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How Wealthy Is Russia?

Measuring Russia's Comprehensive Wealth From 2000-2017

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Abbreviations and Acronyms

BGR	Federal Institute for Geosciences and Natural Resources
BP	British Petroleum
CWON	The Changing Wealth of Nations 2018
ESG	Environmental, social and corporate governance
FA	Foreign assets
FAO	Food and Agricultural Organization
FAOSTAT	Food and Agriculture Organization's Statistical Database
FDI	Foreign Direct Investment
FFA	Fire Free Alliance
FFDC	Fossil-fuel dependent countries
FL	Foreign liabilities
FX	Foreign Exchange
GCC	Gulf Cooperation Countries
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
GFCF	Gross fixed capital formation
GGDC	Groningen Growth and Development Centre
HCI	Human Capital Index
HCP	Human Capital Project
HIC	High-income countries
HSE	Higher School of Economics
IEA	International Energy Agency
IMF	International Monetary Fund
KLEMS	Capital, Labor, Energy, Minerals and Services
LULUCF	Land use, land-use change, and forestry
NFA	Net Foreign Assets
NIR	National Inventory Report
NK	Natural capital
NPV	Net Present Value
NRU	The National Research University
NWF	National Welfare Fund
OECD	Organization for Economic Co-operation and Development
PIRLS	Progress in International Reading Literacy Study
PISA	Program for International Student Assessment
PK	Produced capital
PV	Present value
PWT	Penn World Table
ROSSTAT	Russian Federal State Statistics Service
SEEA	System of Environmental-Economic Accounting
SOE	State Owned Enterprise
TFP	Total factor productivity
TFP	Total Factor Productivity
UMIC	Upper middle-income countries
UN	United Nations
US	United States
USA	United States of America
USGS	United States Geological Survey
WDI	World Development Indicators
WWF	World Wildlife Fund

How Wealthy is Russia?

Measuring Russia's comprehensive wealth from 2000-2017

Executive Summary

5 Findings and 5 Policy Directions

Russia is a country of global importance and great diversity. The world's largest transcontinental country spans eleven time zones and is the ninth most populous country in the world. Russia is the main trading partner for many of its more than a dozen neighbors. It is richly endowed with natural resources, which underscores its importance as a global commodity exporter. Owing to its rich resource base, Russia plays a crucial role in global energy and resource markets. The country holds the world's largest natural gas reserves, the second largest coal reserves, and the eighth largest oil reserves. Russia is one of the largest producers and exporters of natural gas, the third largest oil producer (after the United States and Saudi Arabia), and the second largest oil exporter after Saudi Arabia.

But how wealthy is Russia, really?

Understanding the difference between "wealth" and "income" is crucial. *Wealth* is measured comprehensively to include all assets – produced, human, and natural capital, as well as net foreign assets. *Income*, or GDP, is merely a return on this wealth. While GDP provides an important measure of economic progress, it is a flow measure that captures income and production in one year, but does not account for any changes in the underlying wealth asset base. Hence, used alone, GDP is likely to provide misleading signals about the state of the economy, the efficiency of asset utilization, and the sustainability of development. GDP also does not reflect depreciation and depletion of assets; it does not indicate whether accumulation of wealth keeps pace with population growth, or whether the mix of different assets will support a country's development goals. Economic performance is thus best evaluated by monitoring both GDP growth and wealth.

This report refines and tailors a methodology that, for the first time, comprehensively measures Russia's national wealth. In doing so, it attempts to address the following questions:

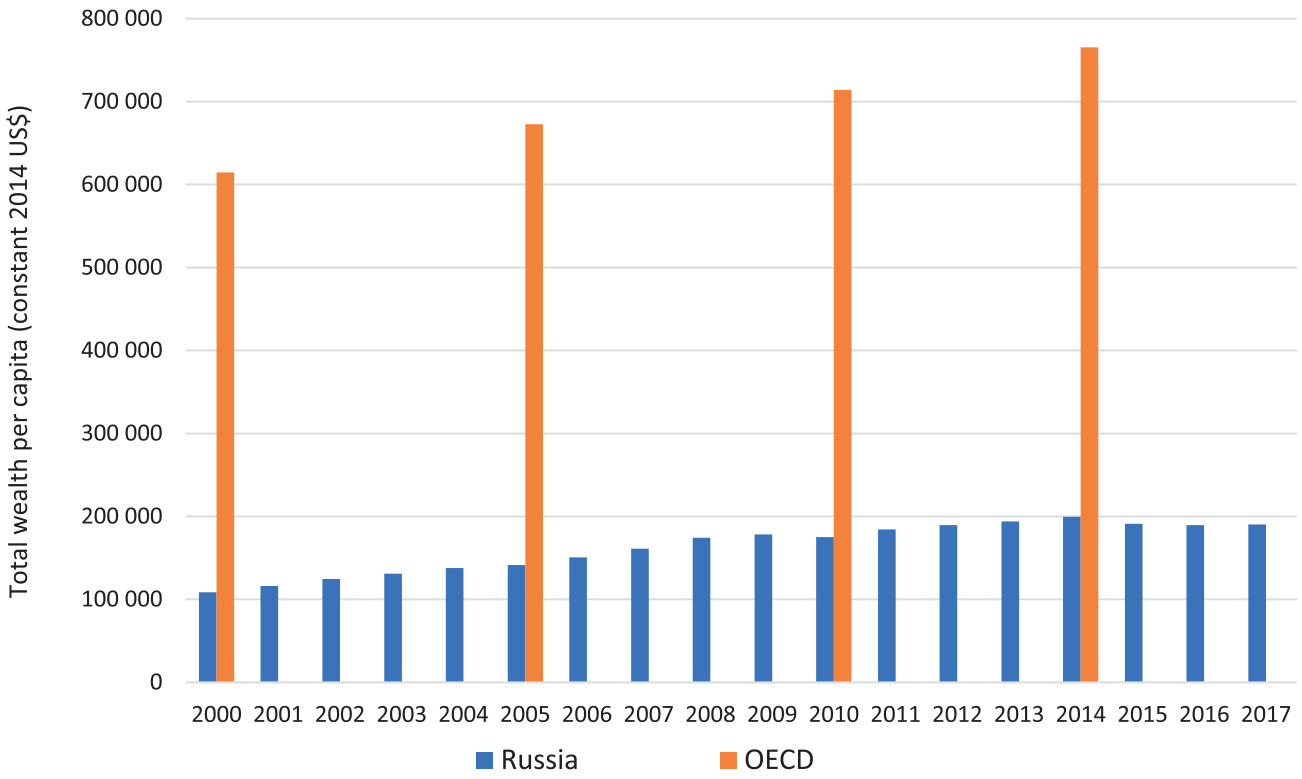
1. How wealthy is Russia as a nation? And is the typical Russian citizen wealthier or less wealthy today than in the past?
2. How does Russia's wealth compare to other countries, and what can Russia do to increase its wealth?
3. How are the returns on this wealth distributed amongst Russian citizens? Who has benefitted from Russia's wealth?

Within this context, five key findings and policy directions are summarized below:

Finding #1: **A typical Russian citizen was 1.8 times wealthier in 2017 than in 2000. However, this is only about a quarter of wealth of a typical OECD resident.**

In 2017, the typical Russian citizen was 1.8 times wealthier than in 2000, with accumulated wealth of about 8.9 million rubles, or about US$ 152,451. Nevertheless, this is only about a quarter of wealth of a typical OECD resident (Figure ES-1).[1] From 2000–2017, Russia's per capita wealth grew multiple times faster than that of high-income countries, albeit from a much lower base. This remarkable performance in per capita wealth growth was uneven, however. The strong growth present in the early 2000s has weakened in recent years due to stagnant growth in human capital and the decline in oil and gas wealth.

Figure ES- 1: Despite strong growth, Russia's per capita wealth is about a quarter of the OECD average
(Trend in Russia and OECD's total wealth per capita, 2000-2017)



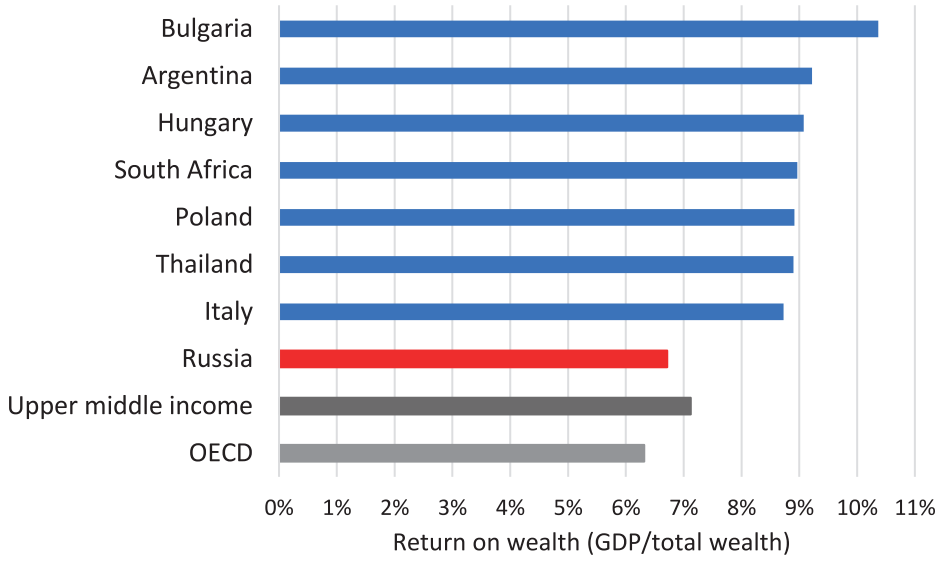
Source: Authors' calculations.

Finding #2: **Around 7 percent, Russia's return on wealth is similar to upper-middle and high-income countries but lower than that of certain Eastern European countries. However, in recent years, this return to wealth has been less evenly distributed than in the past.**

On average, Russia's "return on wealth" (i.e., the ratio of GDP to wealth) has been around 7 percent for the 2000–2017 period, which is similar to the average of upper middle-income and high-income countries (Figure ES-2). However, it is lower than the 8-10 percent return in Eastern European countries such as Bulgaria, Hungary, and Poland, as well as the return in other countries such as Argentina, Italy, South Africa, and Thailand.

1 Russia's values are in constant 2017 prices, however benchmarking / international comparisons are done in 2014 US$ for years 2000 – 2014, based on the CWON 2018 global database.

Figure ES- 2: Russia's return on wealth averaged 7 percent between 2000 – 2017
(*Ratio of GDP to total wealth)*



Source: Authors' calculations.

An important question is: how well has this return to wealth been distributed? Measuring the evolution of two measures of shared prosperity (income growth of the bottom 40 percent of the population and growth in median income) reveals that, while sizeable during the boom years, Russia's shared prosperity premium has been shrinking in recent years. Incomes of the bottom 40 percent fell with the global financial crisis of 2008 – 2009 but recovered quickly and continued to grow, though at a slower pace. They stalled in 2012 with the weakening of the macroeconomic environment and falling oil prices, stagnating in 2012 and 2013, and then dropping faster than average incomes in 2014. Median income growth also decelerated. After growing annually at 9 percent in 2001-2008, median income grew by just 4.5 percent in 2009-2010, and by only 1.6 percent annually during 2010 - 2015.

