts to call "taxes" and what promises of payments in the future to call "principal plus interest" rather than "transfer payments."

The fiscal gap has an enormous advantage over conventional debt accounting insofar as its measurement is guided by economic theory and its calculation is invariant to fiscal labeling conventions. I.e., no matter what a government chooses to call its receipts and payments, the fiscal gap will stay the same since it only cares about the present value of payments net of receipts – not what they are called.

Many Russians, attuned to thinking their country's fiscal condition is quite solid based on its current positive net financial assets, will, no doubt, find it hard to believe that Russia faces a

very serious long-term fiscal problem. But this is, indeed, the reality and the longer this problem is ignored, the harder will be its resolution.

What would it take, starting today, to eliminate Russia's fiscal gap? One answer is to immediately and permanently raise all Russian federal taxes by 29 percent. Another way is to immediately and permanently cut all spending, apart from servicing outstanding debt, by 22.4 percent. A third way to eliminate the gap and achieve fiscal sustainability entails using both tax increases and spending cuts, each of which would eliminate half the fiscal gap. In this case, the requisite immediate and permanent tax hike is 14.5 percent and the requisite immediate and permanent spending cut is 11.2 percent.

These results do not reflect extreme projections. On the contrary. This study relies, wherever possible, on demographic and fiscal projections of Russia's Ministry of Economic Development (MED) and Russia's Federal State Statistics Service (Rosstat). All data and methods used in the analysis are posted on the Gaidar Institute website at (www.iep.ru).

Russia's fiscal gap, scaled by its economy, is close to the largest of any developed country. But the dubious distinction of having the largest fiscal gap relative to its GDP may well lie with the United States. The U.S. fiscal gap now stands at 10 percent of the present value of its future GDP. For the U.S., a 57 percent immediate and permanent tax hike or a 37 percent immediate and permanent spending cut is needed to close the fiscal gap.

The source of the U.S. fiscal gap is population aging coupled with excessive growth in transfer payments per capita to the elderly, particularly government-financed healthcare benefits under the Medicare and Medicaid programs. Since 1970, these benefit levels have grown at twice the growth rate of per capita GDP. And they are projected to continue to grow faster than per capital GDP for decades to come. Today, U.S. government healthcare and pension spending per retiree exceeds $30,000 – twice Russia's per capital income. Were there very few older people in the U.S. to collect these benefits, their growth would be of little consequences. But 42 million American retirees are already collecting old-age benefits and 78 million baby boomers are poised to retire over the next 20 years and collect benefits that will average closer to $40,000 per head.

Russia's fiscal gap has different causes. First, Russia is becoming, and will remain, somewhat older than the U.S. By 2050, approximately 23.0 percent of Russia's population will be 65 or older, compared with 20.9 percent in the U.S. The current elderly population shares of the two countries -- 13.0 percent in Russia and 13.5 percent in the U.S. -- are much smaller and also quite close to one another. The fact that Russia, despite its much lower fertility rate than the U.S., won't have a much older population than the U.S. reflects its projected lower life expectancy and its relatively high projected rate of net immigration.

Second, Russia's pay-as-you-go pension system, not its healthcare system, is the most important transfer program interacting with its demographic transition. Indeed, absent its pension system (both pension benefits and the payroll taxes financing pensions), Russia's fiscal gap would be 480.0 trillion rubles or 54 percent smaller.

Third, Russia's energy resources, from which the government derives roughly a third of current revenues, are finite. Based on Russia's current proven oil reserves and its current rate of extraction, the country will run out of oil in 55 years. If we augment proven reserves

by 25 percent to account for the potential of bringing unproven reserves on line as well as the potential for new oil discoveries, the exhaustion date for oil will occur in 65 years.

Russia's reserves of natural gas will be depleted in 92 years assuming the current rate of extraction is maintained. Depletion will occur in 115 years were natural gas reserves to increase by a quarter due to new discoveries. Even though depletion isn't going to occur in the near term, revenues from natural resources will not grow as fast as the economy and, therefore, will not grow as fast as other revenues or total expenditures. Hence, Russia faces a similar challenge to Norway, Chile, Saudi Arabia, and other natural resources-dependent economies, namely making sure the income from these resources isn't spent too quickly to the detriment of future generations.

Long-term projections are, of course, fraught with uncertainty and these uncertainties concern more than Russia's energy endowments and the ability to extract and develop these resources. What will happen to the prices of oil and natural gas? Will Russia's fertility rate turn around, and soon? Will its immigration rate remain steady as Rosstat forecasts or will it fall as the United Nations predicts? Will mortality rates fall, such that Russian life expectancy reaches Western levels? Will GDP keep growing and if it does, will it grow faster than government expenditures?

No one knows the answers to these questions. The best one can do is to explore the sensitivity of Russia's apparent very major fiscal problem to different assumptions. This study provides three estimates of Russia's fiscal gap. We reference them as intermediate, pessimistic, and optimistic. The intermediate estimate incorporates intermediate assumptions about demographics, GDP growth, discovery and development of additional energy resources, the course of energy prices, labor market structure and the pension system. The pessimistic and optimistic estimates incorporate pessimistic and optimistic scenarios for each of these factors.

In the case of demographics, the pessimistic scenario coincides with Rosstat's assumptions of low fertility, low life expectancy, and low immigration. This produces a low projection of total future Russian population. The optimistic scenario, correspondingly, assumes high values for each of these variables and generates a high projection of total future Russian population.

Based on pessimistic assumptions, Russia's fiscal gap is 278.0 trillion rubles or 5.2 percent of the present value of future GDP. In this case, either a 17.7 percent immediate and permanent tax hike or a 14.9 percent immediate and permanent cut in all non-interest spending would suffice to eliminate the fiscal gap.

Under optimistic assumptions, Russia's fiscal gap is 1,669.5 trillion rubles or 10.5 percent of the present value of GDP. And eliminating the fiscal gap could be accomplished via either an immediate and permanent 36.5 percent tax hike or an immediate and permanent 26.6 percent cut in all non-interest spending.

Recall that Russia's fiscal gap is 8.4 percent of the present value of GDP. Hence, the pessimistic assumptions produce a smaller fiscal gap as a share of the present value of GDP and the optimistic assumptions produce a larger fiscal gap as a share of the present value of GDP. The question, then, is why bad economic times makes for better fiscal times and vice versa?

The explanation is that the pessimistic assumptions imbed two factors that significantly limit Russia's future fiscal challenge. The first is shorter longevity, which reduces the fiscal burden of the pension and healthcare systems. The second is that slower GDP growth reduces future defense and other discretionary government spending, which is assumed to remain fixed relative to the size of the economy. But slower GDP growth does not reduce projected energy-sector revenues. Consequently, energy-sector revenues are able to pay for a larger share of discretionary as well as pension and healthcare spending. The opposite explanations apply to the optimistic scenario, which entail larger fiscal challenges for Russia.

As with any unpaid bill, waiting to pay it makes it bigger, if, as is here the case, unpaid balances accumulate at interest. Under intermediate assumptions, eliminating Russia's fiscal gap would, as indicated, require either a tax hike or 29.0 percent or a benefit of 22.4 percent if one of these adjustments is undertaken immediately. Waiting for 20 years, until 2033, to adjust policy raises these two figures to 34.5 and 25.9, respectively.

Fiscal Gap Accounting -- Methodology

Russia's fiscal gap for 2013 is defined as:

$$Fiscal\ gap = \sum_{t=2013}^{\infty} \frac{X_t - Y_t}{(1+r)^{t-2013}} - W_{2013}$$

where X_t and Y_t stand for total real government expenditures (apart from interest and principal payments on outstanding government debt) and revenues in year *t*, respectively, r is the real discount rate, and W_{2013} stands for 2013 government financial wealth (e.g., foreign reserves) less official debt. All variables referred to the consolidated budget of the Russian Federation. The consolidated budget of the Russian Federation is a budget that consolidates local and federal government budgets with the budgets of extra-budgetary social security funds, specifically, pension funds (local and federal) and healthcare funds.

Government non-interest expenditures include government purchases of goods and services and pension, welfare, healthcare, and other transfer payments to households. Government revenues include all tax and non-tax receipts, including revenues accruing to the government from the energy sector.

We explicitly project both government spending and revenues through 2100. After 2100, we assume that GDP, as well as total spending and total revenues, grow at a constant rate $\bar{g}$. Thus, we can write:

$$Fiscal\ gap = \left[\sum_{t=2013}^{2100} \frac{X_t - Y_t}{(1+r)^{t-2013}} - W_{2013} \right] + \left[\sum_{t=2101}^{\infty} \frac{X_{2100} - Y_{2100}}{(1+r)^{t-2013}} (1+\bar{g})^{t-2100} \right].$$

As described below, several of the components of spending and revenues, including healthcare spending, pension payments, educational expenditures, payroll taxes, and income taxes are projected based on relative-age profiles and age- and year-specific future population counts. Hence, the forecast of future Russian demographics, specifically the

projected number of future Russians by age and sex, to which we turn next, is central to our analysis.

Demographic Forecast

Russia has experienced some remarkable demographic changes since the breakup of the Soviet Union in 1991. At that point Russia's population stood at 148.3 million. Today's population is smaller – 143.3 million. The population decline reflected a rise in death and emigration rates and a decline in birth rates. But in the late 2000s, things started turning around. Since 2009, Russia has experienced positive population growth. Last year, 2012, Russia's population rose by almost 300,000 people. And this year's Russian total fertility rate of 1.691 children per woman topped those of all other countries in Eastern Europe.

There are two major sets of demographic projections available for Russia. One is produced by Rosstat. The other is produced by the United Nations' Department of Economic and Social Affairs (Population Division). The UN population projections report the results in a less detailed manner than Rosstat. It provides population counts in 5-year age groups, rather than the single-year age groups needed for our analysis. But the major difference between the two forecasts involves future net migration into Russia. Although the UN's 2012 population prospects entail more net migration than previously assumed, it still differs significantly from Rosstat's with respect to net migration over the next three decades and particularly in the decade preceding 2031 – the last year of the Rosstat forecast.

On balance, we concluded that the Rosstat projection was more suitable for our analysis. It is more detailed and assumes a higher migration rate, which seems historically reasonable. Also, Rosstat appears to have a better track record forecasting Russia's population than does the UN. Finally, Rosstat's forecast is consistent with other Russian forecasts, including the economic forecast of MED. However, Rosstat's official projection extends only through 2031, and the agency was unable to provide us projections beyond 2031. Hence, it was necessary to rely on our own assumptions in extending Rosstat's forecast.

This task would have been relatively easy were we in possession of Rosstat's age-specific demographic assumptions. However, only the total fertility rate (TFR), life expectancy, and net migration assumptions were publicly released. Consequently, we were forced to make our own assumptions about age-specific mortality, fertility, and migration rates. We did so using Rosstat's 2010 data on these age-specific variables, which is the latest release date for these variables. Note that our age-specific demographic assumptions, which we use to extend Rosstat's demographic projections beyond 2031, may not be consistent with Rosstat's own underlying, but undisclosed age-specific projections for the years 2010 through 2031. But any error will likely be minor.

Projections of Russia's Total Fertility Rate

Past actual and projected future values of TFR under optimistic, intermediate, and pessimistic assumptions are presented in figure 1. The values plotted for 2013 through 2031 are Rosstat's. The values after 2031 are based on our extension of Rosstat's three projections.

As is clear, Rosstat's pessimistic TFR scenario entails a rapid return to Russia's recent low fertility behavior, with the TFR falling below 1.4 over the next decade. However, after 2025, Rosstat assumes the pessimistic path of TFR slowly starts to recover to preclude what would otherwise be an ongoing decline in Russian population levels. We extend this recovery through 2100 at which point TFR is 1.8. After 2100, our pessimistic TFR path keeps TFR at its 2100 value.

Rosstat's optimistic TFR scenario extends the recent observed rise in the total fertility rate, projecting a value above 2.00 by 2031. We extend this optimistic projection by continuing TFR growth until it reaches the level – roughly 2.05 – that would, absent immigration, ultimately produce zero population growth (ZPG).

Rosstat's intermediate TFR forecast foresees a small drop in TFR – to 1.6 from the current 1.7 rate – between now and 2031. After 2031, we assume TFR makes a gradual comeback, reaching the 2.05 ZPG level, not in 2040, as in the optimistic scenario, but in 2080. After 2080, we assume that TFR remains at 2.05.

Projections of Russians' Life Expectancy

Russian life expectancy is very low, especially for males. The current levels of expected life at birth are 64.6 for males and 75.9 for females. In the U.S., these figures are 76 and 81, respectively. That's the bad news. The good news is that Russian life expectancy has risen sharply since 2005 for both males and females.

Projections for male and female life expectancy are shown in Figure 2. As indicated, Rosstat's pessimistic scenario sees life expectancies falling somewhat and returning to roughly their current values over the next two decades. We then assume a slow growth in these values through the course of the century reaching, for males, 75 and, for females, 85 in 2100.

Rosstat's intermediate and optimistic life expectancy projections entail significant further increases through 2031. Our extensions of these projections culminate with male life expectancy at 86 in 2100. For females, our optimistic projection foresees women born in 2100 living, on average, to 95. And our intermediate projection has females born in the long run living, on average, to 86.

Net Migration

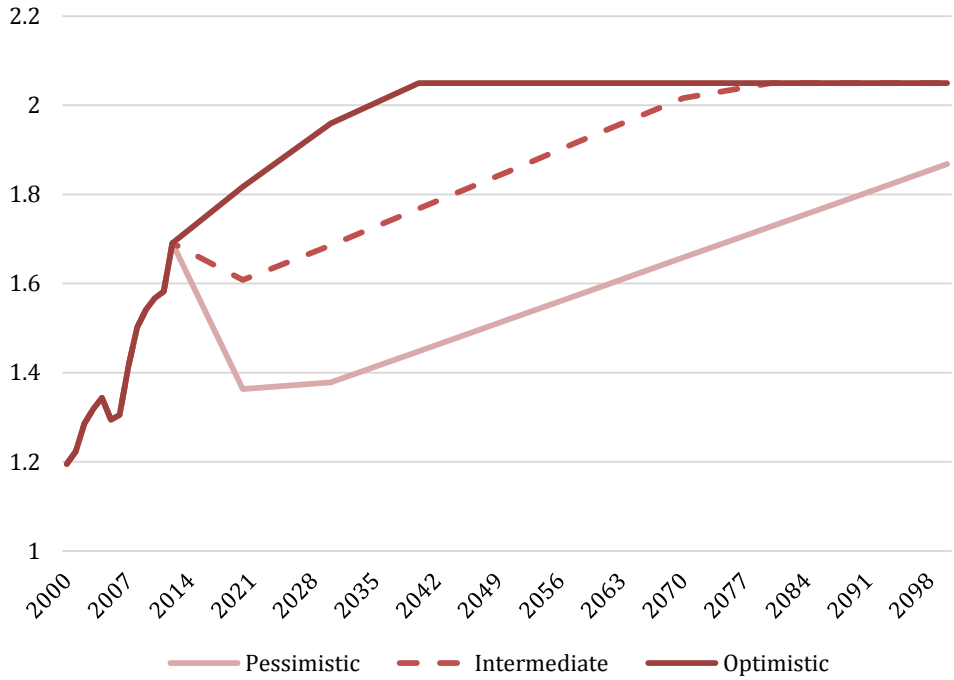
Figure 3 plots our three scenarios for net migration. The first thing to notice is the substantial variability in recent years in net migration, making long-term projections even more tenuous than would otherwise be true.