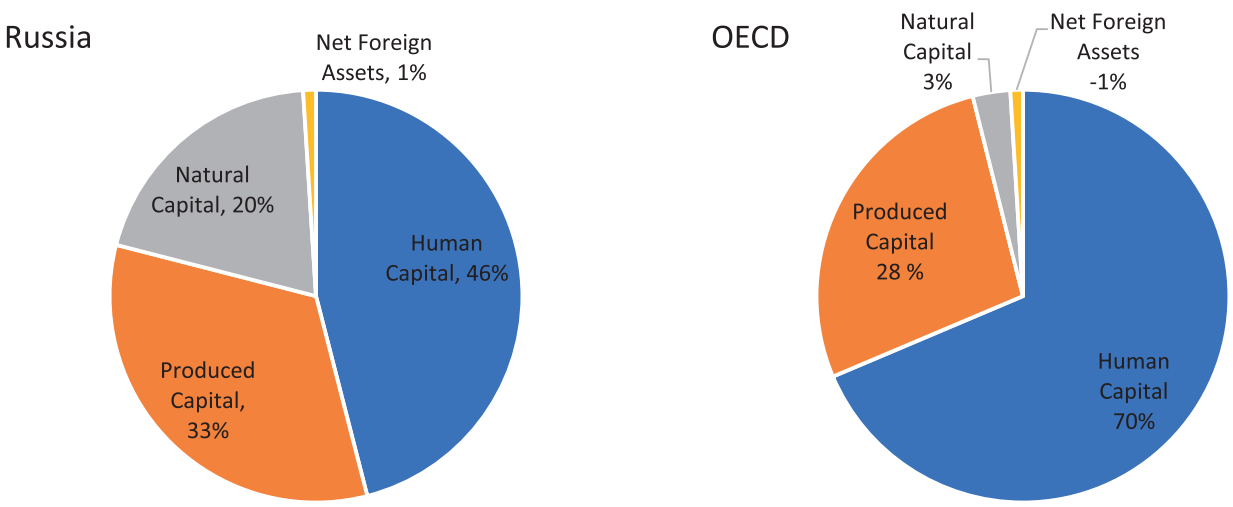
Finding #3: **Human capital, at 46 percent, comprises the largest share of wealth in Russia, however, much less than the OECD average of 70 percent. Russia's natural capital share stands at 20 percent. As a rough approximation, Russia's forests provide global carbon absorption benefits of over US$ 500 billion.**

Perhaps surprisingly, human capital comprises the largest share of wealth in Russia, at 46 percent (Figure ES-3). This is followed by produced capital at 33 percent, natural capital at 20 percent (of which renewables contribute 5 percent and non-renewables 15 percent), and net foreign assets (1 percent). In comparison, the wealth composition of OECD countries, on average, is 70 percent human capital, 28 percent produced capital, 3 percent natural capital, and minus 1 percent net foreign assets.

Russia's 15 percent share of non-renewables is well above the average for upper-middle and high-income countries (other than the Gulf countries), reflecting its abundant oil and gas resources. Russia's forests also hold vast amounts of carbon and, if the value of carbon sequestration is included, would increase its share of natural capital from 20 to 22 percent. Across Russia's varied forestland, the carbon absorption of its European forests is comparable to Finland, that of its Siberian forests to Canada, and the North Caucasus forests to the USA. In 2017, Russia's forests (excluding reserve forests) provided absorption of more than 638 million tons of CO_2 equivalent or around 30,000 billion rubles (over US$ 500 billion). [2]

2 This is the net present value of future annual sequestrations for the life of the forest, using a conservative social cost of carbon of US$ 33 per ton CO2 eq emitted in 2017 at 2017 prices. The estimation is sensitive to assumptions of the lifetime, discount rate, and future carbon sequestration levels and prices.

Figure ES- 3: Human capital comprises the largest share of wealth in Russia, however, much less than in OECD average, meanwhile natural capital is well above the average

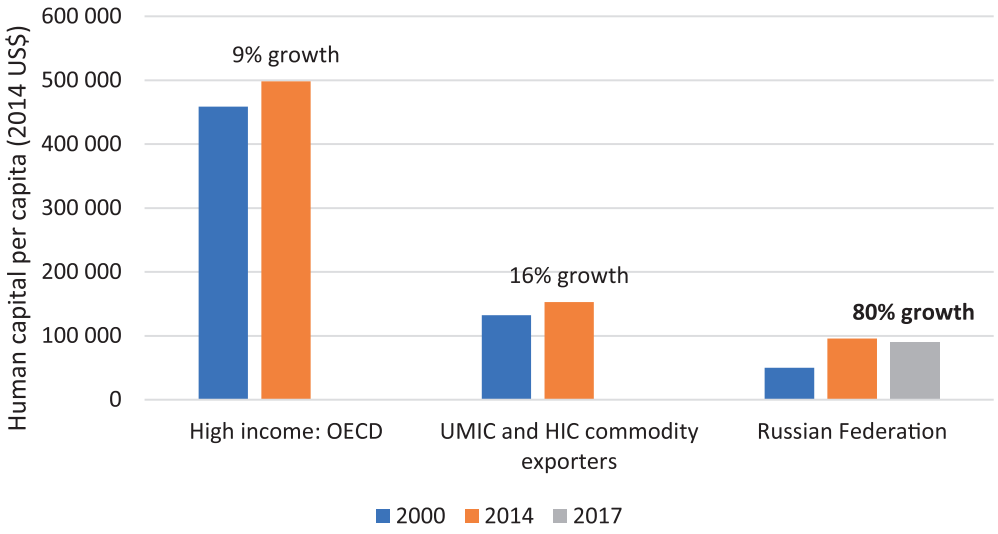


Source: Authors' calculations using *The Changing Wealth of Nations 2018* database.
Note: Russia's figures are for year 2017. The OECD and upper middle-income group averages are for the latest available year, 2014.

Finding #4: **Despite its significant growth, Russia's human capital wealth per capita is one-fifth the OECD average. At current rates, Russia would only catch up after almost 100 years.**

During 2000–2017, Russia's human capital wealth per capita grew rapidly at 80 percent, compared to the overall wealth per capita growth of 76 percent (Figure ES-4). Russia's per capita growth in human capital dwarfed growth rates among OECD countries and commodity exporters. However, its average annual growth rate of per capita human capital wealth has slowed from 4.7 percent for the period covering 2000–2010 to 1.8 percent during 2010 to 2017. If Russia's human capital grew at its 2000–2017 average of 3.5 percent, it would take about 50 years to catch up with the OECD; and at the slower rate of 1.8 percent, Russia would only catch up after almost 100 years.

Figure ES- 4: Despite significant growth in human capital, Russia's human capital wealth per capita is one-fifth the OECD average
(*Trend in human capital per capita, Russia and benchmark countries)*

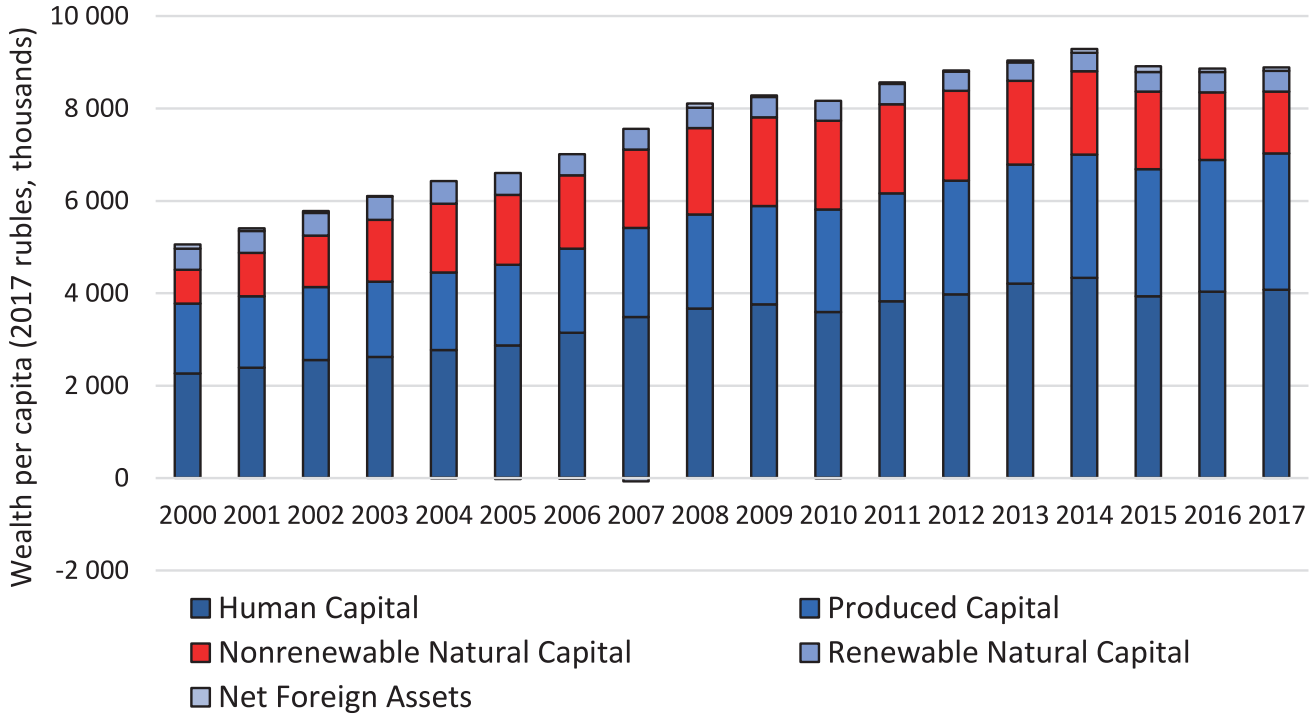


Source: Authors' calculations.

Finding #5: **Russia's large share of carbon-based wealth faces increased risk due to future price uncertainty and large-scale attempts at global decarbonization.**

To maximize the return on wealth, policies to rebalance Russia's wealth portfolio are needed. Russia's dependence on its non-renewable assets poses a specific development challenge, with its carbon-based wealth facing increased risk due to future price uncertainty and large-scale attempts at global decarbonization (Figure ES-5).

Figure ES- 5: Oil and gas are a significant share of Russia's wealth
(*Russia's trend in wealth per capita from 2000 to 2017, by components)*



Source: Authors' calculations.

Emerging Policy Directions

Policy Direction #1: Diversify the wealth portfolio

Rebalancing the portfolio and mitigating the risks of stranded assets will require Russia to diversify its wealth portfolio away from its fossil fuel sector and towards other productive capital. However, Russia continues to depend on underground fossil fuel assets to generate a significant share of export revenues. In 2018, energy exports accounted for 65 percent of total exports (compared to 59 percent in the previous year). Other types of natural capital, such as minerals and timber products also play an important role. Furthermore, the structure of produced capital is skewed towards capital that is close to fossil fuels and require related skills, such as refining and heavy industry, including metals, chemicals and related equipment. This asset structure makes the Russian economy vulnerable to the structural impact of international, regional, and domestic efforts to address climate change, biodiversity, air and plastic pollution. The impact can manifest through technology and policies that reduce demand for fossil fuels and policies that can restrict market access to industrial products with high environmental footprint.

In the short-term, the heavy and polluting industries that currently generate the bulk of revenue could lowering their environmental footprint through adopting modern environmental management systems. The payoffs are likely to be imminent. For example, Russian aluminum already enjoys a low carbon footprint by relying on hydro power, and this may give it a price and market access premium in the near future. Maintaining the fiscal rule – a necessary though not sufficient condition for diversification – is also essential[3]. The new fiscal rule has substantially curbed the economy from oil price volatility and it will be important to refrain from investment of the National Welfare Fund in domestic assets.