Net migration declines over time under each scenario. While the pessimistic and intermediate scenarios level off at a positive value, long-run migration is zero under the optimistic scenario. Were we to assume positive long-term net migration, Russia's population after 2100 would grow indefinitely large.

Population Projections

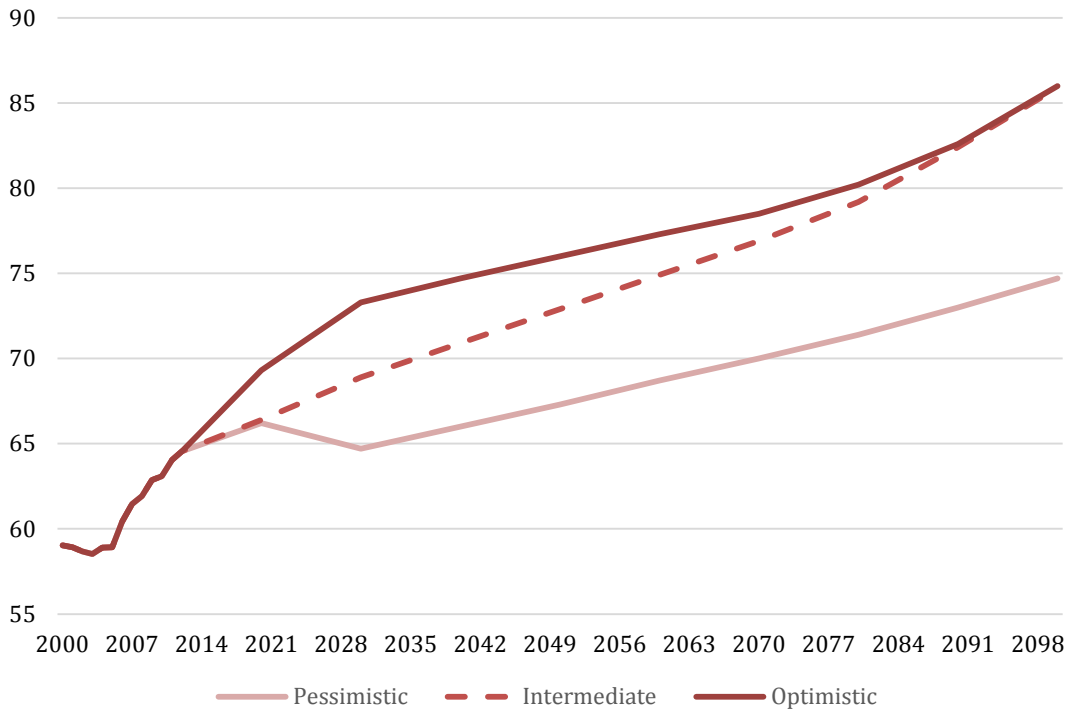
Figure 4 provides projected total population counts under three scenarios. As the graph shows, the projections differ sharply. The pessimistic scenario projects Russia's population in 2100 to total just under 85 million. The optimistic scenario projects it to equal 165 million. And the intermediate scenario foresees a total population in 2100 of 135 million.

Figure 1. Projected Total Fertility Rates



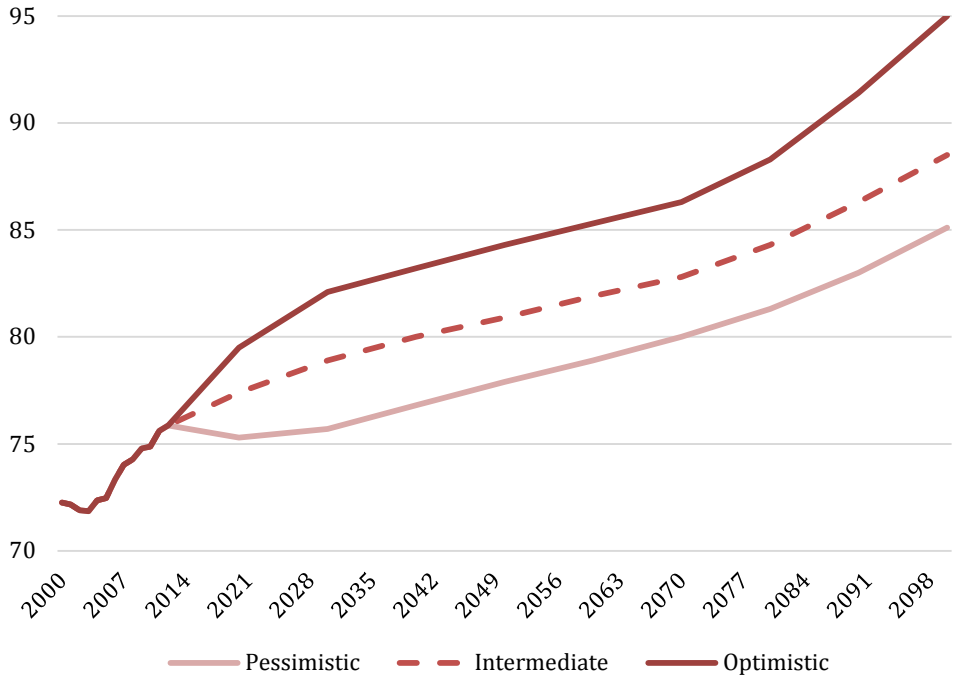
Source: Rosstat data and authors' estimates

Figure 2a. Male Life Expectancy at Birth



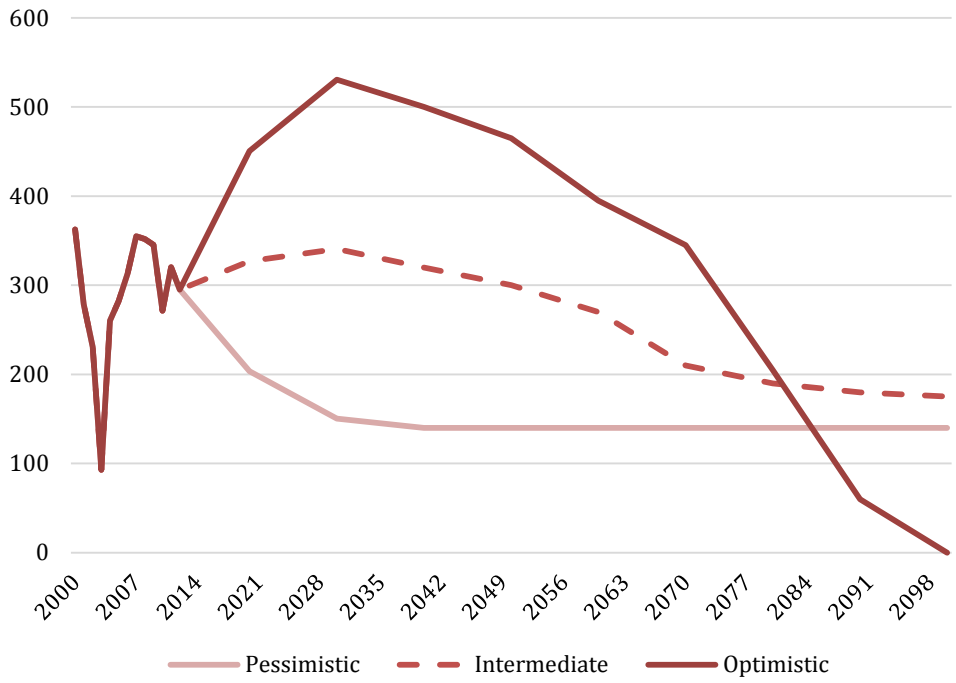
Source: Rosstat data and authors' estimates

Figure 2b. Female Life Expectancy at Birth



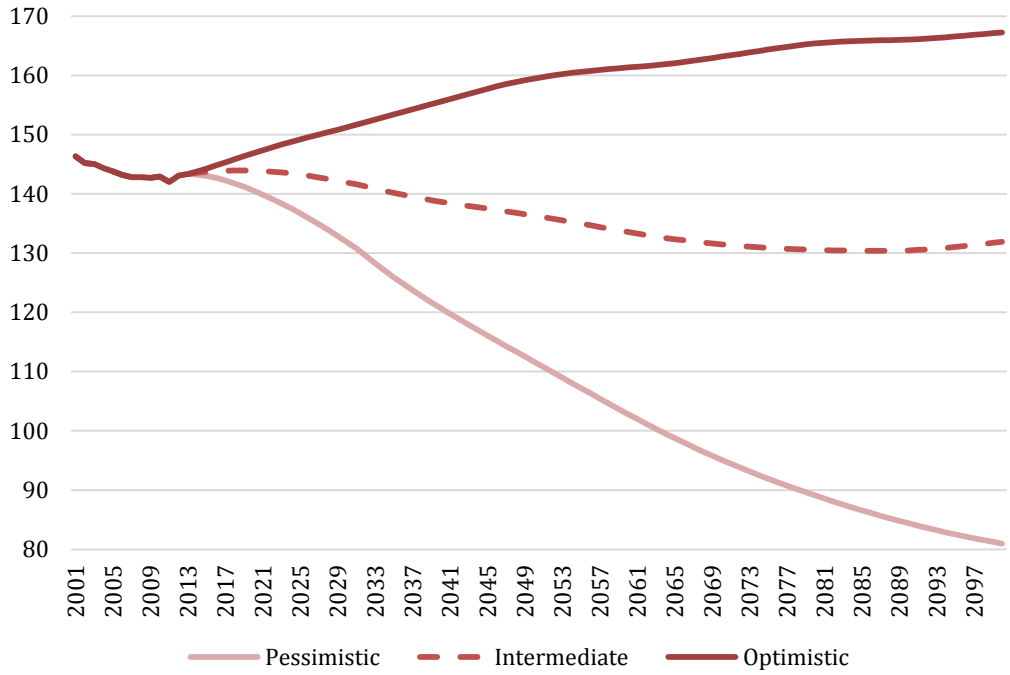
Source: Rosstat data and authors' estimates

Figure 3. Net Migration Projections (in thousands)



Source: Rosstat data and authors' estimates

Figure 4. Total Population Projection (in millions)



Source: Rosstat data and authors' estimates

Long-Term GDP Forecast

Several of our forecasts for expenditures are predicated on the future path of Russia's GDP. Our projection of real GDP through 2100 is based on two components – a projection of labor productivity, specifically output per working age Russian, and a projection of the number of Russians of working age.

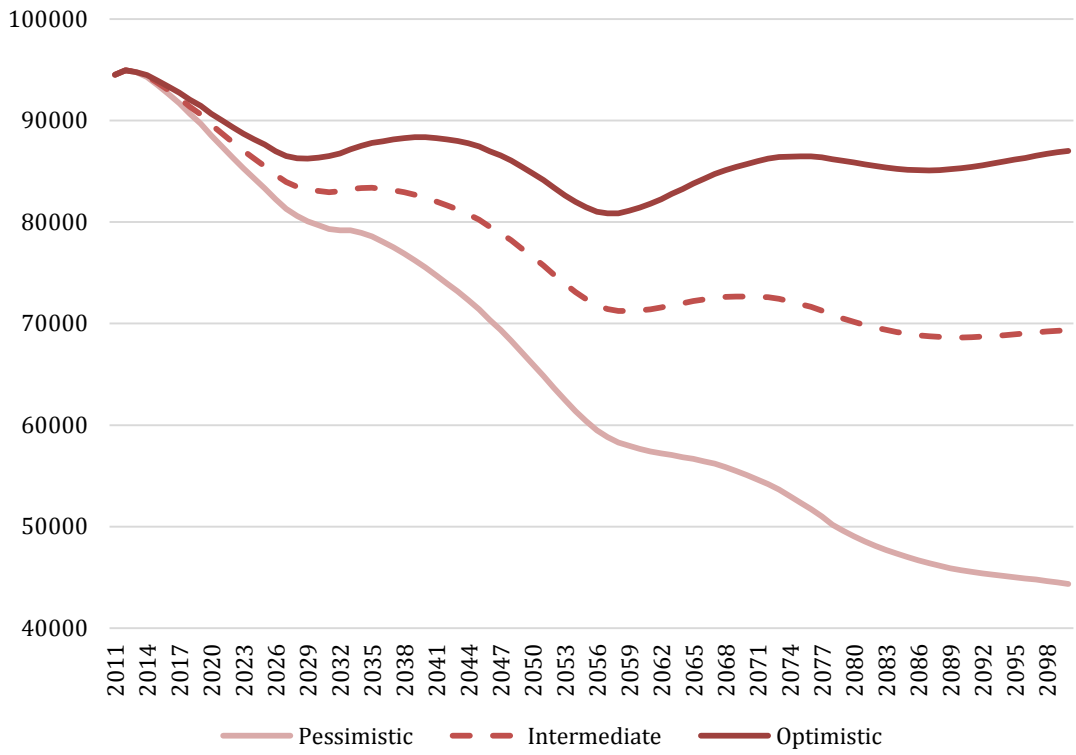
Projecting the Working-Age Population Through 2100

The evolution of the working age population through 2100 relies on Rosstat's demographic forecast through 2031 and our extension of that forecast through 2100. We take the working age population as all Russians age 20 through 64, inclusive. This definition differs from the official one in Russia which states that working age population includes women age 16-54 and men age 16-59. The reason for our decision to redefine working age is that the official definition doesn`t describe the current economic reality accurately. In modern Russia most young people start working after at least a couple of years of higher education and don`t retire until their mid 60s.

Figure 5 shows how the work force is projected to decline through time. This is true even for the optimistic scenario, notwithstanding a projected rise in the Russian population under that scenario of over 20 million between now and 2100. How can the total population rise in this scenario while the working-age population declines? The answer lies primarily in the assumed increases in fertility and longevity. I.e., over the remainder of this Century, the

projected expansion of the population will arise among the young and the old, not among people of working age.

Figure 5. Projection of Working-Age Population (in thousands)



Source: Rosstat data and authors' estimates

Projections of Labor Productivity

Our projection of labor productivity is based on three labor productivity scenarios, through 2030, provided by the Ministry of Economic Development of the Russian Federation (MED). Figure 6 presents labor productivity from 2000 through 2013 as well as MED's official projections of this variable through 2030[1].

The global financial crisis of the late 2000s produced a major drop in Russian output without a concomitant drop in employment of equal magnitude. Consequently, measured Russian productivity (output per unit of labor input) fell plunged this period.

Currently, Russia's labor productivity is growing at slightly higher than 2 percent per year, and all three of MED's projections foresee either higher or very much higher labor-productivity growth rates in over the next two decades.

Why do the three MED productivity forecasts through 2030 differ so much?

[1] Note that MED doesn't publish labor productivity forecast in 2021-2024 as well as in 2026-2029. So, we estimate productivity growth during these periods on the basis of extrapolation of average growth rates between 2020-2025 and 2025-2030.

MED's pessimistic scenario assumes moderate long-term economic growth arising from modernization of the fuel, energy, and materials sectors of the Russian economy. It also assumes relatively slow growth in civilian high- and medium-tech sectors.

MED's intermediate growth scenario foresees significant economic growth based on the creation of a modern transport infrastructure, the modernization of Russia's energy and resources sector, Russia's becoming more competitive with respect to high-tech/knowledge-based industries, and substantial inflows of foreign investment capital.

MED's optimistic scenario is developed on the basis of the innovation scenario, while it is characterized by an accelerated pace of growth, increased rate of accumulation of private businesses, the creation of a large-scale, non-oil export sector, and a significant inflow of foreign capital[2]

Our projection of labor productivity growth from 2030 (when MED's projection stops) through 2100 assumes that Russia's productivity growth rate will decline at a constant rate, with the growth rate ending up at an assumption 1.7 percent level. This is the rate that the Congressional Budget Office projects will prevail in the U.S. from 2022 onward.[3]

Specifically, let LP_{2030} stand for the MED's assumed 2030 labor productivity growth rate (which will differ depending on whether the pessimistic, intermediate, or optimistic scenario is considered). We solve for the constant rate *d* at which Russia's productivity growth rate declines as follows:

$$LP_{2030}\left(1+d\right)^{70}=0.017,$$

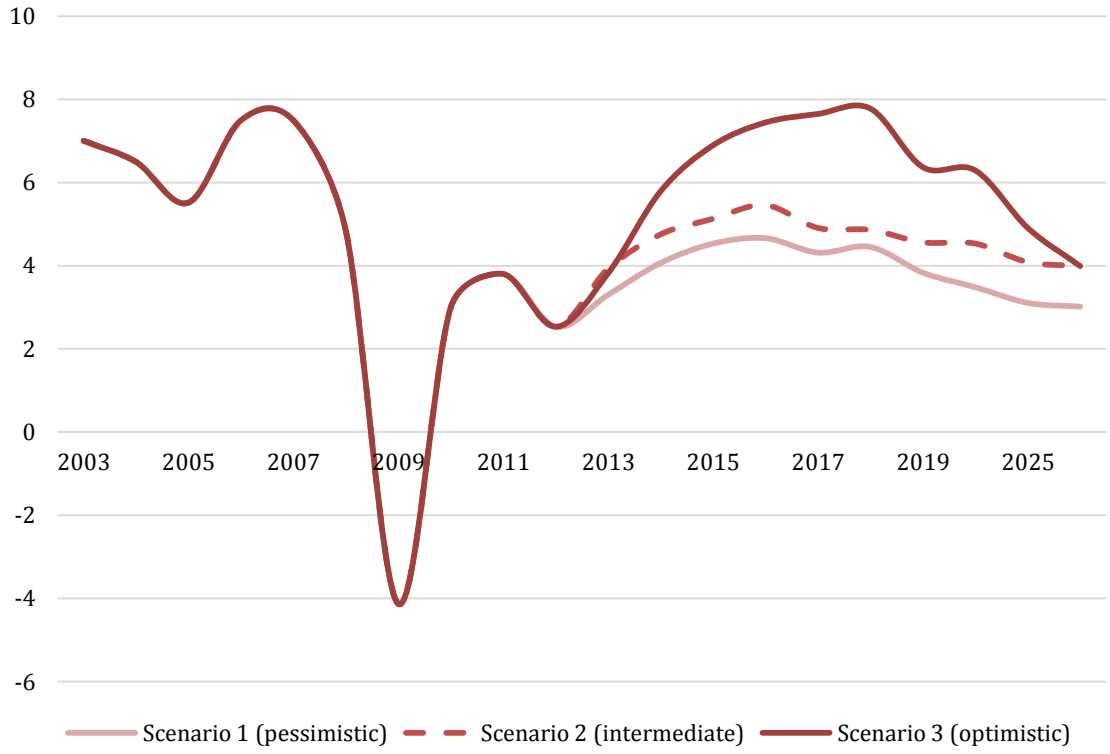
Russia's absolute labor productivity in years between 2030 and 2100 is, then, our productivity level for 2030 multiplied by *1+d* raised to the number of years between 2030 and the year in question.

Figure 7 presents projected labor productivity levels through 2100 for 3 MED scenarios described above. And figure 8 shows projected absolute productivity levels from 2013 through 2100, that is output per worker in constant (2013) prices.

[2] See Ministry of Economic Development of the Russian Federation. Long-term forecast of socio - economic development of the Russian Federation for the period up to 2030. Moscow, March 2013 r., pp. 51-52 (http://www.economy.gov.ru/minec/activity/sections/macro/prognoz/doc20130325_06).

[3] http://www.cbo.gov/publication/43902.

Figure 6. Past and Projected Future Labor Productivity Growth Rate



Source: Rosstat and MED

Projections of GDP

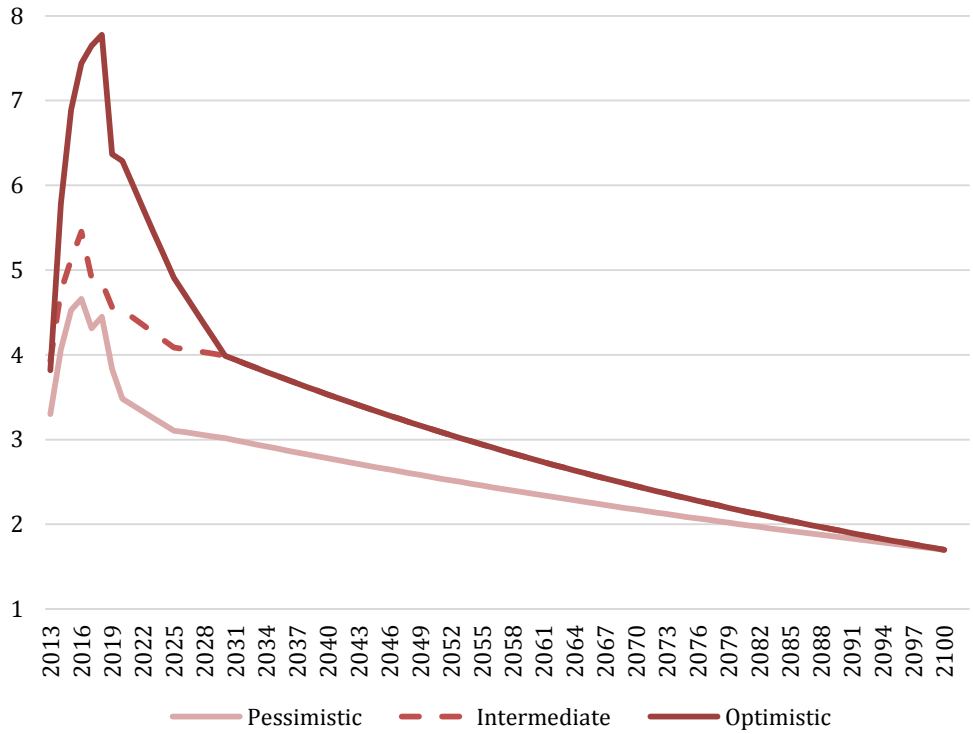
Prior to 2030, we use MED'S GDP forecasts adjusted for differences in our projections of total population of the Russian Federation and MED's projections. Our projections of total population through 2030 are those produced by Rosstat in 2012, whereas MED's projections use slightly different population projections. We also measure labor productivity differently from Rosstat. Specifically, we define labor productivity as output per person of working age, where working age is defined as ages 20 to 64.

To be precise, we take the MED GDP forecast till 2030 and multiply it by the ratio of our estimate of total population to the MED estimate of total population (for each year). After that we divide adjusted 2013 GDP forecast by the Rosstat 2012 forecast for 2013 of the working age population and arrive at our measure of labor productivity for 2013. We then grow this initial level of productivity through 2030 based on MED's assumed annual labor productivity growth rates, notwithstanding that MED's definition of labor productivity is somewhat different from ours (due to their defining the work force differently). We do this for each of the three scenarios separately. This produces three paths of projected labor productivity through 2030. Multiplying these year-specific values of output per working age population by the Rosstat 2012 projection of the working age population in each year produces our forecast of GDP in that year.

Between 2030 and 2100 we multiply, for the pessimistic, intermediate, and optimistic scenarios, our projected levels of labor productivity, the derivation of which was described above, by our projected estimates of the number of Russians of working age for the year in

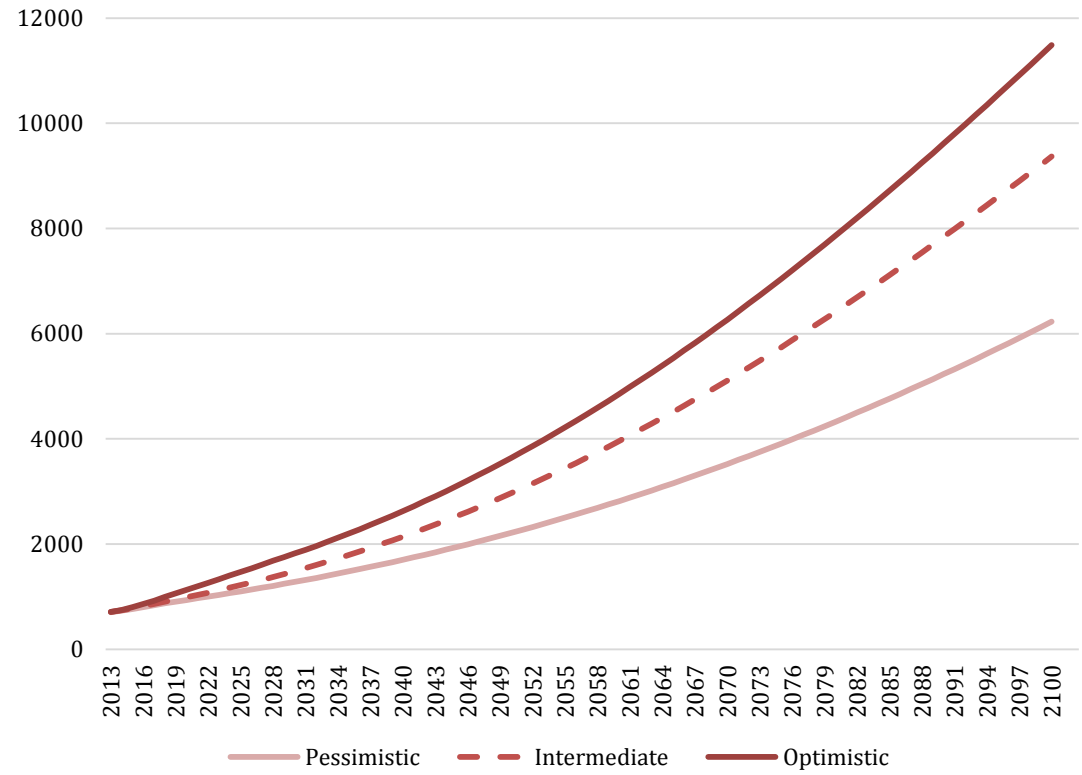
question. The pessimistic GDP projection combines the pessimistic labor productivity and the pessimistic work force projections. The intermediate GDP projection combines the intermediate labor productivity and work force projections. And the optimistic GDP projection combines the optimistic labor productivity and work force projections. Figure 9 shows actual and projected GDP in 2013 rubles.

Figure 7. Projections of Labor Productivity Growth Rate



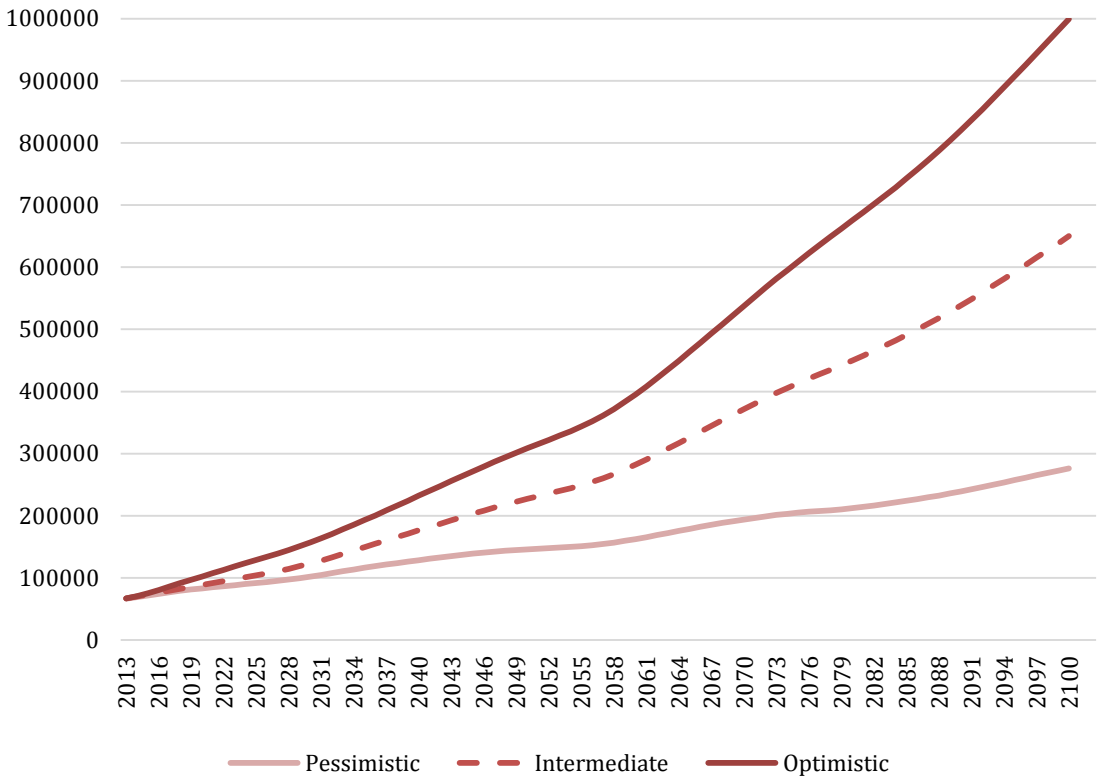
Source: Rosstat data and authors' estimates

Figure 8. Projections of Labor Productivity Levels (thousands of 2013 rubles per worker)