In the medium- to long- term, it would be important to increase fuel excise taxes and differentiate tax rates by the social and environmental cost of fuel use, as well as explore carbon taxes or other forms of carbon pricing harmonized within broader trade and technology agreements with prospective trading partners. This could include, among other things, eliminating non-transparent subsidies to producers and consumers, which can be regressive and distort incentives for efficient consumption, and replacing them with more targeted cash transfers to the poor and vulnerable. Russia can also engage more proactively in international climate policies to access support (technology, finance, and access to market) for asset diversification, as well as leverage such cooperation to facilitate global market access for knowledge-intensive and environmentally sustainable goods and services made in Russia. The recent adoption of the Paris Agreement by Russia is a elcome step in this direction.

3 According to the fiscal rule, the portion of the oil/gas revenue the federal government can spend in a given year is determined by a fixed oil price benchmark (US$40 per barrel in 2017 prices). If actual oil prices exceed the benchmark price, the difference will be saved in the National Welfare Fund (NWF). If actual prices are below the benchmark price, the government can supplement the oil/gas revenue shortfall by withdrawing an equal amount from the NWF.

Policy Direction #2: Sustain policy focus on human capital

Specifically, given the significance of human capital in Russia's overall wealth, a sustained policy focuses on both increasing its share and increasing returns on the stock of human capital wealth will help. Some targeted measures to improve Russia's human capital performance (education and health) include:

a. Further developing Russia's university education potential: Although the situation is improving, Russia does not yet have a university among the top 100 in the world;
b. Improving the quality of Russia's vocational education system: Vocational education continues to attract a large stream of Russian students; for example, post-secondary vocational programs enrolled about 40 percent of graduates in 2018;
c. Improving collaborative problem-solving skills, communication, and creativity of Russian students: Russian students perform below the OECD average in these softer-skill areas;
d. Emphasizing primary care disease detection, prevention, and management rather than expensive ex-post, curative care.
e. Increasing health care efficiency and financing: This could be in the form of introducing evidence-based clinical protocols and quality assurance systems, rationalizing excessive hospital infrastructure, and better using information technology to digitize electronic health records.

One area that merits further examination is the reason why Russia's human capital proportion of its total wealth is significantly lower than the OECD norm. Prima facie, this is surprising since Russia's education performance appears to be on par -- and even better — than the OECD's in certain areas. For example, the proportion of the labor force with university degrees is higher in Russia than the OECD and the quality of education as measured by standardized tests such as PISA is on par with OECD. Women have long outranked men in accessing university education. A fertile area of policy enquiry thus lies in the interface of education and the labor market, through a thorough investigation of the private and social returns to education.

Policy Direction #3: Increase produced capital by improving investment climate

Russia's produced capital per capita is almost a fourth of the OECD average, and increasing produced capital would require improving the investment climate. This could be done through creating a level playing field for firms, by enhancing competition conditions and streamlining regulatory requirements. This includes:

a. Reversing a trend towards cartelization of the economy, especially in public procurement;[4]
b. Promoting competitive neutrality principles among state-owned enterprises (SOEs) and private sector actors;
c. Ensuring the transparency of state support and privileges to minimize competition distortions.

Policy Direction #4: Better manage natural capital and enhance Russia's role as an "ecological donor"

Although renewable resources make up a smaller share of Russia's natural capital (they are also underestimated), they can produce benefits in perpetuity if managed sustainably. An immediate priority is reducing forest fires, which are the main factor driving forest loss. Russia is home to 20 percent of the world's forest resources, and between 2015-2018, fires on both forest and non-forest lands increased 2.4 times. Scarce financing of forest management complicates efforts to fight or prevent forest fires, but if successfully implemented, the new national priority project, "Ecology" (2019-2024), could increase the values of timber and forest ecosystem services, including sequestration. This would also enhance Russia's role as an ecological donor to the planet.

Policy Direction #5: Pursue policies to distribute returns on wealth more equitably

The waxing and waning of two measures of shared prosperity (growth in incomes of the bottom 40 percent of the population and median income), coupled with the overall macro-economic conditions, underscores both the importance of increasing returns to Russia's wealth and pursuing policies that distribute these returns more equitably.

4 Source: Federal Antimonopoly Service.

I. The Case for Measuring Russia's Wealth

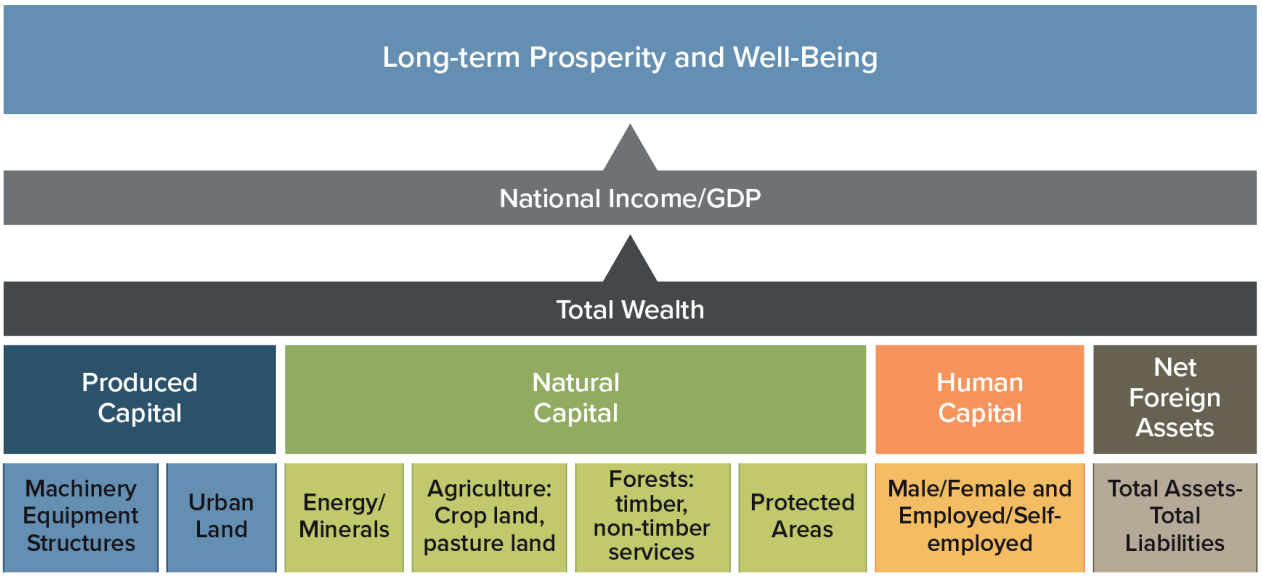
Russia is a country of global importance and great diversity. The world's largest transcontinental country spans eleven time zones and is the ninth most populous country in the world. Russia is the main trading partner for many of its more than a dozen neighbors. It is richly endowed with natural resources, which underscores its importance as a global commodity exporter. Owing to its rich resource base, Russia plays a crucial role in global energy and resource markets. The country holds the world's largest natural gas reserves, the second largest coal reserves, and the eighth largest oil reserves. Russia is one of the largest producers and exporters of natural gas, the third largest oil producer (after the United States and Saudi Arabia), and the second largest oil exporter after Saudi Arabia. But how wealthy is Russia, really?

Why measure wealth?

Understanding the difference between "wealth" and "income" is crucial. *Wealth* is measured comprehensively to include all assets – produced, human, and natural capital, as well as net foreign assets. *Income*, or GDP, is merely a return on this wealth. While GDP provides an important measure of economic progress, it is a flow measure that captures income and production in one year but does not account for any changes in the underlying wealth asset base. Hence, used alone, GDP is likely to provide misleading signals about the state of the economy, the efficiency of asset utilization, and the sustainability of development. GDP also does not reflect depreciation and depletion of assets; it does not indicate whether accumulation of wealth keeps pace with population growth, or whether the mix of different assets will support a country's development goals. Economic performance is thus best evaluated by monitoring both GDP growth and wealth.

The World Bank has an on-going initiative to measure national wealth and changes in wealth in order to monitor long-term economic well-being and guide the development process through the lens of a country's portfolio of assets. The first report, *Where is the Wealth of Nations? Measuring Capital for the 21st Century* (2006), was a 'proof of concept' that demonstrated that wealth accounts could be constructed for many countries. The second edition, *The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium* (2011), provided time series of wealth accounts for 140 countries over 10 years that allowed us to examine the dynamic relationship between development and wealth. The most recent edition, *The Changing Wealth of Nations 2018: Building a Sustainable Future* (2018), included, for the first time, an explicit measure of countries' human capital, disaggregated by gender and including the self-employed. Previous wealth accounts, the World Bank's Human Capital Project, and extensive research have shown that the accumulation of human capital has been a key factor in economic growth, sustainable development, and poverty reduction.

Figure 1. The assets and capital that drive wealth and development



Source: World Bank.

As shown in Figure 1 above, wealth accounts include the following asset categories, all measured in market prices and in constant US$:

- **Natural capital**:
  - Nonrenewable resources: 14 types of minerals and fossil fuels;
  - Renewable resources: Cropland, pastureland, forest timber, forest services (an estimate of nontimber forest products, watershed services, recreation values), protected areas (value estimated as the opportunity cost of converting to agriculture);
- **Produced capital** and urban land**:** Infrastructure, machinery, buildings, equipment, and urban land (For the sake of brevity, the abbreviated term 'produced capital' is used to include both);
- **Human capital**: Measured as the discounted value of earnings over a person's lifetime;
- **Net foreign assets**: The sum of a country's external assets and liabilities.

Building on the data and methods of the 2018 CWON report, which covered the period 1995 to 2014, this analysis extended the Russian wealth time series to 2017 and where possible, substituted country data for the report's global figures.

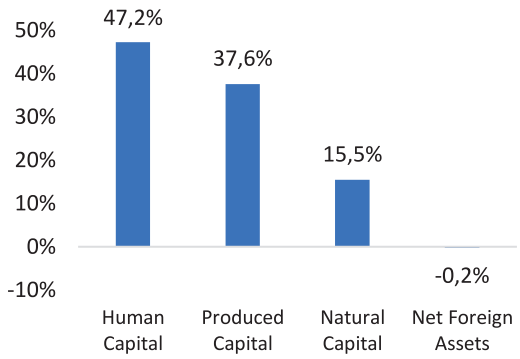
This note begins with an overview of Russia's total wealth from 2000 to 2017 and provides a comparison of Russia's wealth trend to comparator countries. The next section provides a detailed review of each of the four components of Russia's wealth accounts; the data and methodology are explained briefly but more information can be found in *The Changing Wealth of Nations 2018: Building a Sustainable Future*.[5] The final section discusses policy applications and directions for future work.

5 This report can be found at: https://openknowledge.worldbank.org/handle/10986/29001

II. A Closer Look at Russia's Total Wealth

From the period 2000 to 2017, Russia's total wealth grew 73 percent from 753,000 to 1,306,000 billion rubles (in constant 2017 prices). The growth in per capita terms was similar, at 76 percent, with total wealth per capita growing from 5,057,000 rubles to 8,891,000 rubles, though Russia's total population decreased by an overall 1.4 percent in this period (with some limited growth in the period 2011-2017). Figure 2 shows that human capital contributed to almost half of the growth in total wealth per capita during this period, followed closely by produced capital.