Source: MED projections and authors' estimates

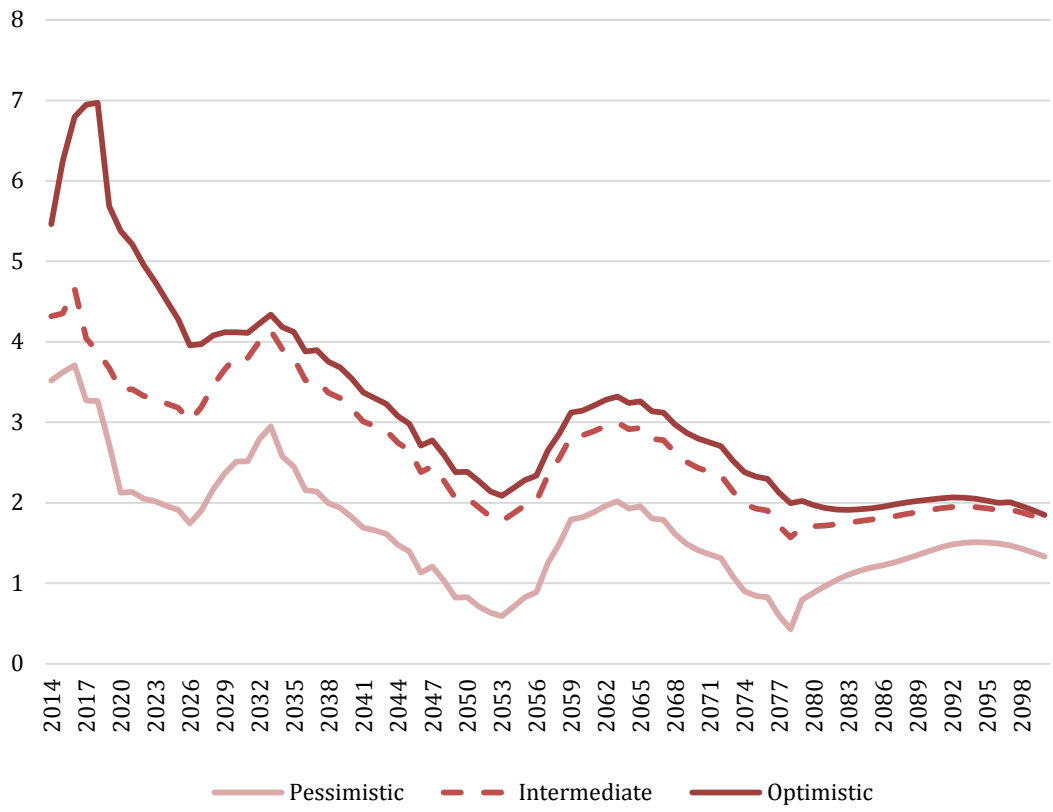
Figure 9. Actual and Projected GDP (billions of 2013 rubles)



Source: Rosstat and MED data, authors' estimates

For each scenario we assume that the output growth rate after 2100 is equal to the average growth rate in the last projected decade (2090-2100). Figure 10 presents GDP growth rates corresponding to the three GDP projections shown in figure 9.

Figure 10. Projected Annual Real GDP Growth Rates

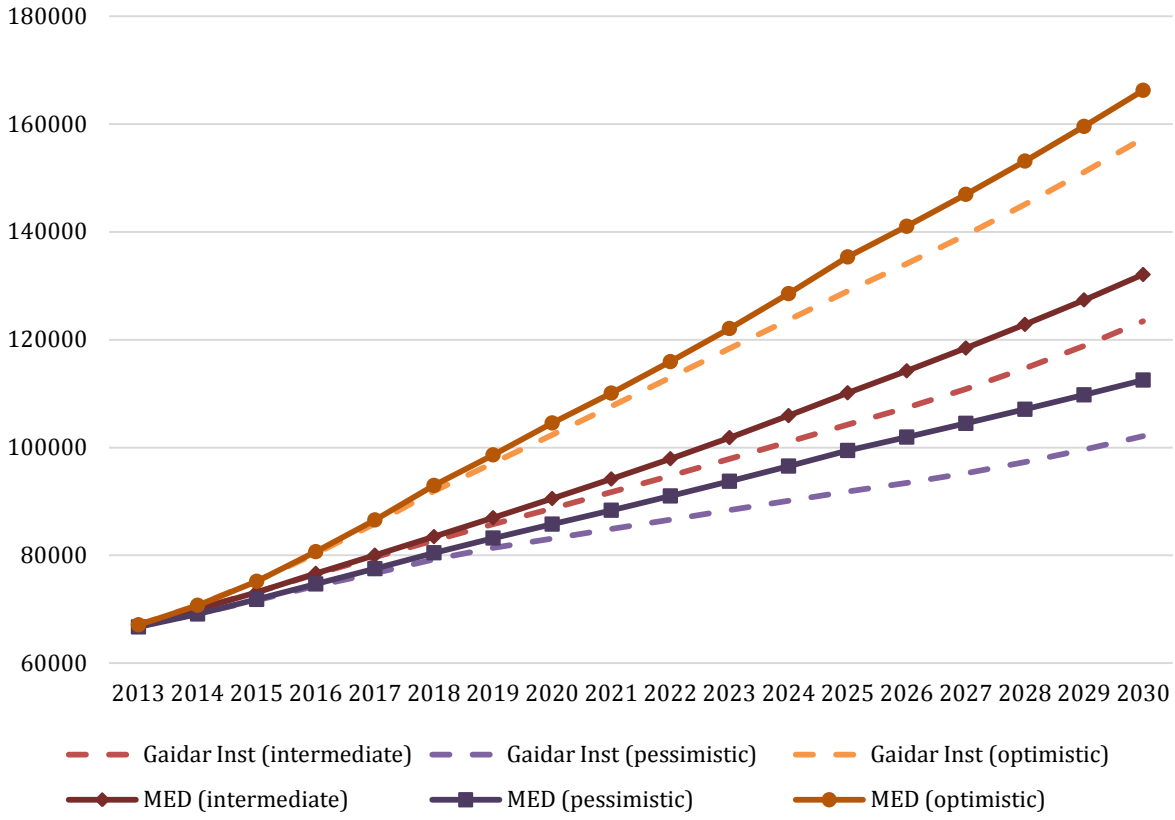


Source: MED and Rosstat data, authors' estimates

According to figure 9, Russian GDP growth rates while gradually declining through 2100 remain positive. This doesn't reflect growth in the working age population because, as we've seen, all three scenarios foresee a decline in the number of Russians of working age. The explanation is the growth in labor productivity, which, though declining after 2030, remains high enough to permit GDP to increase.

Figure 11 presents our projection versus MED projections of real GDP levels according to three scenarios. Under each set of assumptions, our projections of GDP are lower than those of MED. But, to reemphasize, the differences here are due only to two things – our use of Rosstat's most recent (2013) demographic projections and to our definition of the work force.

Figure 11. Gaidar Institute Versus MED Real GDP Projections (billions of 2013 rubles)



Source: MED and Rosstat data, authors' estimates

Projecting Government Expenditures

This section discusses our projection of future government spending. Our starting point is the consolidated budget of the Russian Federation. The general categories of the federal budget, as well as details of what they include, are specified in table 1. Discretionary expenditures, such as national defense, which are of a public goods nature, are projected to grow with GDP; i.e. they are assumed to be the same share of GDP in the future as they are now. These expenditures as well as their current GDP shares are specified in table 2. Figure 12 shows our projection of these expenditures in real terms (2013 rubles) under our pessimistic, intermediate, and optimistic assumptions.

One important discretionary expenditure not included in table 2 and figure 12 is spending on education. This expenditure category as well as expenditures on pensions, healthcare, and other transfer payments depend on the age structure of the population. Consequently, as detailed below, our projection of these expenses take into account their age patterns as well as the projected changes in age-specific population counts.

Forecasting Public Spending on Healthcare

Healthcare spending is highly age dependent, with per capita expenditures on the elderly generally much higher than healthcare expenditures on the young and middle aged. Given Russia's projected aging, total healthcare spending will likely rise significantly in the long run. Moreover, in many developed economies per capita healthcare spending has been growing much more rapidly than per capita GDP.

Table 1 The Budget of the Russian Federation

1. General public services

- administration, operation or support of executive and legislative organs, civil and criminal law courts;
- financial and fiscal affairs and services; management of public funds and public debt; operation of taxation schemes

2. National defense

- military defense affairs and services; operation of land, sea, air and space defense forces; operation of engineering, transport, communication, intelligence, personnel and other non-combat defense forces; operation or support of reserve and auxiliary forces of the defense establishment;
- civil defense affairs and services and military aid

3. Public order and safety

- police services; border and coast guards; fire protection; administration of prisons
- operation of the judicial system (*excluding* law courts): offices of public prosecutors, etc.;
- alien registration, issuing work and travel documents to immigrants; internal troops

4. Economic affairs

- general economic, commercial, and labor affairs;
- fuel and energy, mining (subsidies to the private and state-owned enterprises);
- space exploration; reproduction of mineral base, geological prospecting;
- agriculture, forestry, water resources, fishing, and hunting
- transport, roads infrastructure, communication, informatics (administration

5. Housing and community amenities

- housing development (construction, renovation or purchase of dwelling units for the general public, for people with special needs, civil servants);
- community development (administration; construction or renovation of systems and facilities; subsidies to private and state-owned enterprises)
- street lighting, accomplishment, etc.

6. Environmental protection

- waste management; waste water management;
- pollution abatement; protection of biodiversity and landscape.

7. Education

- provision services of pre-primary and primary, secondary and postsecondary education
- youth policy and children's rehabilitation

8. Culture, cinematography and mass media

- provision of cultural services (including construction or renovation of cultural facilities)
- broadcasting and publishing services (including subsidies to state-owned mass media)

9. Health

- Medical products, outpatient services, hospital services, public health services

Table 1 continued

10. Social policy

- Pensions, other elderly benefits, unemployment; sickness and disability, survivors benefits, family and children
- housing (provision of social protection in the form of benefits to help households meet the cost of housing)
- provision of social protection to other categories of persons who are socially excluded or at risk of social exclusion

11. Sport and physical culture

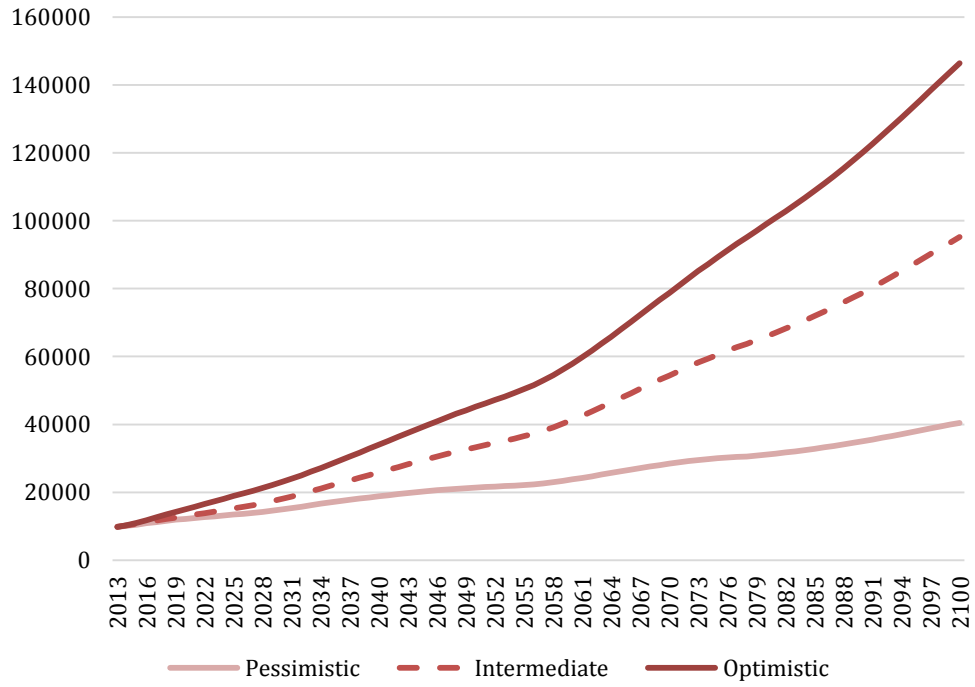
- provision of sport services (including construction or renovation of sporting facilities), administration
- administration of sporting affairs, supervision and regulation of sporting facilities

Table 2. Discretionary Spending as Percent of GDP, 2012

National economy	4.63
Sport	0.30
National security and law enforcement	3.09
General national issues	2.92
National defense	2.91
Culture, cinematography and mass media	0.73
Environment protection	0.07

Source: Ministry of Finance of the Russian Federation

Figure 12. Projection of Non Age-Related Spending (billions of 2013 rubles)



Source: authors' estimates

Our projection of future Russian healthcare expenditures is based upon the following formula: $E_t = \Sigma_i \varepsilon_{50\text{-}64,2012} (1+d)^{t-2012} \alpha_i P_{i,t}$, where $t \geq 2013$, E_t stands for aggregate healthcare expenditures in year t, $\varepsilon_{50\text{-}64,2012}$ is the average 2012 per capital level of healthcare spending on those ages 50-64, d is the growth rate in per capital spending on those 50-64, α_i is per capital expenditure on age group i relative to per capital expenditures on those age 50-64, and $P_{i,t}$ is the projected number of population age i in year t.

In words, our projection of total healthcare expenditures in year t depend on four things: demographic projections (described above and captured in the equation by $P_{i,t}$), an age-profile (α_i) of relative government healthcare spending by age, an initial level of healthcare expenditure per person in our reference age group, $\varepsilon_{50\text{-}64,2012}$, and an assumed growth rate in real healthcare spending per capita (d).

Unfortunately, there are no official or even unofficial age-healthcare expenditure profiles for Russia. Consequently, we chose to use the profile for Sweden reported in Hagist and Kotlikoff (2009) as our source for α_i. Our sense/hope is that the Russian and Swedish profiles are similar in shape. This values of the α_i provide the ratios of per capita expenditure for the age ranges 0-14, 15-19, 20-49, 65-69, 70-74, 75-79 and 80 and above to per capita expenditure in the age range 50-64.

The Swedish profile is shown in table 3. Per capita spending on children through age 19 is 43 percent of that on 50-64 year olds. For those 20-49, relative spending is 63 percent. Above 65, but below age 75, it's 150 percent, and above age 75 its 196 to 199 percent.

To calculate $\varepsilon_{50\text{-}64,2012}$, we set t to 2012 in the formula for E_t and solve for $\varepsilon_{50\text{-}64,2012} = E_{2012} / \Sigma_i \alpha_i P_{i,2012}$. Finally, to inform our assumption concerning the future growth rate, d, in real per capital healthcare spending for those age 50-64, we calculate the values of $\varepsilon_{50\text{-}64,t}$ for the years 2003 through 2015 based on the demographics and total actual real healthcare expenditures from 2003 through 2012 and total real expenditures for 2013 through 2015 projected by the Ministry of Finance. "Total healthcare expenditures" refers to the combination of federal and regional budgets as well as federal extra-budgetary funds (Pension Fund of Russian Federation, Federal Compulsory Medical Insurance Fund Social Insurance Fund Russian Direct Investment Fund Technology Development Fund and Fund of Assistance to Development of Small Forms of the Enterprises in Scientific and Technical Sphere).

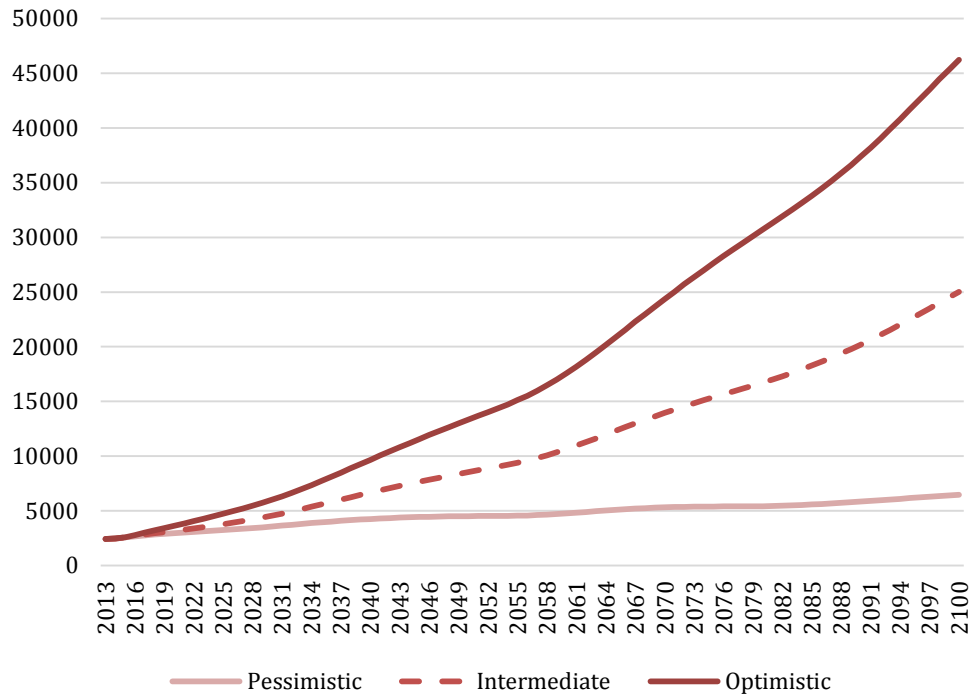
Our resulting projections for total real government healthcare expenditures are shown in figure 13.

Table 3 Swedish Profile of Healthcare Spending

Swedish Profile of Healthcare Spending	
0-14	0.43
15-19	0.43
20-49	0.63
50-64	1
65-69	1.5
70-74	1.5
75-79	1.96
80+	1.99

Source: Hagist, Kotlikoff (2009)

Figure 13. Healthcare Expenditure Projections (billions of 2013 rubles)



Source: authors' estimates

Forecasting Public Spending on Education

The education expenditures projections follow the same principle as the healthcare expenditures projections. The only difference is that we can infer the age-profile of education spending, at least crudely, from government budget data. Specifically, the budget details separate expenditures on primary, secondary, and tertiary education. Dividing these

respective expenditures by the numbers of primary, secondary, and tertiary students, provides our profile of educational spending by broad age group. As with our other age-specific expenditure and tax profiles, we assume the educational profile remains stable through time. Future research will, hopefully, provide a basis for understanding how these age-profiles can be expected to change in the future.

To generate our age-education profile, we use data from the unified education budget of 2005-2012. This data have a breakdown into subcategories that can be assigned to different age groups of people. The earlier data with such breakdown is not available because of changes in accounting principles. The spending for 2013-2015 is available as the Ministry of Finance's forecast of total spending on education. To estimate the breakdown for these years we need an age-spending profile for education. We get it by taking the average of age-spending profiles calculated for available and projected data, that is 2005-2012. The calculated average profile is given in Table 4. The division of items is as follows: pre-school education, compulsory education (in-school), higher and postgraduate education, primary vocational education, secondary vocational education, retraining, youth policy and children's healthcare, applied research in education and others.

We consider three age groups. Group of 0-6 years old is provided with pre-school education; group 7-17 with compulsory education as well as youth policy and children's healthcare which constitutes a relatively small sum; group 18-39 receives higher and postgraduate education, primary vocational education, secondary vocational education and retraining; applied research in education and other spending are divided equally between all people 0-39 years old.

We use the same data on demographic structure of the population by age as we did for healthcare spending analysis. Hence, we group the younger part of the population accordingly in three groups: 0-6, 7-17, 18-39. Summing up the corresponding items of the budget we derive total public expenditures on each age group *i,* $E_{i,t}$, which we divide by the number of group *i's* population to form per capita spending per member of each group $e_{i,t} = E_{i,t}/P_{i,t}$. Then expenditures of each year are deflated to 2013 rubles. Using these calculations, we can estimate the age profile of education expenditures. The profile is reported in table 4.

Table 4 Age-Education Relative Expenditure Profile

Age Group	Profile
0-6	0.33
7-17	1
18-39	0.59

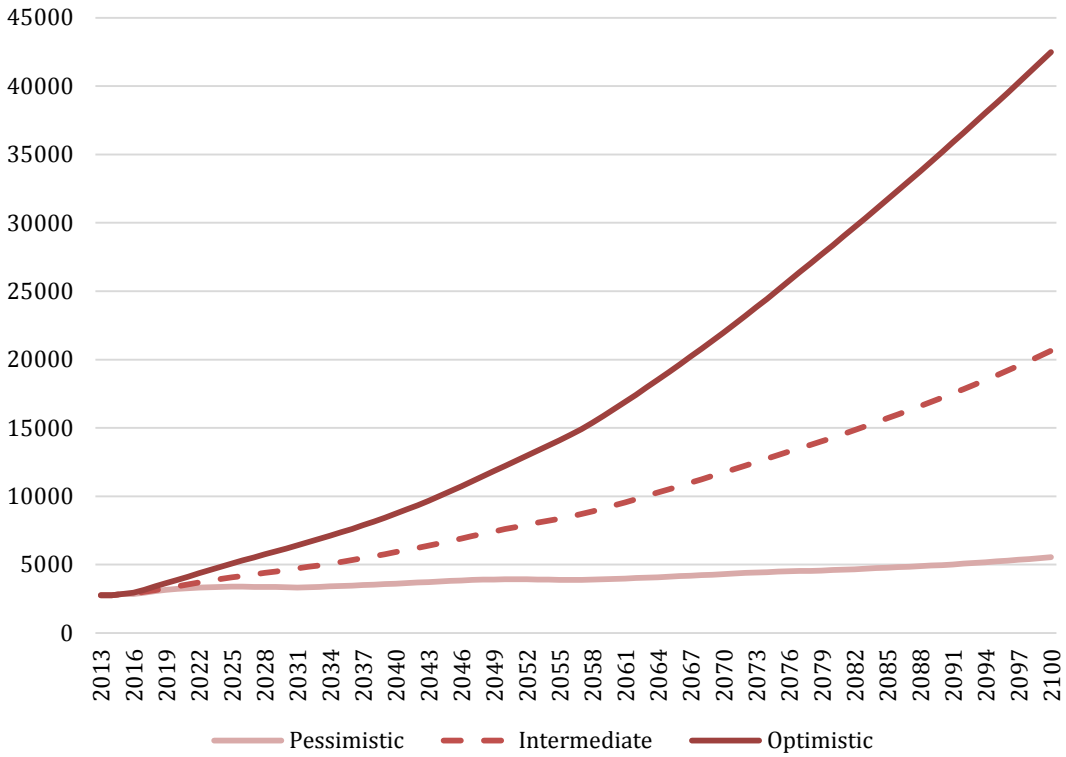
Source: authors's estimates

After 2015, we assume that spending on education at a given age *a* in year *t* equals spending per person at age *a* in 2015 multiplied by a) the cumulative projected growth in output pre working age person between 2015 and year *t* and b) the projected number of Russians age *a* in year *t*. Figure 14 displays projected education expenditures in 2013 rubles through 2100.

Forecasting Public Spending on Housing

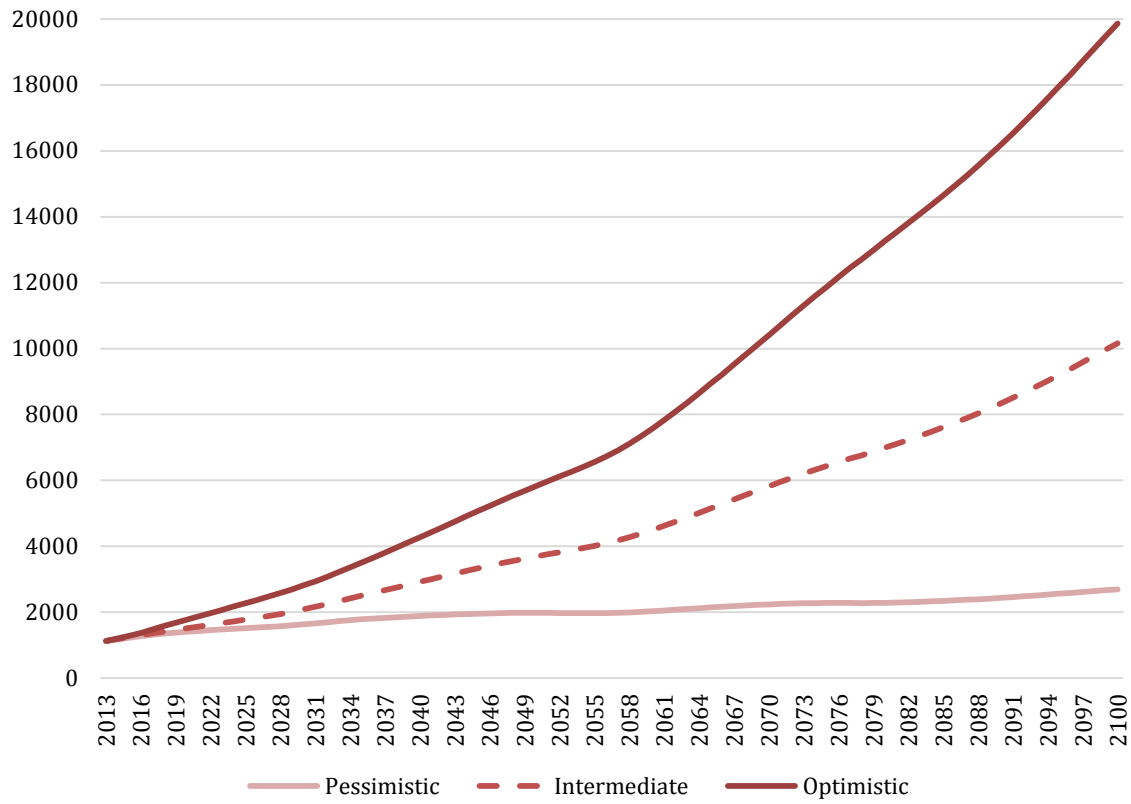
When we forecast expenditures on housing we also take into account population dynamics. We assume the real per capita housing expenditures grow with the rate of GDP per working age person growth. Unlike healthcare and education expenditures forecasts, we assume that housing expenditures per person are independent of age, i.e., we assume a flat age housing-expenditure profile.

Figure 14. Projection of Education Spending (billions of 2013 rubles)



Source: authors' estimates

Figure 15. Projection of Housing Expenditures (billions of 2013 rubles)



Source: authors' estimates

Forecasting Pension Expenditures and Revenues from Taxes for Social Needs

Russia's pension system features labor pensions, public provision of pensions, and employer-provided private pensions. Labor pensions are provided to all retired individuals by the government. Public provision of pensions concerns only certain professions employed in the public sector and some other privileged categories. Employer-provided pensions are paid by private pension funds. Thus, we are interested mainly in labor pensions.

Labor pensions consist of old-age pensions, disability pensions and survivor's pensions. The old-age pension is provided to those people who paid insurance premium payments for at least five years prior to reaching the pension collection eligibility age, which is age 60 for men and age 55 for women. Some professions may have earlier pension eligibility ages, and these ages can differ for the pay-as-you-go and funded parts.

The latest reform of the Russian labor pension system occurred in 2002. Before that it the system operated solely on a pay-as-you go (PAYG) basis. The reform added a funded pillar to the system and also modified the PAYG benefit formula such that a portion of the PAYG benefits would be paid out on the basis of a *notional defined contribution* (NDC) formula. NDC pension plans credit workers for their past contributions and adjust for the timing of the contributions by accumulating past contributions at a designated rate of return. Benefits are then determined as a function of this *notional* (pretend) defined contribution account balance.

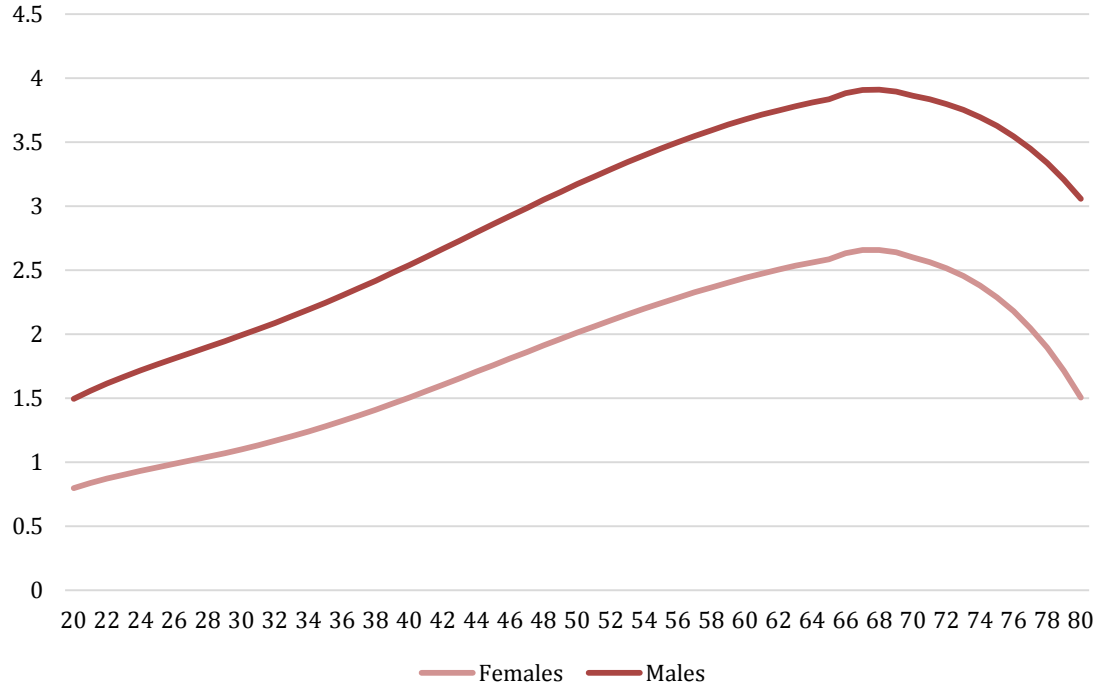
The PAYG benefits consists of base amount, which does not depend on one's history of contributions to the pension fund. This base *first pillar* amount currently equals 3610.31 rubles (or $112.82) for all pensioners except those who are over 80, people with group-1 disability, and dependent family members incapable of work. These people have higher base pensions, the role of which is to provide a minimally acceptable standard of living to all pensioners. The NDC part of one's PAYG benefit is calculated by dividing accumulated past contributions by the expected number of months of future payments. The NDC benefit is meant to emulate the type of lifetime wealth accumulation and decumulation that would arise were the worker saving on her own in attempting to smooth her living standard. This desire to have a smooth living standard over time is called *consumption soothing*.