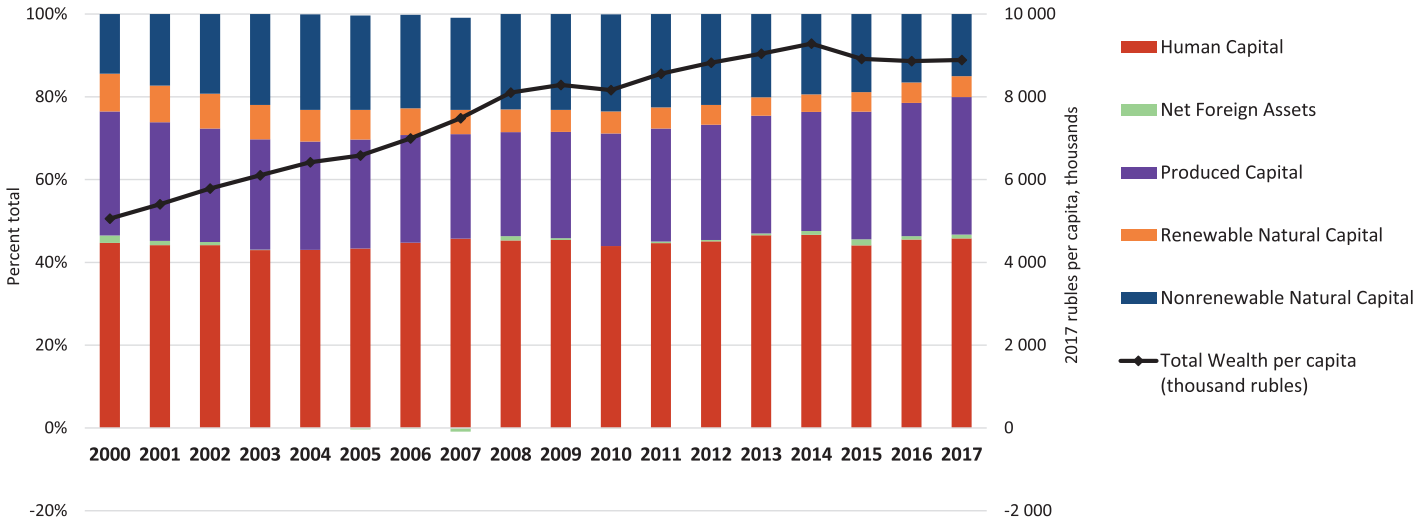
Figure 2. Human capital contributed the most to the total wealth per capita growth in 2000 – 2017 (Contribution by components, percent)



Source: Authors' calculations.

Figure 3 shows the trend in total wealth per capita (black line, right axis) over the 2000-2017 period. Wealth per capita grew steadily from 2000 to 2008, with a slight decline during the global financial crisis, and it has since decreased and stagnated over recent years due to the decline in oil and gas wealth on the back of lower oil prices and subdued human capital growth. The figure also provides the composition of wealth (stacked column, left axis) by share of total wealth. Human capital was the largest share of total wealth, averaging 45 percent over this period, with produced capital averaging around 28 percent. Nonrenewable natural capital comprised 14 percent of total wealth in 2000 and rose to its peak of 23 percent in the late 2000s; its share has since pulled back to 15 percent in 2017. The stagnant total wealth per capita in the most recent three years is largely due to a decline in the value of oil and gas.

Figure 3. Russia's wealth per capita grew 76 percent over the past two decades
(*Composition and trends in total wealth per capita, 2000 to 2017)*



Source: Authors' calculations.

Table 1 presents the trends above by looking at the average annual growth rate of the wealth components, broken down into two time periods. In per capita terms, from 2000 to 2010, nonrenewable natural capital grew at over 10 percent a year but has been declining at an average of 5 percent from 2010 to 2017. Growth in human capital per capita also slowed by more than half in the 2010 – 2017 period to 1.8 percent, while produced capital's growth remained steady throughout the two decades at around 4 percent.

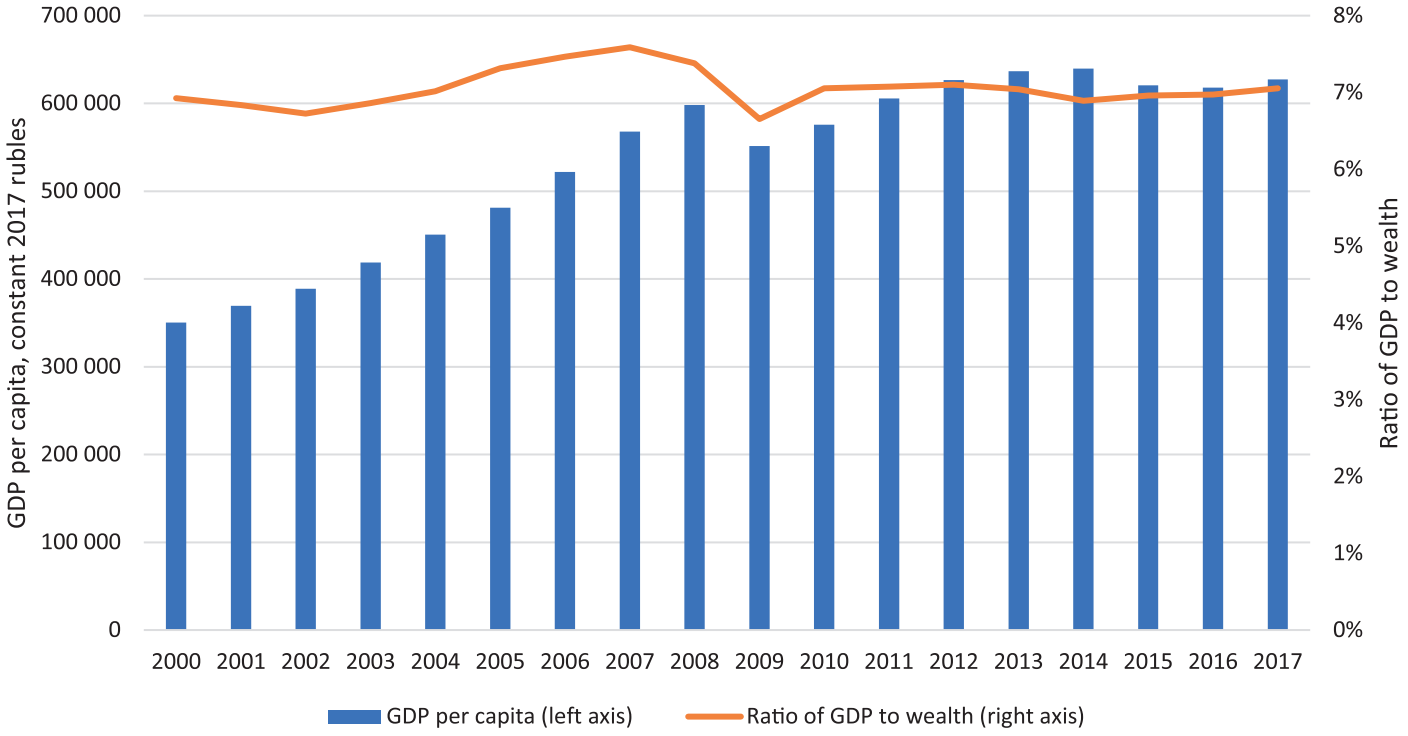
Table 1. Annual growth in Russia's wealth has slowed down in the last decade
(Total wealth per capita in 2017 and average annual growth rates)

	Year 2017		Average annual growth rate of wealth *(in constant prices, per capita terms)*		
Rubles, thousands	**Per capita wealth**	**Share**	**2000-2010**	**2010-2017**	**2000-2017**
Total wealth	8,891		4.9%	1.2%	**3.4%**
Produced capital	2,956	33%	3.9%	4.1%	**4.0%**
Human capital	4,073	46%	4.7%	1.8%	**3.5%**
Natural capital	1,782	20%	7.0%	-3.9%	**2.4%**
Renewables	448	5%	-0.6%	0.5%	**-0.2%**
Nonrenewables	1,334	15%	10.2%	-5.1%	**3.6%**
Net foreign assets	80	1%			

Source: Authors' calculations.

In Figure 4, the bar chart (left axis) shows the trend of GDP per capita, which largely exhibits the same trend in wealth per capita. The line graph (right axis) displays the ratio of Russia's GDP to total wealth, or its return on wealth. Russia's return on wealth has averaged around 7 percent for the 2000 – 2017 period, similar to the average among upper-middle and high-income countries. But it was lower than the 8-10 percent return in some Eastern European countries such as Bulgaria, Romania, Poland, and Hungary.

Figure 4. Russia's return on wealth averaged 7 percent between 2000 – 2017
(*GDP per capita and the ratio of GDP to wealth)*

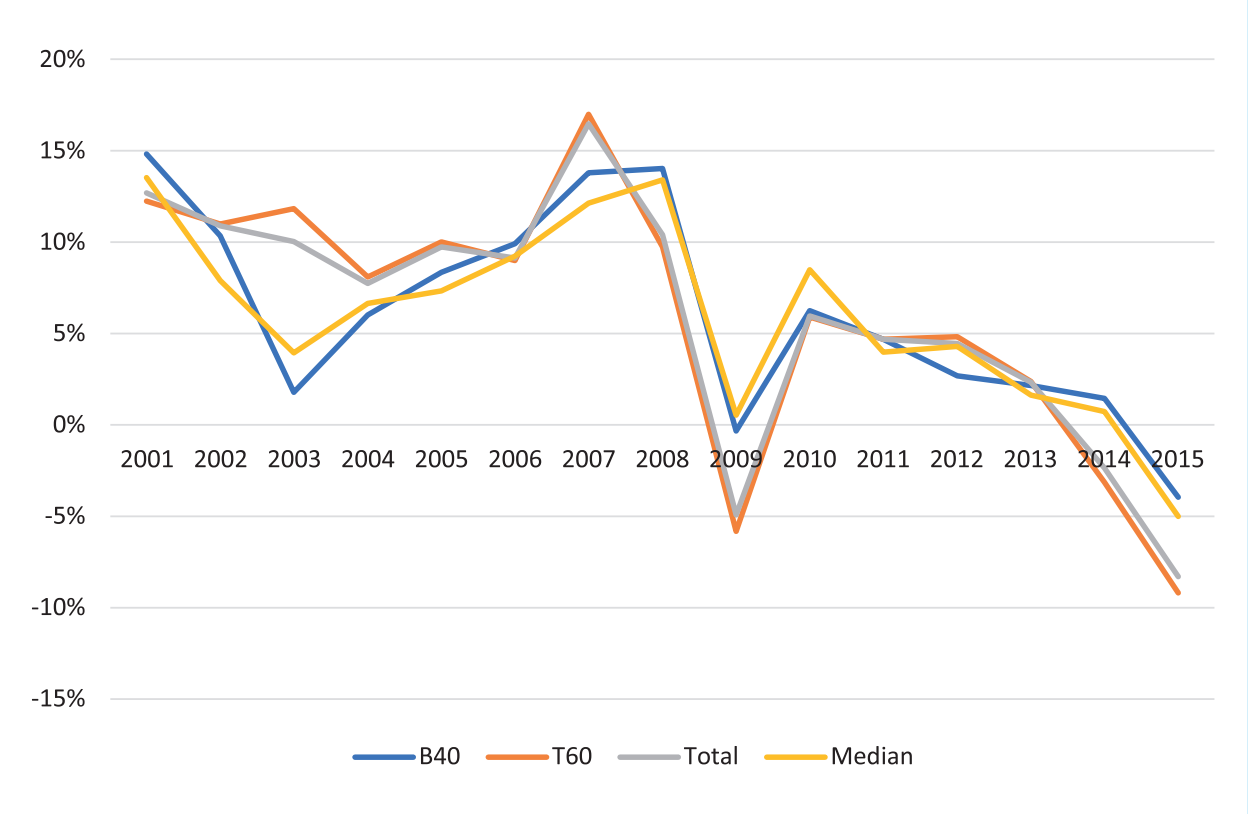


Source: Authors' calculations.

One important factor to consider is how well this return to wealth is distributed. Box 1 discusses how various measures of shared prosperity such as income growth of the bottom 40 percent of the population as well as growth in median incomes, have evolved.