Both the base- and contribution-related pension payments are indexed for inflation and financed through the Pension Fund of Russia (PFR). The contribution rate is now set ati22 percent for people born before 1967 and 16 percent those born after.

The *funded pillar* of the pension system consists of obligatory and voluntary payments. Obligatory payments to the funded pillar are made by people born after 1967 and equal 6 percent of their earnings. Adding 6 percent to 16 percent bring us back to the 22 percent total contribution rate required of older participants. All contributions to the funded account are invested among different assets at the workers' discretion.

Our long-term pensions forecast involves several steps, the first of which is forecasting the number of pensioners. Our data sources here are the Russian Pension Fund's data on the total number of pensioners in 2011 and the number of people who became pensioners in 2011, Rosstat's population structure data for 2011-2012, our three population projections, and age-specific estimates of the above-average mortality rates of disabled pensioners (see figure 16).

Figure 16. Above-Average Mortality Rates of Disabled Pensioners by Sex and Age



Source: V.N. Baskakov, A.L. Lelchuk, D.V. Pomazkin, Russian Pension System Model, http://www.actuaries.ru/lib/detail.php?ID=1888#6

The first step in projecting total benefit outlays by the pension system is forecasting the total number of new pensioners in each year. We assumed that the shares of each sex-age group that became pensioners remain constant throughout the forecast period and equal to the corresponding shares of each sex-age group that became pensioners in 2011.

In the second stage, the number of pensioners who are alive in this year and were awarded a pension in prior years, so called “old” pensioners, is determined for each year throughout the forecast period. It is assumed that mortality rates of old-age pensioners equal the mortality rates of the population. For disabled pensioners, age-specific estimates of the above-average mortality rates are used. Moreover, all disability pension recipients move to the old-age pension category after the retirement age in accordance with the current legislation.

The total number of pensioners in year N is calculated as a sum of “old“ pensioners, that are alive in year N and receiving pension for more than a year, and new pensioners who were awarded a pension in year N.

After the calculations some adjustments are made to ensure that the total number of pension recipients never exceeds the actual number of people alive in a given age group.

Forecasting the Number of Insured Workers

In order to forecast insured workers we use the following data sources: the distribution of employed by sex and age-groups in 2009 (Rosstat survey data), the average yearly number of employed, the MED's forecast of economic development (GDP and labour productivity) through 2030, and the World Labor Organization's (WLO) forecast of labor force participation rates in Russia till 2020.

On the first step the distribution of employed by sex and age-groups from Rosstat survey data was corrected in order to correspond to the average yearly number of employed. After that a forecast of this distribution was constructed using the WLO data.

Labor force information was calculated using WLO LFPRs and Rosstat Population figures (as opposed to the UN data used by WLO):

$$\text{Labor_force}_{\text{Age}}^{\text{Year}} = \text{LFPR}_{\text{Age}}^{\text{Year}} * \text{Population}_{\text{Age}}^{\text{Year}}$$

After that yearly increases in labor force of each group were calculated. The number of employed through 2020 were calculated based on the assumption that they grow proportionally to the size of the labor force. These figures were then corrected in order to correspond to the Ministry of Economic Development Data. The forecast from 2020 to 2030 is constructed using the same sex-age profile taking into account the overall growth imposed by MED. After 2030 the share of employed in each age-sex group was considered constant.

Forecasting Earnings of Insured Workers

Our next step in projecting aggregate pension benefit payments as well as social needs revenues is to project the earnings of insured workers. Our data here are the accrued average monthly wages of employees of organizations by sex and age (Rosstat data, 2002-2010), the total size of insurance contributions on funded and pay-as-you-go parts of retirement pension in 2002-2010 (Russian Treasury data), data from the Russia Longitudinal Monitoring Survey (RLMS) (2002-2010), and the distribution of insured workers by sex and age-groups, 2002-2010 (based on Rosstat's distribution of employed by sex and age-groups during 2002-2009 and the average yearly number of employed).

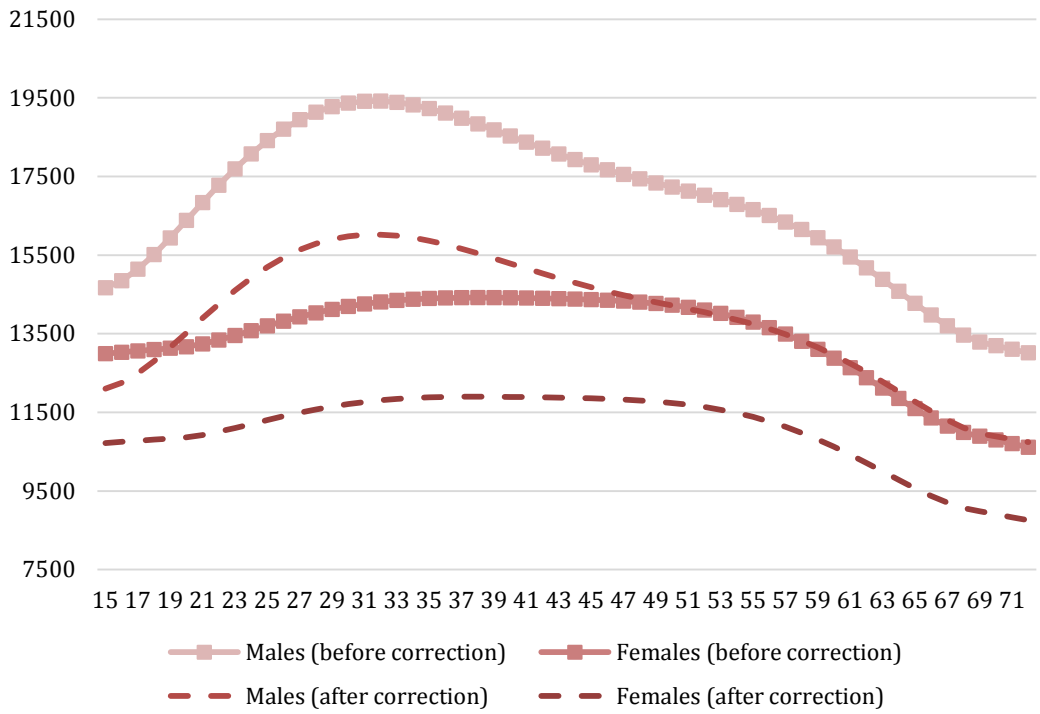
The average monthly wages of employees of organizations by sex and age were estimated based on individual data of The Russia Longitudinal Monitoring Survey for 2002-2010.

Estimated average monthly wages were corrected in order to correspond to Rosstat data in years 2002-2010. Then the average monthly wages of employees of organizations by sex, age and contribution rate schedules were estimated based on the corrected individual data of RLMS (2002-2010).

For each year in period 2002-2010 the total size of insurance contributions on funded and pay-as-you-go parts of retirement pension was estimated based on the estimated average monthly wages of employees of organizations by sex, age and contribution rate schedules and the distribution of insured by sex and age-groups.

The estimated average monthly wages of employees of organizations by sex, age and contribution rate schedules were corrected in order to correspond to Russian Treasury data, 2002-2010 (see figure 17 below).

Figure 17. Average Monthly Wages of Workers with Annual Earnings Below 415000 rubles, 2010, by Age



Source: authors' estimates

The estimated average monthly wages of employees of organizations by sex, age and contribution rate schedules in 2010 were used to calculate the average monthly wages of employees of organizations by sex, age and contribution rate schedules in 2011-2100. It was assumed that the wage growth rate corresponds to the labor productivity growth rate.

Forecasting Pension Expenditures

For each year in the forecast period the size of old-age and disability retirement pensions of new pensioners is calculated by the following formulas:

$$SPeld = \frac{PK}{T} + Beld + \frac{AP}{T},$$

$$SPdsb = \frac{PK}{T \cdot K} + Bdsb$$, where

$SPeld$ - size of old-age retirement pension;

$SPdsb$ - size of disability retirement pension;

PK - size of pension capital of the insured person taking into account indexation;

AP - size of pension accruals of the insured person taking into account indexation;

T - estimated period of future pension payment legislatively defined;

К - coefficient for disability pension on the basis of qualifying period of employment;

$Beld$ - base size of pay-as-you-go size of old-age retirement pension;

$Bdsb$ - base size of pay-as-you-go size of disability retirement pension.

The size of pension capital of the insured person is calculated based on forecasted earning of insured workers using the estimation of pension capital in year 2002, the accrued sum of insurance contributions on the pay-as-you-go part of retirement pensions taking into account indexation from 2002 to year N and the value of pension capital in year 2010. The accrued sum of insurance contributions on the funded part of retirement pension is also calculated based on forecasted earnings of insured workers.

For each year in the forecast period the size of old-age and disability retirement pensions of old pensioners is calculated on the basis of the size of old-age and disability retirement pensions in previous years taking into account indexation and the size of insurance contributions paid for insured person this year. The size of old-age and disability retirement pensions in base 2009 year is calculated on the bases of the data of The Russia Longitudinal Monitoring Survey (RLMS).

The size of expenditures on retirement pensions is calculated as:

$\mathrm{S_N} = \mathrm{Seld_N^{new}} \cdot \mathrm{Peld_N^{new}} + \mathrm{Seld_N^{old}} \cdot \mathrm{Peld_N^{old}} + 1.53 \cdot \left(\mathrm{Sdsb_N^{new}} \cdot \mathrm{Pdsb_N^{new}} + \mathrm{Sdsb_N^{old}} \cdot \mathrm{Pdsb_N^{old}}\right)$, where

$\mathrm{Seld_N^{new}}$- size of old-age retirement pension of new pensioners in year N;

$\mathrm{Peld_N^{new}}$ - number of new pensioners that receive old-age retirement pension in year N;

$\mathrm{Seld_N^{old}}$- size of old-age retirement pension of 'old' pensioners in year N;

$\mathrm{Peld_N^{old}}$- number of 'old' pensioners that receive old-age retirement pension in year N;

$\mathrm{Sdsb_N^{new}}$- size of disability retirement pension of new pensioners in year N;

$\mathrm{Pdsb_N^{new}}$ - number of new pensioners that receive disability retirement pension in year N;

$\mathrm{Sdsb_N^{old}}$ - size of disability retirement pension of 'old' pensioners in year N;

$\mathrm{Pdsb_N^{old}}$- number of 'old' pensioners that receive disability retirement pension in year N;

1,53 – coefficient that takes in account the size of expenditures on survivors pensions.

Forecasting "Social Policy" Expenditures

In order to estimate the expected value of total expenditures on Social Policy, which consists of the following items: pension benefits, social services, social security, family and child welfare, applied social policy research, and other social policy issues, we have assumed that the changes in "pension benefit" expenditures are in line with estimated expenditures on old-age, disability and survivor retirement pensions. So we estimate the ratio between

"pension benefit" expenditures and estimated value of expenditures on old-age, disability and survivor retirement pensions in 2012 and use this ratio to approximate the value of expenditures on "pension benefit" in 2013-2100.

A second assumption is made that the remaining part of expenditures on Social Policy remain fixed through time as a share of GDP. The sum of these two estimated parts of Social Policy expenditures gives us our projection of total Social Policy expenditures from 2013 through 2100.

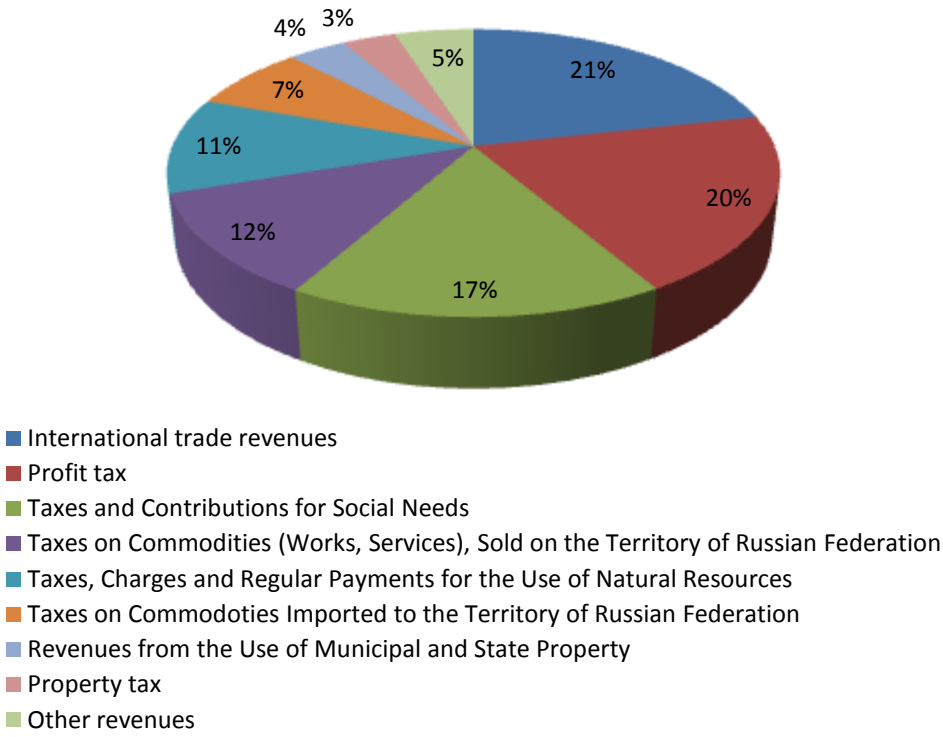
Projecting Government Budget Revenues

This section considers the projections of government revenues. As chart 1 below shows, a large fraction of revenues are derived from the extraction and export of natural resources, which are subject to depletion. Indeed, international trade revenues, which primarily consist of flows from natural resources, including export duties and taxes and charges for the use of natural resources, constitute 32 percent of total consolidated budgetary receipts. We also separately project revenues from taxes and contributions for social needs. These revenues represent 17 percent of total budget revenues, and they are linked to budget expenditures for social policy and pension capital dynamics. Therefore, we derive social tax income from the core model that forecasts the evolution of pension system. The remaining revenues, apart from those associated with energy sector and pensions and social needs, are assumed, in our analysis, to remain constant through time at their current share – 20.4 percent -- of GDP.

Total revenues from oil (including revenues from oil products export duties) are projected to be a fixed share of the total value of oil produced and this share varies across the three scenarios. For the optimistic scenario this share is set at 45 percent. For the intermediate and low scenarios it is set at 40 percent and 35 percent, respectively. The same approach is used to project gas revenues, however it is assumed that in all scenarios the government received a 7 percent share of all receipts from the extraction of gas. These shares are in accordance with the past relationship between energy-sector receipts and energy-sector revenues.