Box 1: Who has benefitted from the return on wealth?

Figure B1-1: While sizeable during the boom years, Russia's shared prosperity premium has been shrinking recently.



Source: Rosstat, World Bank staff calculations.

Note: B40 – Bottom 40 percent of the income distribution. T60 - Top 60 percent of the income distribution.

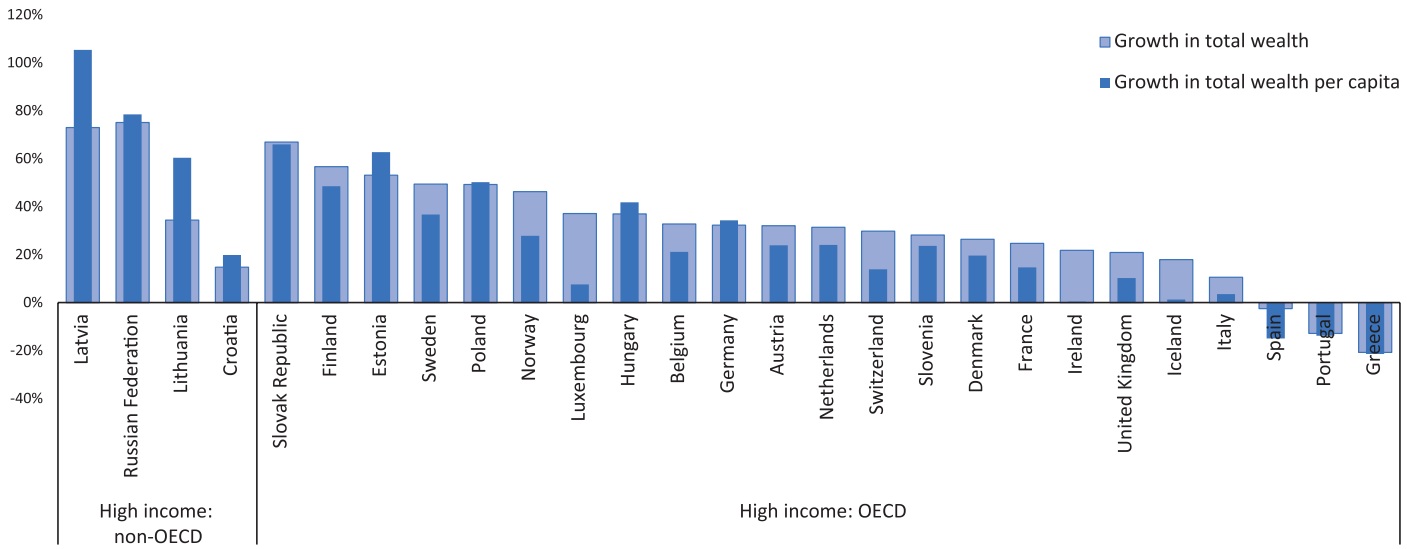
The favorable macroeconomic environment and high rates of growth during the boom years benefitted the bottom of the income distribution. During the commodity boom, Russia's growth was highly inclusive, resulting in a remarkable performance in shared prosperity. The bottom 40 percent's consumption rose by close to 10 percent annually during the period of strongest growth (2004-2009), slowing to a still high 5.9 percent in 2007–12. Both figures are well above the average increase in consumption for the total population in either period, which was about 8 percent in the first and 5.3 percent in the second. Russia's performance over 2007-2012 is even more impressive when compared to that of other countries—including many commodity exporters.

The rise in shared prosperity, however, was interrupted by the global financial crisis of 2008–2009. Incomes of the bottom 40 percent fell with the crisis but recovered quickly and continued to grow (though at a slower pace). They stalled in 2012 with the weakening of the macroeconomic environment and falling oil prices, stagnating in 2012 and 2013, and then dropping faster than average incomes in 2014. Median income growth also decelerated. After growing annually at 9 percent in 2001-2008, median income grew by just 4.5 percent in 2009-2010, and by only 1.6 percent annually during 2010 - 2015.

The waxing and waning of two measures of shared prosperity (growth in incomes of the bottom 40 percent of the population and median income) with overall macro-economic conditions underscores both the importance of increasing returns to Russia's wealth and pursuing policies that distribute these returns more equitably.

Figure 5 shows the growth in total and per capita wealth for all high-income countries in the Europe and Central Asia region from 2000 to 2014 as reported in CWON 2018.[6] Russia's updated results (for 2000 – 2014) are also included in the figure. Compared to the high-income OECD countries, Russia performed well and fared better through the global financial crisis, with higher growth in total and per capita terms during this period.

Figure 5. Compared to high-income countries, Russia performed well with higher growth in total and per capita wealth (*Growth in total and per capita wealth, High-income Europe and Central Asia, 2000 to 2014*)



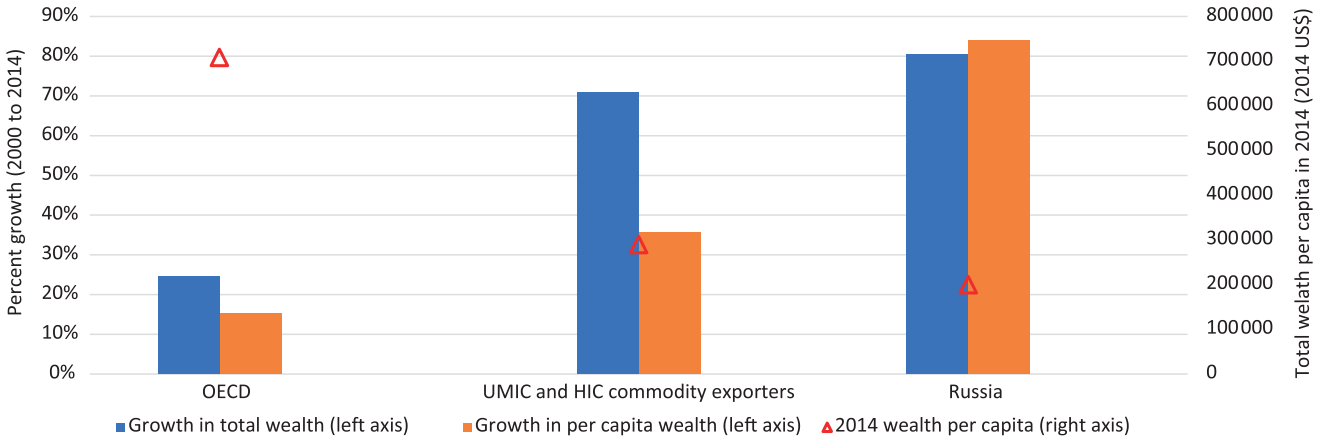
Source: Authors' calculations.
Note: In the CWON 2018 database, Russia was categorized as high-income based on its income level in year 2014.

Figure 6 shows Russia's growth in total and per capita wealth from 2000 to 2014 compared to the averages of OECD countries and commodity exporters (upper middle-income (UMIC) and high-income (HIC)).[7] While Russia saw higher growth rates in total wealth per capita, its level of wealth per capita (red triangles, right axis) is still significantly lower than the OECD average and even slightly lower than its peers in the commodity exporters group; therefore, Russia's economic growth has to be on a faster trajectory in order to catch up.

6 Throughout the report, when Russia is being compared to other benchmark countries, the time period of comparison is from 2000 to 2014 and the units are in constant 2014 US$.

7 See Appendix 2 for the list of benchmark countries included in the OECD and UMIC and HIC commodity exporter categories.

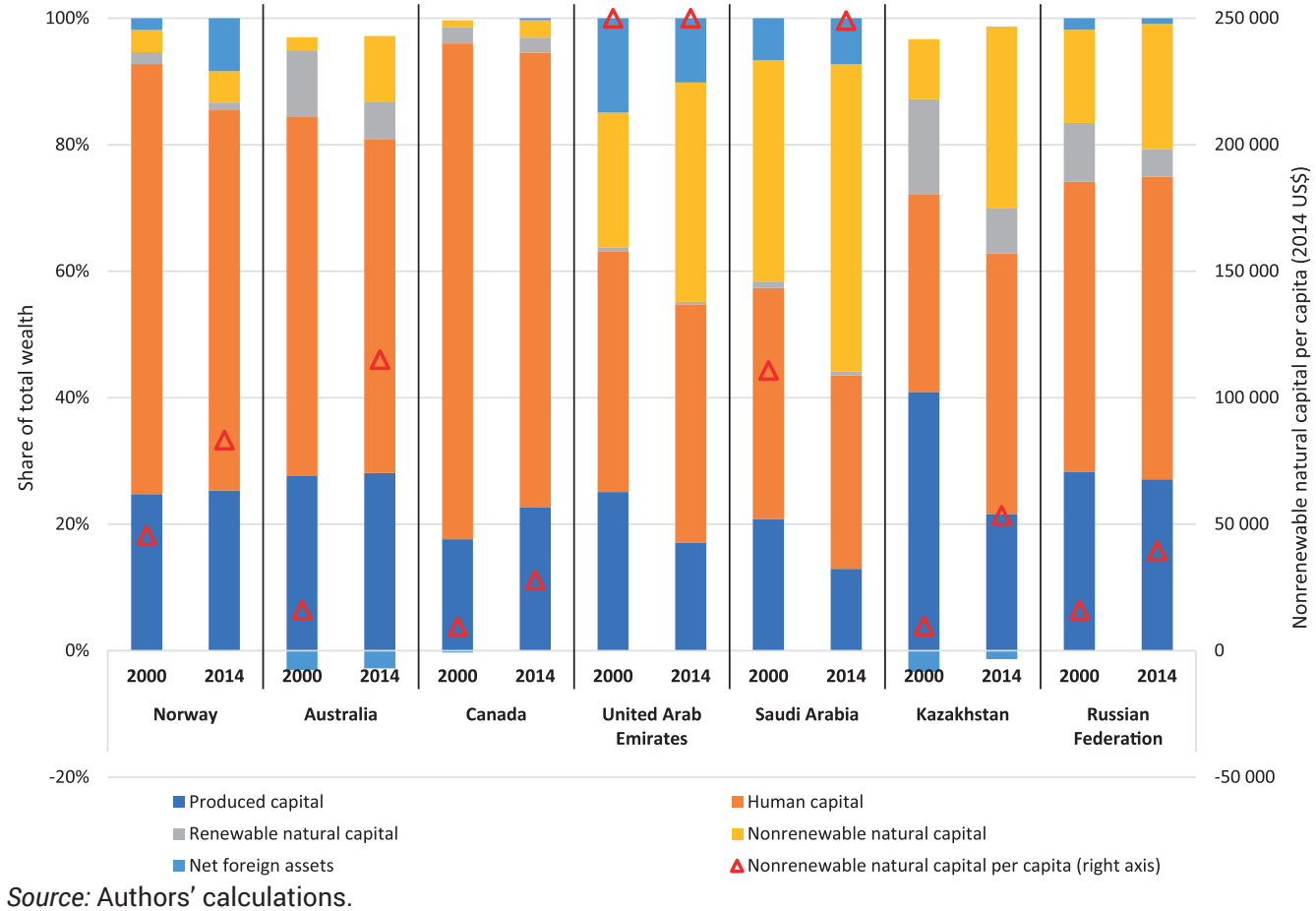
Figure 6. Despite higher growth rates, Russia's wealth per capita remains significantly lower than OECD countries (*Growth in total and per capita wealth, Russia and benchmark countries, 2000 to 2014*)



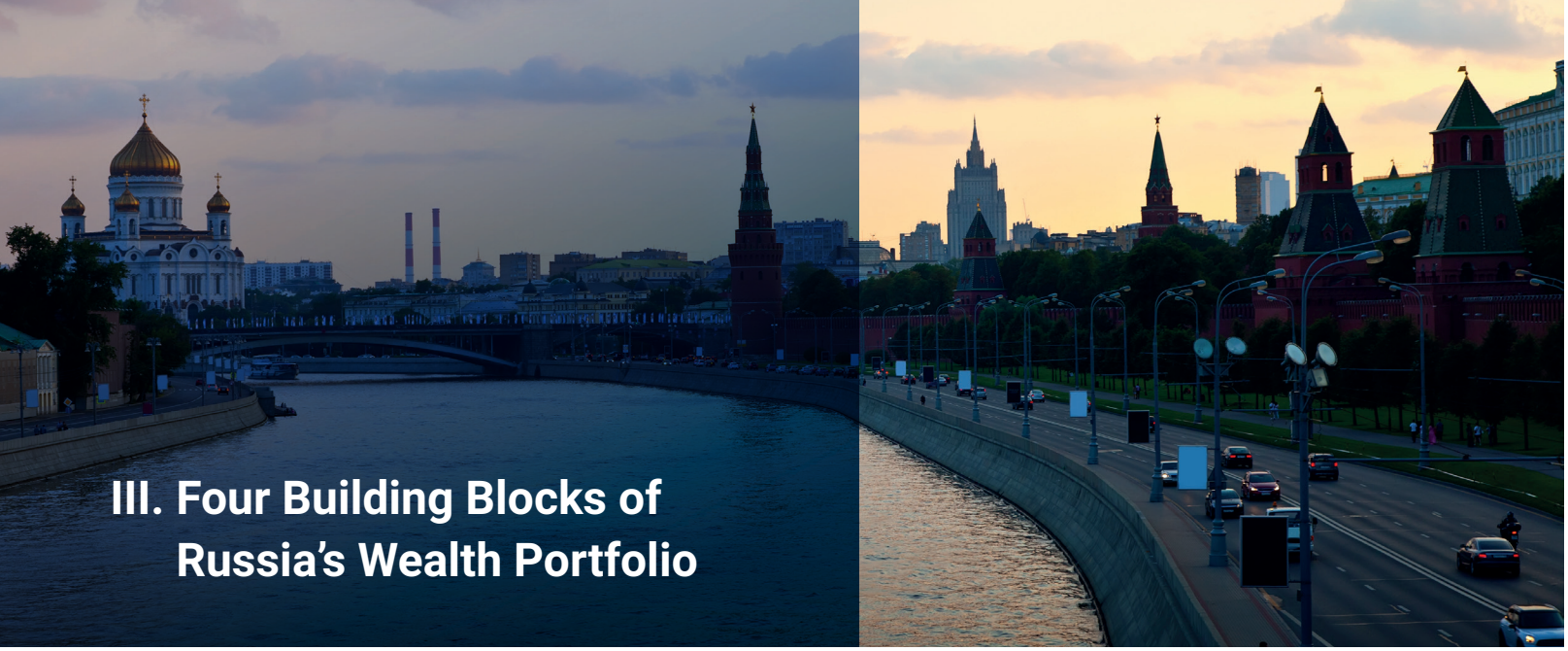
Source: Authors' calculations.

Looking at Russia's wealth composition in comparison to select resource-rich countries (Figure 7), the country's heavy dependence on its oil and gas resources is clear. While Russia's nonrenewable share of total wealth is not as large as the share in Gulf countries and Kazakhstan, it is much higher compared to OECD countries. Though resource-rich Norway and Australia's *values* of nonrenewable resources were two and three times larger than Russia's, their respective *share* of total wealth were 5 and 11 percent compared to Russia's 20 percent (in 2014). Maximizing returns to Russia's wealth portfolio would require its asset base to be better balanced given the heavy dependence on natural capital of just two assets; i.e., oil and gas.

Figure 7. Russia's oil and gas comprise a significant share of its total wealth
(Total wealth composition from 2000 to 2014, Russia and select resource-rich countries)



Source: Authors' calculations.



III. Four Building Blocks of Russia's Wealth Portfolio

The four building blocks of Russia's wealth portfolio include produced capital, natural capital, human capital, and net foreign assets. Total wealth equals the sum of these four asset groups.

As mentioned earlier, this analysis builds on CWON 2018 data and methods, which covered the period 1995 to 2014, and extended the Russian wealth time series to 2017. Where possible, country data were substituted for global figures used in CWON 2018 (Box 2). Appendix 1 provides a summary of the data and methods of CWON 2018 as well as additional information on the calculations of Russia's wealth estimates used in this report.

Box 2: Caveats, measurement issues, and limitations

For the estimation of Russia's comprehensive wealth, country data are used where available and when they can be incorporated without comprising the ability to compare Russia's results to other countries in CWON. However, the measurement exercise still remains within the broad framework of the existing CWON methodology for continuity, consistency, and comparability. Therefore, it is important to note that results are sensitive to various issues such as price deflators (e.g., GDP deflator vs. commodity-specific deflator), discount rates, and assumptions of future rents or wages. Regarding specific components, produced capital estimates may not entirely reflect the value of urban land, which is currently measured crudely. The value of natural capital does not include a number of components such as water resources, fisheries, renewable energy, and marine protected areas; also, the value of natural capital does not account for the impact of climate change and land and forest degradation. Human capital estimates rely on a "wage equation". However, in recent years, the nature of the Russia labor market has seen macroeconomic adjustment relying on real wages and a lot less on employment. Thus, human capital may be somewhat undervalued because of this wage behavior.

Produced Capital

Produced capital consists of manufactured or built assets such as machinery, equipment, physical structures, and transport vehicles. Data for Russia's capital stock value and asset structure are provided by Rosstat[8] for the period 2011 – 2017.[9] A time series for the real growth rate of produced capital was constructed on the basis of the Russia KLEMS database.[10] The World Bank's wealth accounts also include the value of

8 Russian Federal State Statistics Service, or Rosstat, is the governmental statistics agency of Russia.

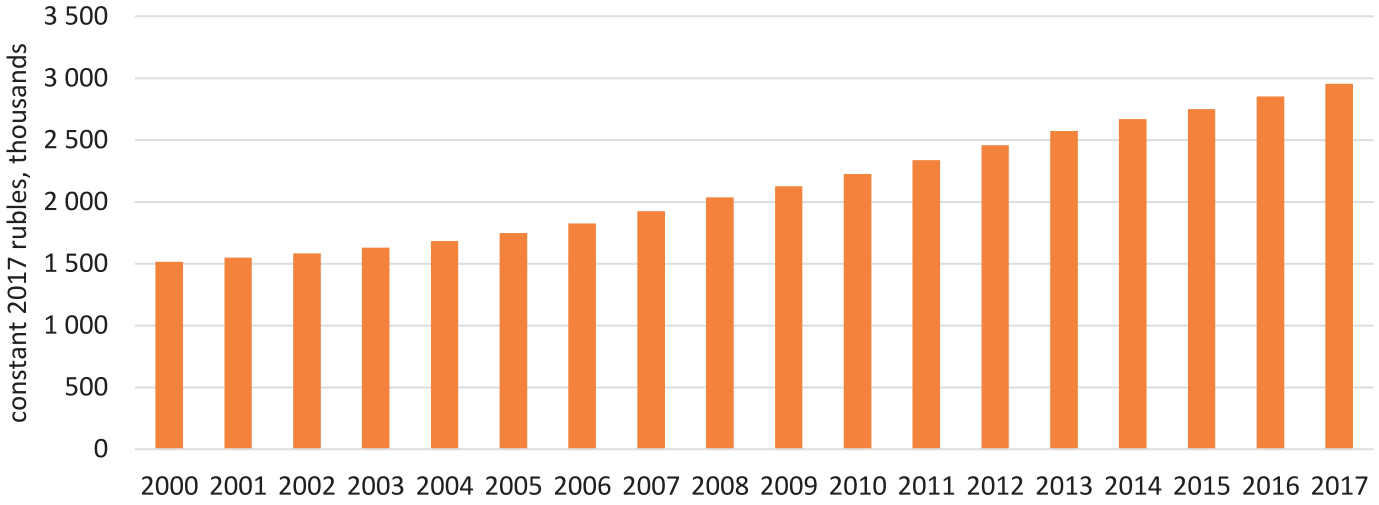
9 Please see the detailed description of produced capital types and methodology in Appendix 1.

10 Russia KLEMS was released by the National Research University, Higher School of Economics and Groningen Growth and Development Centre. Voskoboynikov, Ilya B, (2012), «New measures of output, labour and capital in industries of the Russian economy,» GGDC Research Memorandum N 123. KLEMS database covered the period until 2014. Data for the period 2014 – 2016 are preliminary and will be reviewed in December 2019. The 2015 - 2017 growth rates were taken from Rosstat.

built-up urban land, which is valued as a fixed proportion (24 percent) on other produced assets. For brevity, the term produced capital includes both built capital and urban land.

Estimates of produced capital per capita grew 95 percent from 1.5 million rubles in 2000 to 3.0 million rubles in 2017 (Figure 8), faster than overall per capita wealth in Russia. The share of produced capital in total wealth totaled about 33 percent in 2017. Russia's composition of produced capital is shown in Figure 9, with the share of buildings and structures totaling about 80 percent (without urban land). In line with this structure, capital wealth is concentrated in the real estate sector (about 44 percent of total produced capital) (Figure 10). The energy sector accumulates the second largest produced capital stock (mineral resource extraction, transportation and electricity production).

Figure 8. Russia's produced capital per capita grew 95 percent over the past two decades, faster than overall wealth (*Produced capital per capita, 2000 to 2017*)



Source: Rosstat and Russia KLEMS database.

Figure 9. Composition of produced capital in 2017: Share of building and structures totals about 80 percent

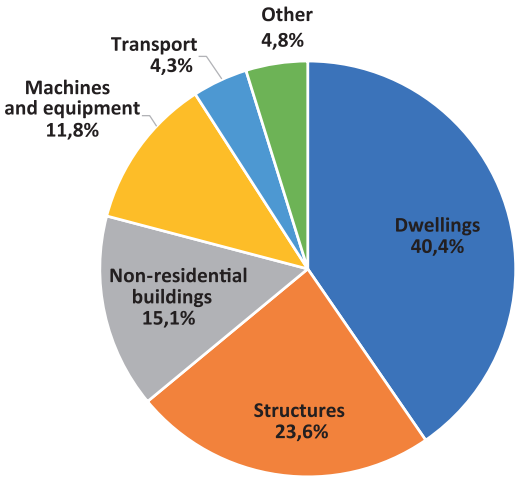
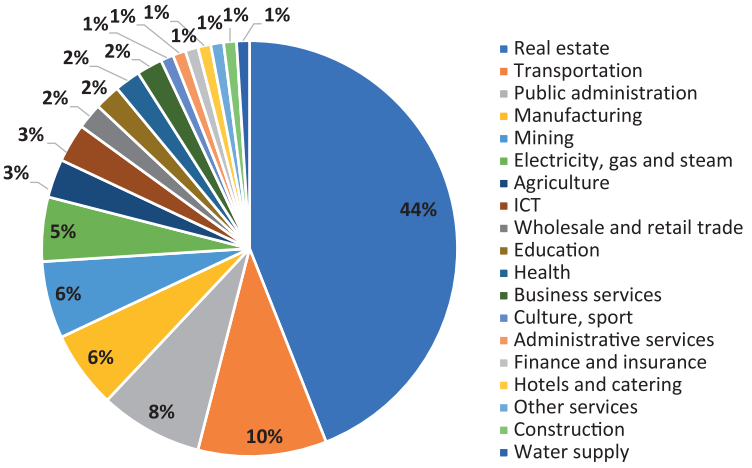