The value of oil production is defined as the product of the dollar Urals oil price, the rubles-dollar exchange rate, and total oil extraction. Similarly the value of gas extracted is defined as the product of total gas extraction, the nominal exchange rate and the Russian natural gas border price in Germany denominated in dollars.

Chart 1. Structure of Consolidated Revenues of Russian Federation, 2012



Source: Russian Federal Treasury

In our calculations, we simply consider alternative paths of the real ruble prices of natural resources, rather than focus on the particular sources, e.g., change in the exchange rate. Specifically, we consider three different oil and gas price paths. In the optimistic scenario, we assume that real ruble oil and gas price increases annually by 1 percent through 2030 and remain fixed thereafter. Our pessimistic scenario assumes real energy prices fall by 1 percent each year through 2030, remaining constant thereafter. Finally, under our intermediate scenario the real oil and gas price remains fixed through time at its 2012 level.

The annual levels of oil and gas extraction are assumed to be identical under all three scenarios and equal to the extraction amounts projected by MED in its forecast for the period from 2013 to 2030. After 2030, we assume that extraction equals MED's projected 2030 level and continues at this level through time until all reserves are depleted For each scenario we employ different assumptions with respect to extractable reserves.

Our source for the current levels of oil and gas reserves is the Ministry of Natural Resources and Environment of Russian Federation. Under the pessimistic scenario we assume that only 75 percent of these reserves are available for extraction. For the optimistic projection, we assume that new discoveries will raise the total volume of both oil and gas reserves by 25 percent. Also, as a robustness check, we evaluate the fiscal gap for Russia using alternative estimates for total reserves of natural resources.

Table 5. Assumptions About the Total Volume of Extractable Reserves

	Pessimistic scenario	Intermediate scenario (official data)	Optimistic scenario	Alternative estimate
Oil (end of 2011, bln tonnes)	21.5	28.7	35.9	21.3
Natural gas (end of 2011, trln cu m)	51.3	68.4	85.5	81.0

Sources: Ministry of Natural Resources and Environment of Russian Federation, BP Statistical Review of World Energy 2012, USGS

There are alternative data for extractable oil and gas reserves. We could, for example, take estimates of proven reserves from the BP Statistical Review of World Energy 2012 and add it to estimates of undiscovered reserves provided by USGS. According to these estimates, presented in table 6, total oil reserves are only 74 percent of those officially reported. But using these alternative data sources for natural gas reserves raises our estimate of natural gas reserves by 18 percent. On balanced utilizing these alternative reserve measures together with our intermediate assumptions produces no significant differences in Russia's fiscal gap or the size of the fiscal adjustments needed to eliminate it.

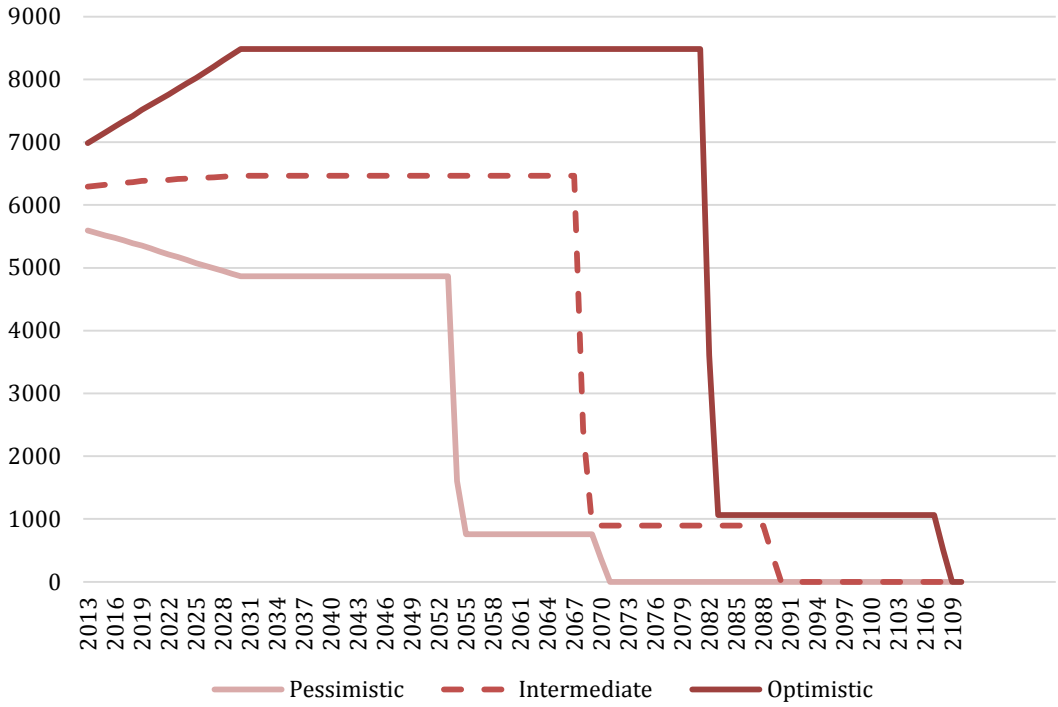
Table 6. Alternative Estimates of Total Oil and Gas Reserves

	Proven Reserves	Undiscovered Reserves	Total Reserves
Oil (end of 2011, bln tonnes)	11.8	9.5	21.3
Natural gas (end of 2011, trln cu m)	44.6	36.4	81.0

Source: BP Statistical Review of World Energy 2012,U.S. Geological Survey

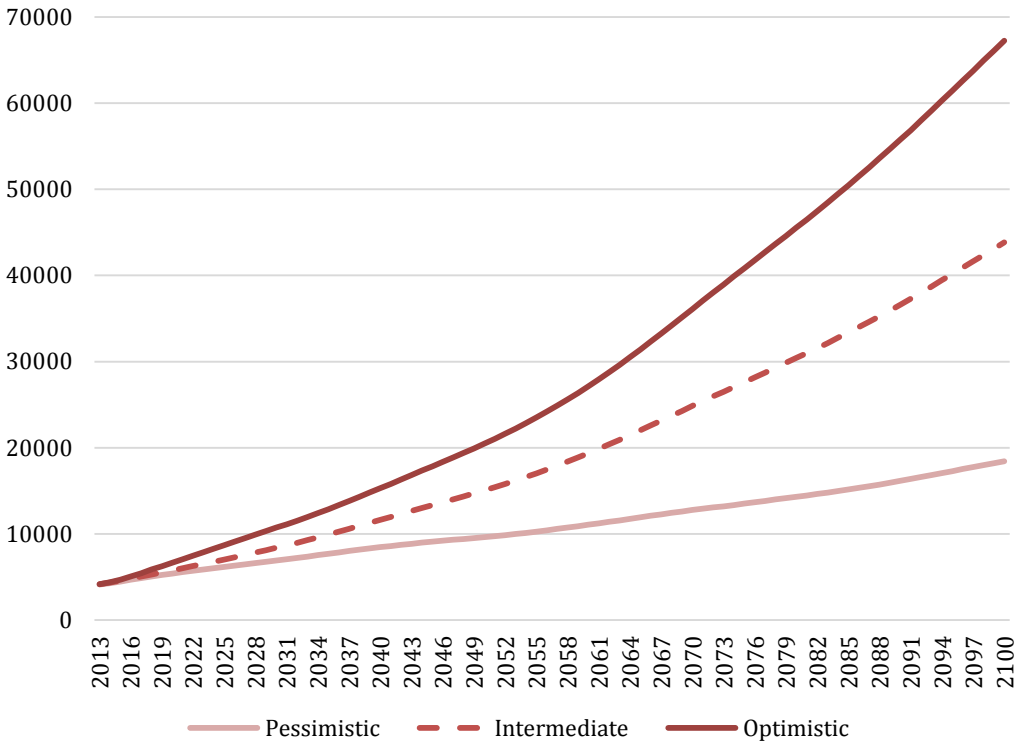
Figure 18. Projection of Oil and Gas Revenues

(billions of 2013 rubles, 2013-2110)



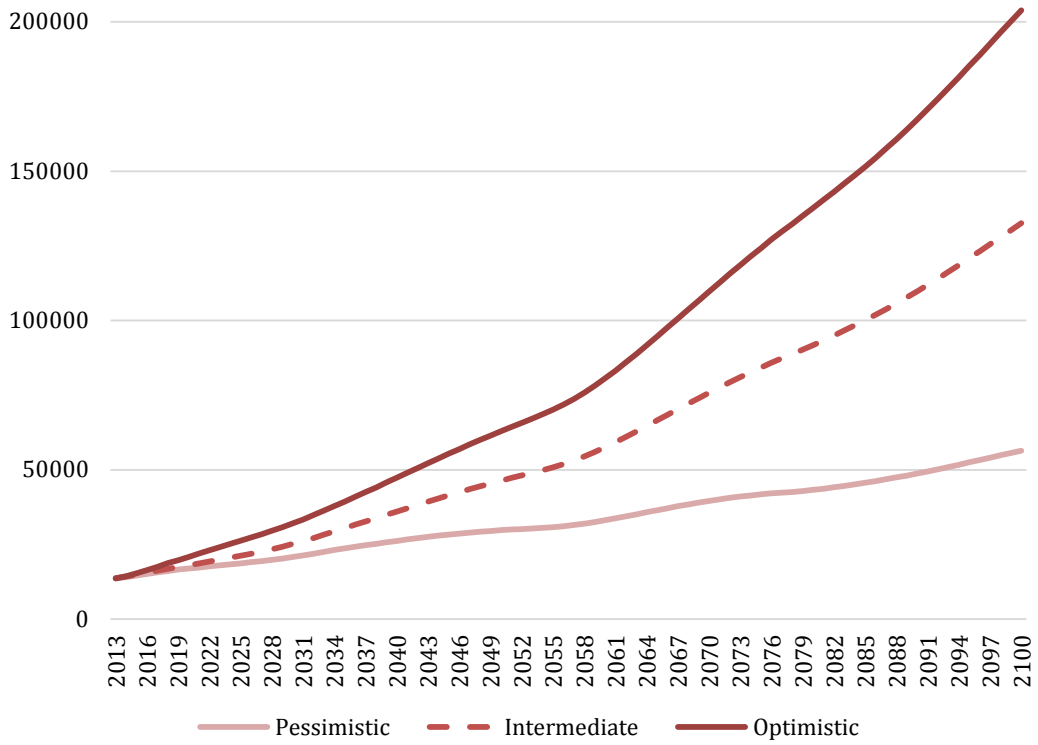
Source: author's estimates

Figure 19. Projection of Social Taxes (billions of 2013 rubles)



Source: author's estimates

Figure 20. Projection of Other Government Revenues (billions of 2013 rubles)

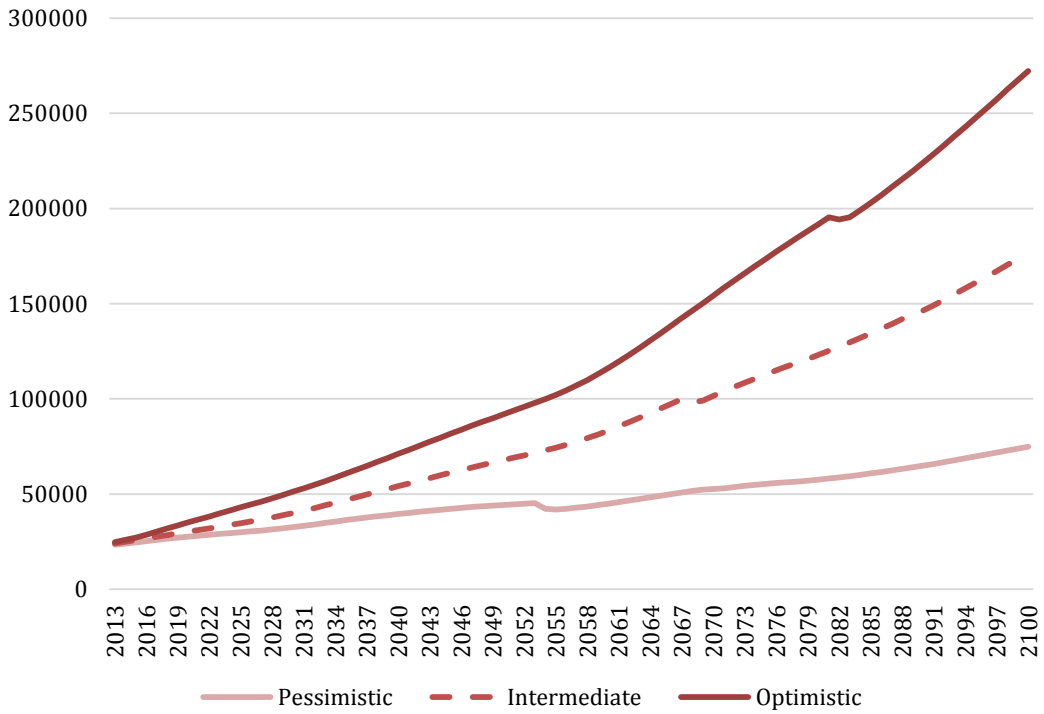


Source: authors' estimates

Russia's Fiscal Gap -- Findings and Sensitivity Analysis

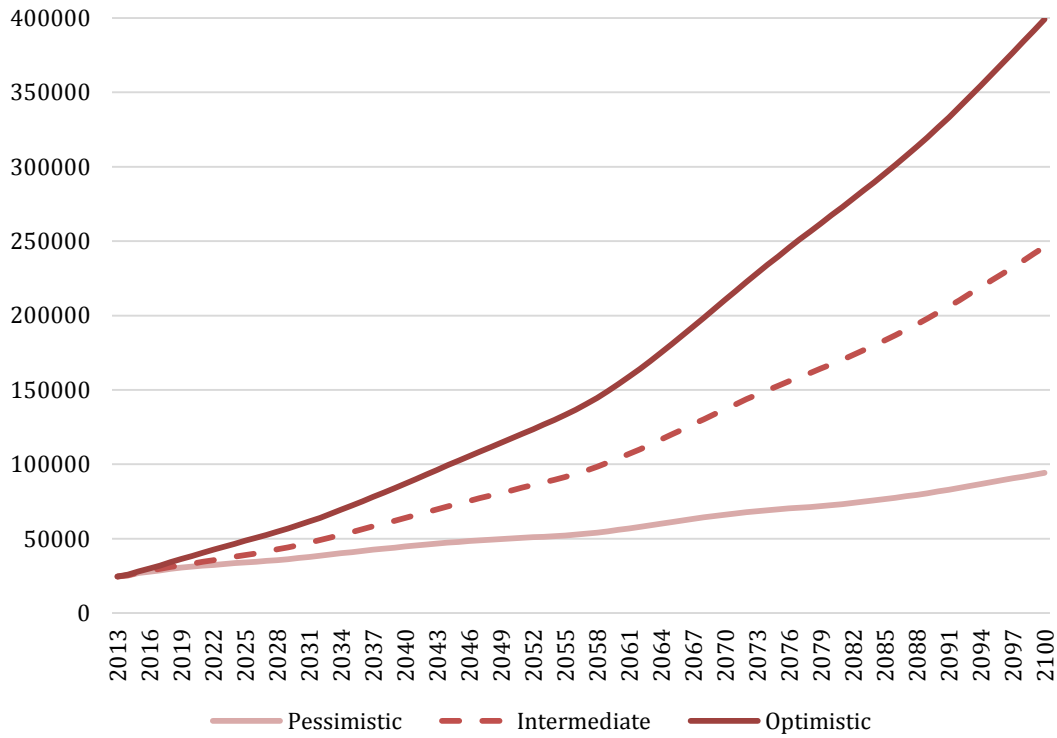
Figures 21 and 22 present projections of total government revenues and expenditures for our three scenarios. Tables 7 - 8 present annual value for 2013-2100 of each of our major expenditure and revenue categories.