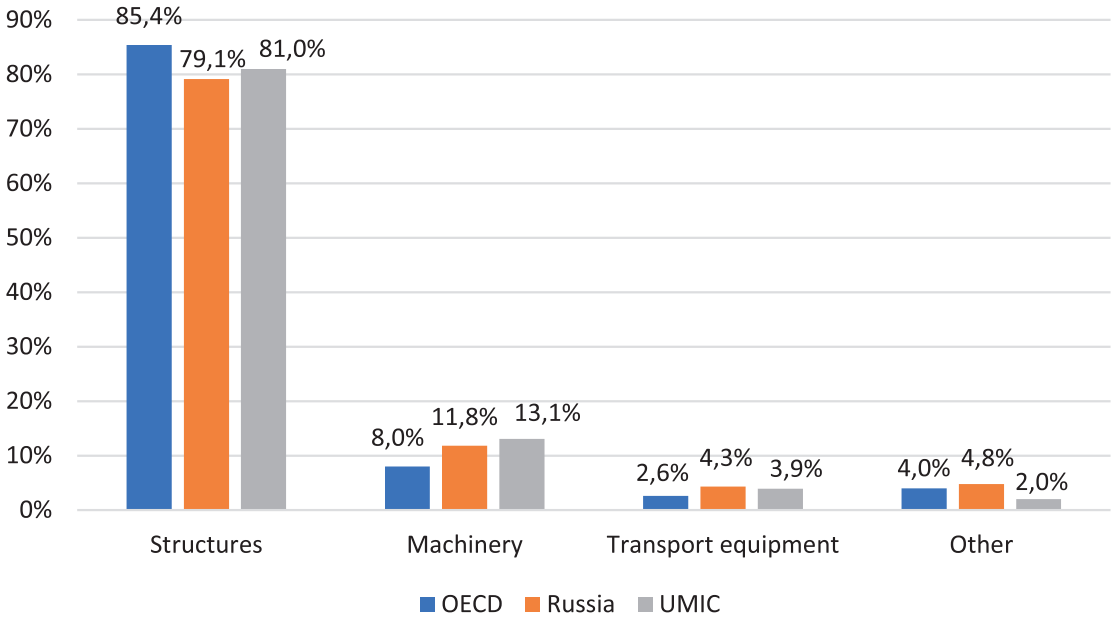
Figure 10. The real estate sector accumulates the largest share of produced capital



Source: Rosstat.

In Russia, the share of structures (dwellings, non-residential buildings, and other structures) in total produced capital stock is close to that in upper middle-income countries but slightly lower than in OECD countries (Figure 11).

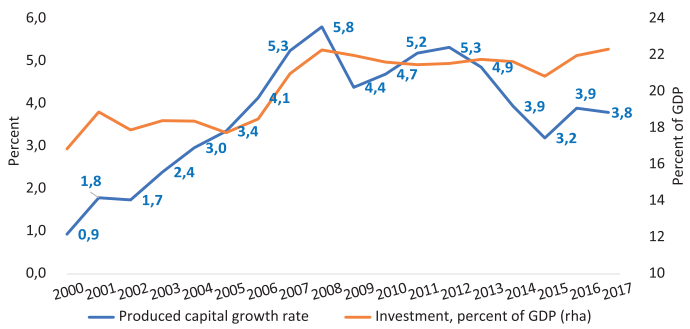
Figure 11. The share of structures in produced capital is slightly lower in Russia compared to OECD countries *(Share of total produced capital in 2017, percent)*



Source: Penn World Table, Rosstat.

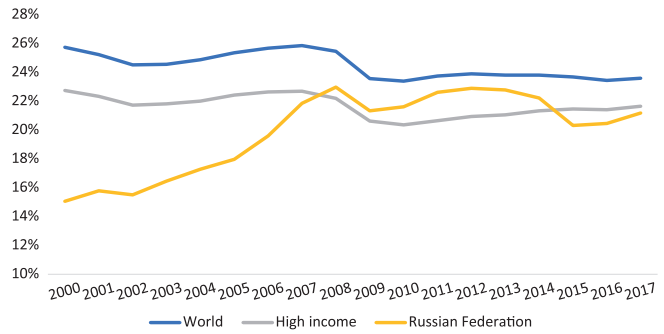
After reaching its peak growth rate in 2012, produced capital growth softened on the back of lower fixed capital investment growth which is attributed to the slowdown of potential growth, coupled with the double shock of lower oil prices and economic sanctions, which constrained Russia's access to international financial markets (Figure 12).

Figure 12. A higher share of investment supported robust capital growth



Source: WDI, World Bank.

Figure 13. Russia's share of investment in GDP is close to that of advanced economies, making it difficult to catch up with these economies in terms of capital stock per capita
(GFCF as a share of GDP, constant 2010 prices)



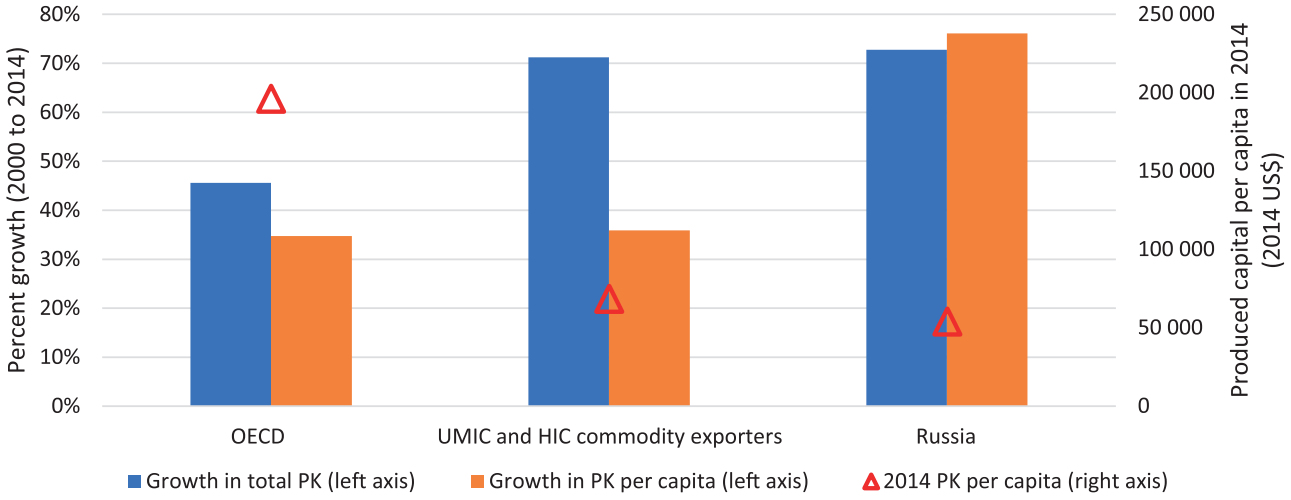
Source: WDI, World Bank.

Figure 14 compares Russia's growth in produced capital (denoted PK), both in total and per capita terms, to OECD countries and commodity exporters from 2000 to 2014. Though Russia and other commodity exporters saw faster growth in produced capital per capita compared to OECD countries (bar graphs, left axis), the value of produced capital per capita in OECD countries was almost four times their value in 2014 (red triangles, right

axis). In 2014, Russia's produced capital share of total wealth was 27 percent, similar to OECD countries (28 percent) and slightly higher than in commodity exporters (24 percent).

Russia's share of investment in GDP is slightly below that in advanced economies (Figure 13), which would make it difficult to catch up with these economies in terms of capital stock given Russia's current modest GDP growth rate. Russia's share of investment in GDP was below that of upper middle-income countries and below the world average for the period 2000 – 2017. This gap in capital stock affects Russia's production functions directly (lower capital stock is translated into lower GDP production) and indirectly (as technological improvements are often embodied in investment, which could raise TFP).

Figure 14. Russia's produced capital per capita is almost a fourth of the OECD average
(*Growth and per capita values of produced capital, Russia and benchmark countries, 2000 to 2014)*



Source: Authors' calculations.

At the macro level, switching to a flexible exchange rate regime, introducing the fiscal rule, and continuing inflation targeting has set important macro fundamentals for growth. At the micro- and meso- levels, progress in de jure regulatory simplification has been impressive. As measured by the World Bank global Doing Business report, Russia moved up in the overall rankings from its 120th position (out of 183 economies) in 2012 to being ranked 28th (out of 189 economies) in 2020. Yet, competition conditions in Russia have not improved as rapidly as broader investment climate conditions. Its product market regulations remain the most restrictive in the OECD (OECD Product Market Regulations Index) and Russia is ranked 95th out of 137 countries on the Global Competitiveness Index's competition perceptions indicator. The continuing presence of high price-cost margins, lower than average market entry rates, and lower levels of private investment in innovation all point to limited levels of competition.

While considerable progress has been achieved in establishing a functioning legal and institutional competition framework, several challenges need to be addressed to make this framework more effective in enhancing competition:

- Reverse a trend towards cartelization of the economy, especially, in public procurement (Source: Federal Antimonopoly Service);
- Promote competitive neutrality principles among SOEs and private sector actors;
- Ensure the transparency of state support and privileges to minimize competition distortions.

The 2018 Global Competitiveness Index (GCI) ranks Russia's infrastructure relatively high (51st out of 140 countries), above Brazil, India, South Africa, Kazakhstan, and Argentina. However, the aggregate ranking masks significant differences in the quality of the different types of infrastructure measured. While Russia scores very high in air transport capacity (18) and mobile connectivity (11), the quality of its roads is low (104), and the efficiency of air transport (52) and port infrastructure (45) is worse than in OECD countries.[11]

11 For more details, see World Bank, (2016), *Pathways to Inclusive Growth*. http://documents.worldbank.org/curated/en/477441484190095052/pdf/FINAL-Russia-SCD-Dec-22-ENG-12222016.pdf

According to Rosstat data, public sector gross fixed capital formation averaged about 3.9 percent of GDP in 2011 – 2014. This is largely in line with public investment in OECD countries but lower than in upper middle-income countries and oil exporters. Meanwhile, Russia's infrastructure gaps are large. Depreciation of capital stock, particularly in transport, energy, public utilities, and social infrastructure, is the main driver of the need for significant infrastructure investment. Russia's large spatial inequities in part reflect differences in transport connectivity measured by the time it takes to travel to markets. There are notorious differences in the stock of transport infrastructure across regions. The western side of the country has a complex and sophisticated transport network, while in the Far East, the trunk networks of transport (main roads and rail lines) are virtually non-existent. More than 40 percent of the Russian Federation lacks reliable access to the transport network, and one-third of the settlements lack all-season roads.[12]

Public investment growth has been subdued in the period since 2014 as a result of the limited fiscal space amidst fiscal consolidation. Recently, 13 national projects totaling 25.7 trillion rubles (about US$ 390 billion, or 2.8 to 3.2 percent of GDP annually) were announced, with the aim to enhance human capital, to raise the quality of life, and accelerate economic growth. Investments in infrastructure under national projects if conducted efficiently could improve public infrastructure and they represent steps in the right direction. The use of public-private partnerships (PPPs) envisaged in the national projects could mobilize private capital to expand infrastructure without creating excessive fiscal pressure.

Natural Capital

The value of natural capital in this analysis includes renewable resources (cropland, pastureland, forest timber, forest services, and protected areas) and nonrenewable resources (oil, gas, hard and soft coal, and 10 minerals[13]). In contrast with renewable resources, nonrenewable natural capital—fossil fuels and minerals—offer a one-time chance to finance development by investing resource rents. The challenge of development for countries rich in energy and minerals has been well documented in the literature on the "resource curse." Resource-rich economies like Russia face unique development challenges to transform an exhaustible resource, such as oil, into assets that can continue to generate income and employment once the oil is gone. Oil rents, for example, provide substantial revenues for financing development and moving a country onto a higher growth trajectory, but this goal can only be achieved with the right institutions and governance to capture the rents and invest them effectively in other productive assets (human capital, produced capital, renewable natural resource capital).