Figure 21. Projection of Total Revenues (billions of 2013 rubles)



Source: author's estimates

Figure 22. Projection of Total Spending (billions of 2013 rubles)



Source: authors' estimates

Table 7 presents Russia's fiscal gap for our three different scenarios. It also indicates the various components underlying the fiscal gap. The results, as indicated above, indicate a

2013 fiscal gap ranging from 5 to 10 percent of the present value of Russia's projected future GDP. In absolute terms, the gap ranges from 278 trillion ($8.6 trillion) to 1,669 trillion rubles ($52.0 trillion). The 890 trillion rubles ($27.8 trillion) intermediate fiscal gap is 8.35 percent of the present value of future GDP. Sensitivity analysis implies that fiscal gap depends on different assumptions about the total oil and gas reserves only marginally, i.e. the fiscal stance of Russia is not significantly sensitive to the volume of oil and natural gas available for extraction.

Table 8 presents these fiscal gaps as shares of the present value of future revenues and future non-interest expenditures. Consider the top panel in the table. In the case of tax hikes, the pessimistic, intermediate, and optimistic tax increases needed (starting immediately and retained indefinitely) to eliminate the fiscal gap are 17.7 percent, 29.0 percent and 36.5 percent, respectively. In the case of spending cuts, the requisite pessimistic, intermediate, and optimistic reductions (also starting today and remaining in place forever) are 14.9 percent, 22.4 percent, and 26.6 percent, respectively.

The other panels in table 8 show the impact of waiting to address the fiscal gap. Specifically, they consider what would happen were policy to remain as now projected, but the fiscal gap were addressed via tax hikes or spending cuts starting in 2023, 2033, and 2043, i.e., 10, 20, or 30 years from now. As expected, the requisite adjustments get bigger. Take, for example, the fiscal gap that would prevail in 2043 absent policy changes between now and then. The required pessimistic, intermediate, and optimistic tax hikes are not 17.7 percent, 29.0 percent, and 36.5 percent, as they are now. Instead, they are 29.2 percent, 38.1 percent, and 45.4 percent. In the case of spending cuts, the pessimistic, intermediate, and optimistic reductions increase from 14.9 percent, 22.4 percent, and 26.6 percent, respectively, to 23.6 percent, 28.2 percent, and 31.8 percent, respectively.

These fiscal gaps are calculated using a three percent real discount rate. We also calculated fiscal gap values using real discount rates of 2 percent and 4 percent. Our findings, presented at table 9 imply that higher discount rate leads to lower but still positive fiscal gap. For the intermediate scenario raising the discount rate from 3 percent to 4 percent reduces the fiscal gap from 8.4 percent to 6.7 percent of the total present value of GDP. In contrast, using a 2 percent discount rate increases the fiscal gap to 10.5 of the present value of future GDP.

Altering the choice of the real discount rate significantly affects all three components of fiscal gap. A higher rate drives up both revenues and net debt and lowers expenditures all measured as a share of total discounted GDP flows. The observed pattern holds not only for intermediate scenario but also for the two others. Table 10 reports the values of each fiscal gap component for all scenarios and discount rates.

This result is generally driven by three effects. The first and strongest effect is associated with the relatively short-run nature of energy tax revenues. Higher discount rates make this source of revenue relatively more important in present value terms. The second effect is associated with population aging. Higher discount rates place relatively less weight on the long-run costs of paying pension and healthcare benefits to the elderly whose ranks are swelling substantially, but gradually. The third effect relates to the government's positive net financial wealth. The larger the discount rate, the more important is this government resources relative to the present value of the bills it has to help pay.

Conclusion

Notwithstanding having financial assets that exceed official debt and looking, on a net debt basis, like one of the fiscally most solvent and prudent governments in the developed world, Russia, like the U.S. and other seeming fiscally secure countries, faces a substantial fiscal gap. In Russia, as elsewhere, most of the country's debts are being kept off the books thanks to bookkeeping practices, which, while followed throughout the world, are designed to leave most of a country's liabilities off the books. They are also designed to omit most of a country's assets.

Russia's pension and other expenditure obligations are real debts the country must pay, yet they have been kept off the books. And its future taxes and energy income are real sources of income that are also being ignored in what is standard international practice – focus on a country's short-term fiscal situation, especially its immediate cash flows.

Economic theory doesn't sanction such accounting. Indeed, it tells us that what's entered on the books as an official obligation and what's kept off is a linguistic choice, not a scientific decision. But what is put on the books, in terms of recorded debts and assets, and what is kept off the books makes an enormous difference in the assessment of a country's fiscal condition.

Russia's short-term and economically arbitrary accounting practices are averting attention from three major problems. First, the country is dramatically aging even based on Rosstat's potentially optimistic assumptions about ongoing fertility improvements. Second, the country's aging is going to interact with its large and growing pension and healthcare benefit obligations to the elderly. Third, the country is highly dependent on income from energy to sustain its public finances. But these resources are finite and will, based on current extraction rates, be exhausted by the end of the Century even under optimistic assumptions about new energy discoveries.

Unfortunately, time is not on Russia's side when it comes to addressing its massive fiscal gap. The longer adjustments on the tax, spending, or tax and spending sides take, the more painful will be the medicine that the Russian public is forced to swallow.

Table 7. Russia's Fiscal Gap in 2013 Rubles and as a Percentage of the Present Value of Future Russian GDP

	Pessimistic	Intermediate	Optimistic	Pessimistic	Intermediate	Optimistic
	bln 2013 RUR	bln 2013 RUR	bln 2013 RUR	% GDP PV	% GDP PV	% GDP PV
Total Revenues	**1,569,727**	**3,069,308**	**4,577,320**	**29.41**	**28.80**	**28.64**
Energy taxes	126,240	180,287	244,537	2.37	1.69	1.53
Social tax	354,604	715,271	1,072,911	6.64	6.71	6.71
Other revenues	1,088,883	2,173,750	3,259,871	20.40	20.40	20.40
Total Expenditures	**1,868,691**	**3,979,916**	**6,267,767**	**35.01**	**37.35**	**39.22**
Pensions	404,245	855,410	1,289,328	7.57	8.03	8.07
Social policy (excl pensions)	314,638	637,989	958,090	5.89	5.99	6.00
Healthcare	156,783	402,809	708,930	2.94	3.78	4.44
Education	142,054	352,286	661,037	2.66	3.31	4.14
Housing	68,921	170,208	309,103	1.29	1.60	1.93
Other expenditures	782,048	1,561,212	2,341,277	14.65	14.65	14.65
Financial Wealth	**20,933**	**20,933**	**20,933**	**0.39**	**0.20**	**0.13**
Fiscal Gap	**278,030**	**889,674**	**1,669,514**	**5.21**	**8.35**	**10.45**

Table 8. Russia's Fiscal Gap as a Percent of the Present Value of Revenues and Non-Interest Expenditures

Immediate Adjustment (discounted to 2013)				
		Pessimistic	Intermediate	Optimistic
Fiscal gap	% PV of GDP	5.21	8.35	10.45
	% PV of Revenues	17.71	28.99	36.47
	% PV of Expenditures	14.88	22.35	26.64

No adjustment until 2023 (discounted to 2023)				
		Pessimistic	Intermediate	Optimistic
Fiscal gap	% PV of GDP	5.96	8.94	10.98
	% PV of Revenues	20.73	31.50	38.77
	% PV of Expenditures	17.20	23.94	27.92

No adjustment until 2033 (discounted to 2033)				
		Pessimistic	Intermediate	Optimistic
Fiscal gap	% PV of GDP	6.90	9.66	11.69
	% PV of Revenues	24.45	34.46	41.74
	% PV of Expenditures	20.07	25.85	29.65

No adjustment until 2043 (discounted to 2043)				
		Pessimistic	Intermediate	Optimistic
Fiscal gap	% PV of GDP	8.08	10.56	12.60
	% PV of Revenues	29.15	38.06	45.35
	% PV of Expenditures	23.61	28.20	31.82

Table 9. Russia's Fiscal Gap Calculated Using Different Discount Rates

		Pessimistic			Intermediate			Optimistic		
		2%	3%	4%	2%	3%	4%	2%	3%	4%
Fiscal gap	**% PV of GDP**	**6.28**	**5.21**	**4.41**	**10.49**	**8.35**	**6.77**	**12.8**	**10.45**	**8.61**
	% PV of Revenues	**22.39**	**17.71**	**14.54**	**38.39**	**28.99**	**22.62**	**47.2**	**36.47**	**28.89**
	% PV of Expenditures	**18.22**	**14.88**	**12.47**	**27.73**	**22.35**	**18.24**	**32.06**	**26.64**	**22.25**
No adjustment until 2023 (discounted to 2023)		2%	3%	4%	2%	3%	4%	2%	3%	4%
Fiscal gap	**% PV of GDP**	**6.60**	**5.96**	**5.51**	**10.54**	**8.94**	**7.78**	**12.81**	**10.98**	**9.59**
	% PV of Revenues	**23.75**	**20.73**	**18.67**	**38.66**	**31.50**	**26.61**	**47.20**	**38.77**	**32.85**
	% PV of Expenditures	**19.21**	**17.20**	**15.76**	**27.88**	**23.94**	**20.97**	**32.07**	**27.92**	**24.67**
No adjustment until 2033 (discounted to 2033)		2%	3%	4%	2%	3%	4%	2%	3%	4%
Fiscal gap	**% PV of GDP**	**6.95**	**6.90**	**6.97**	**10.61**	**9.66**	**9.06**	**12.81**	**11.69**	**10.95**
	% PV of Revenues	**25.25**	**24.45**	**24.26**	**38.97**	**34.46**	**31.64**	**47.21**	**41.74**	**38.22**
	% PV of Expenditures	**20.32**	**20.07**	**20.22**	**28.06**	**25.85**	**24.45**	**32.07**	**29.65**	**28.05**
No adjustment until 2043 (discounted to 2043)		2%	3%	4%	2%	3%	4%	2%	3%	4%
Fiscal gap	**% PV of GDP**	**7.36**	**8.08**	**9.01**	**10.69**	**10.56**	**10.78**	**12.81**	**12.60**	**12.77**
	% PV of Revenues	**26.95**	**29.15**	**32.10**	**39.31**	**38.06**	**38.25**	**47.21**	**45.35**	**45.19**
	% PV of Expenditures	**21.55**	**23.61**	**26.28**	**28.27**	**28.20**	**28.98**	**32.07**	**31.82**	**32.48**

Table 10. Russia's Fiscal Gap Components Calculated Using Different Discount Rates (in parentheses difference with 3% discount rate case)

	Pessimistic Scenario % GDP PV					Intermediate Scenario % GDP PV					Optimistic Scenario % GDP PV				
	2%		3%	4%		2%		3%	4%		2%		3%	4%	
Total revenues	**28.07**	(-1.34)	**29.41**	**30.35**	(+0.94)	**27.31**	(-1.49)	**28.80**	**29.94**	(+1.14)	**27.13**	(-1.51)	**28.64**	**29.81**	(+1.17)
Energy taxes	**1.00**	(-1.37)	**2.37**	**3.33**	(+0.96)	**0.17**	(-1.52)	**1.69**	**2.86**	(+1.17)	**0.00**	(-1.53)	**1.53**	**2.71**	(+1.18)
Social tax	**6.67**	(+0.03)	**6.64**	**6.62**	(-0.02)	**6.74**	(+0.03)	**6.71**	**6.68**	(-0.03)	**6.73**	(-0.02)	**6.71**	**6.69**	(-0.02)
Other revenues	**20.40**	(0.00)	**20.40**	**20.40**	(0.00)	**20.40**	(0.00)	**20.40**	**20.40**	(0.00)	**20.40**	(0.00)	**20.40**	**20.40**	(0.00)
Total expenditures	**34.49**	(-0.52)	**35.01**	**35.41**	(+0.40)	**37.81**	(+0.46)	**37.35**	**37.12**	(-0.23)	**39.93**	(+0.71)	**39.22**	**38.71**	(-0.51)
Pensions	**7.86**	(+0.29)	**7.57**	**7.44**	(-0.13)	**8.49**	(+0.46)	**8.03**	**7.76**	(-0.27)	**8.36**	(+0.29)	**8.07**	**7.87**	(-0.20)
Social policy (excl pensions)	**5.95**	(+0.06)	**5.89**	**5.87**	(-0.02)	**6.08**	(+0.09)	**5.99**	**5.93**	(-0.06)	**6.06**	(+0.06)	**6.00**	**5.96**	(-0.04)
Healthcare	**2.62**	(-0.32)	**2.94**	**3.13**	(+0.19)	**3.84**	(+0.06)	**3.78**	**3.74**	(-0.04)	**4.62**	(+0.18)	**4.44**	**4.28**	(-0.16)
Education	**2.29**	(-0.37)	**2.66**	**2.91**	(+0.25)	**3.19**	(-0.12)	**3.31**	**3.40**	(+0.09)	**4.25**	(+0.11)	**4.14**	**4.05**	(-0.09)
Housing	**1.12**	(-0.17)	**1.29**	**1.40**	(+0.11)	**1.57**	(-0.03)	**1.60**	**1.62**	(+0.02)	**1.99**	(+0.06)	**1.93**	**1.89**	(-0.04)
Other expenditures	**14.65**	(0.00)	**14.65**	**14.65**	(0.00)	**14.65**	(0.00)	**14.65**	**14.65**	(0.00)	**14.65**	(0.00)	**14.65**	**14.65**	(0.00)
Financial wealth	**0.14**	(-0.25)	**0.39**	**0.64**	(+0.25)	**0.02**	(-0.18)	**0.20**	**0.40**	(+0.20)	**0.00**	(-0.13)	**0.13**	**0.29**	(+0.16)
Fiscal gap	**6.28**	(+1.07)	**5.21**	**4.41**	(-0.80)	**10.49**	(+2.14)	**8.35**	**6.77**	(-1.58)	**12.80**	(+2.35)	**10.45**	**8.61**	(-1.84)

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