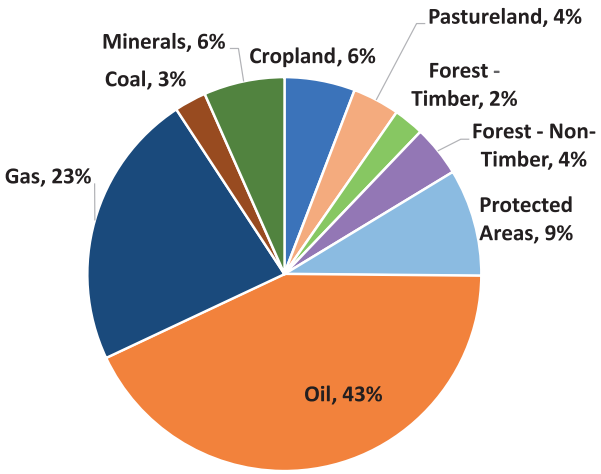
The CWON estimate of natural capital wealth follows the asset valuation approach, where a resource's value is measured as the present value of the stream of future rents over the time horizon of the asset (time to exhaustion for nonrenewable resources, and infinity for renewables). Note that the value of agricultural land is conceptually divided into cropland and pastureland and is estimated as the present value of returns to land based on crop and livestock production as opposed to market data on land sales. The value of terrestrial protected areas follows a quasi-opportunity cost approach and is estimated as the lower value of the returns per hectare to cropland and pastureland; this is likely to be a lower bound on the true value of protected areas.

Figure 15 shows the breakdown of Russia's natural capital wealth in 2017, where it is evident that nonrenewable resources are the nation's most valuable resources, overshadowing renewable resources. Oil is estimated to be almost half of the total value of natural capital, at 764 thousand rubles per capita. Together with natural gas, coal, and minerals, nonrenewable resources account for about 75 percent of total natural capital.

12 World Bank, (2017), *The Russian Federation: An Exploratory Assessment of Transport Connectivity*.

13 The 10 minerals include bauxite, copper, gold, iron ore, lead, nickel, phosphate rock, silver, tin, and zinc.

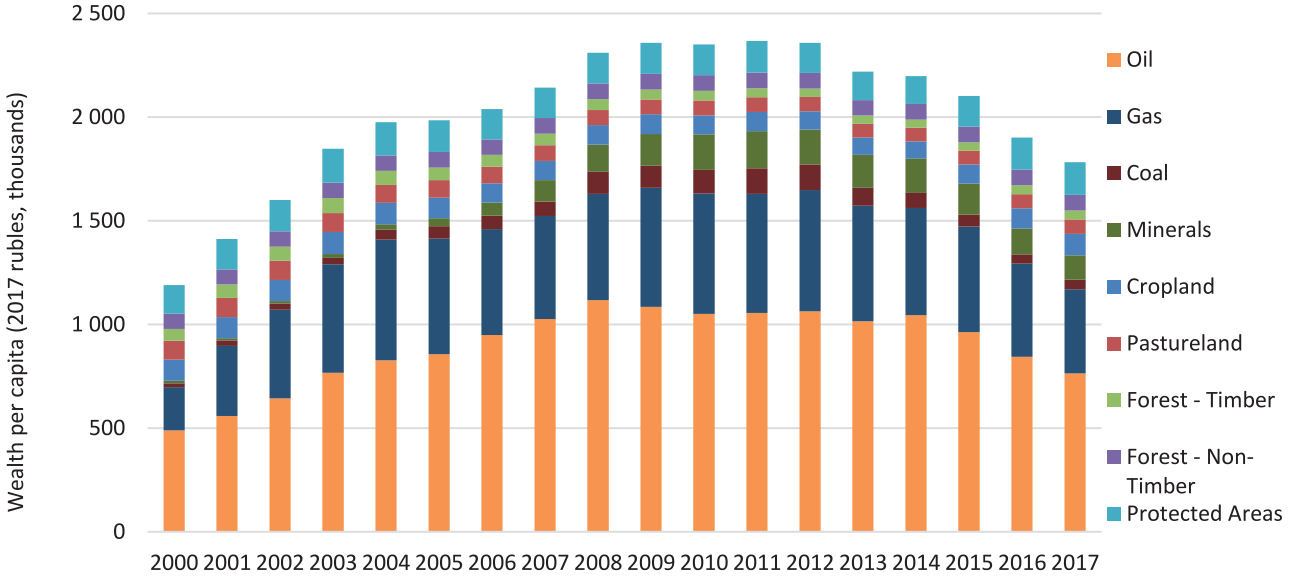
Figure 15. Russia's natural capital is dominated by oil and gas (*Natural capital composition in 2017, percent*)



Source: Authors' calculations.

Figure 16 presents the natural capital estimates from 2000 to 2017 in thousand rubles per capita. While total natural capital per capita grew by 50 percent during this period, two very different stories emerge when breaking up the two decades. From 2000 to 2010, natural capital per capita grew at an average annual rate of 7 percent, driven by oil and gas. But from 2010 to 2017, it decreased at an average annual rate of 4 percent, again due to the valuation of oil and gas.

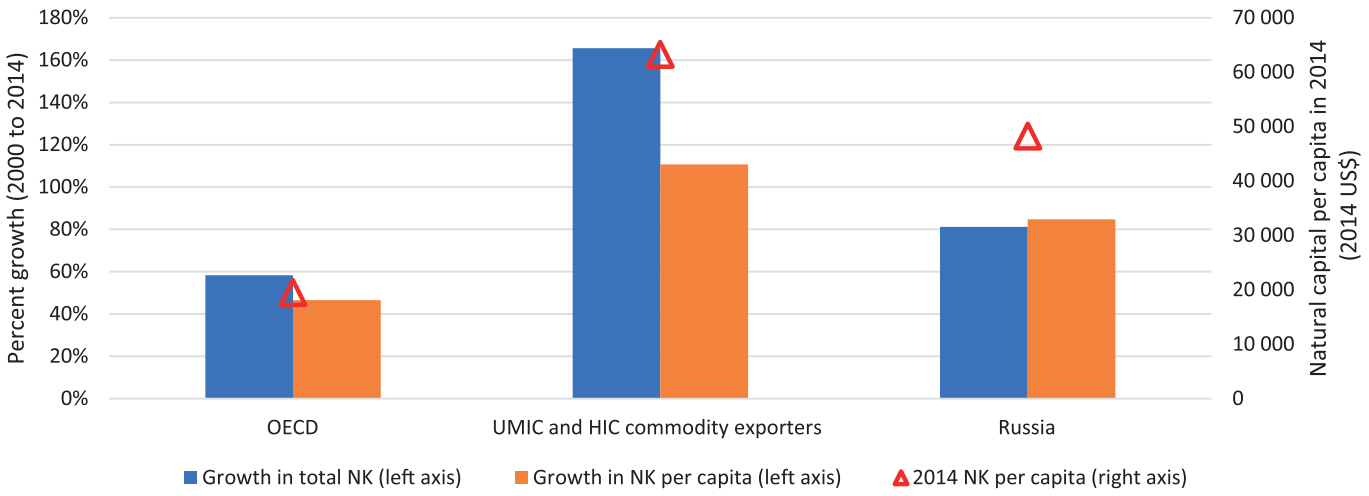
Figure 16. In recent years, Russia's natural capital per capita has decreased with the fall in oil prices
(*Russia's natural capital per capita from 2000-2017, constant 2017 rubles, thousands)*



Source: Authors' calculations.

Looking again at the standard benchmark graph, this time for natural capital, Figure 17 shows that from 2000 to 2014, Russia's growth in natural capital (denoted as NK) was almost double the average of OECD countries but less than the growth rate among other UMIC and HIC commodity exporters. Russia's value of natural capital per capita was also less than other commodity exporters in 2014 but more than double the value of the OECD average.

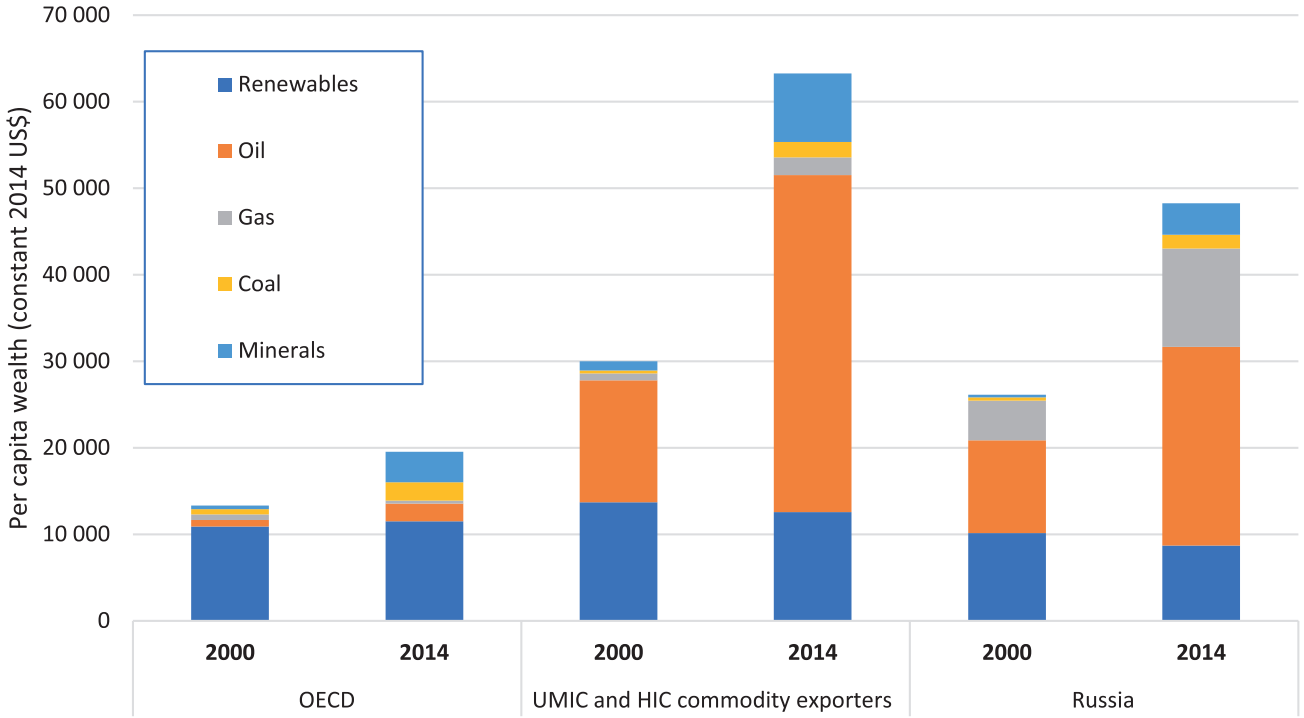
Figure 17. Though Russia's natural capital per capita is double the OECD average, it trails the average of other commodity exporters
(*Growth and per capita values of natural capital, Russia and benchmark countries, 2000 to 2014*)



Source: Authors' calculations.

Figure 18 provides an additional perspective on the graph above by comparing the magnitude and evolution of natural capital from 2000 to 2014 for the same countries. While oil (orange bar) was the driving force behind the significant increase in natural capital among the commodity exporters, Russia's growth was fueled by both oil and gas.

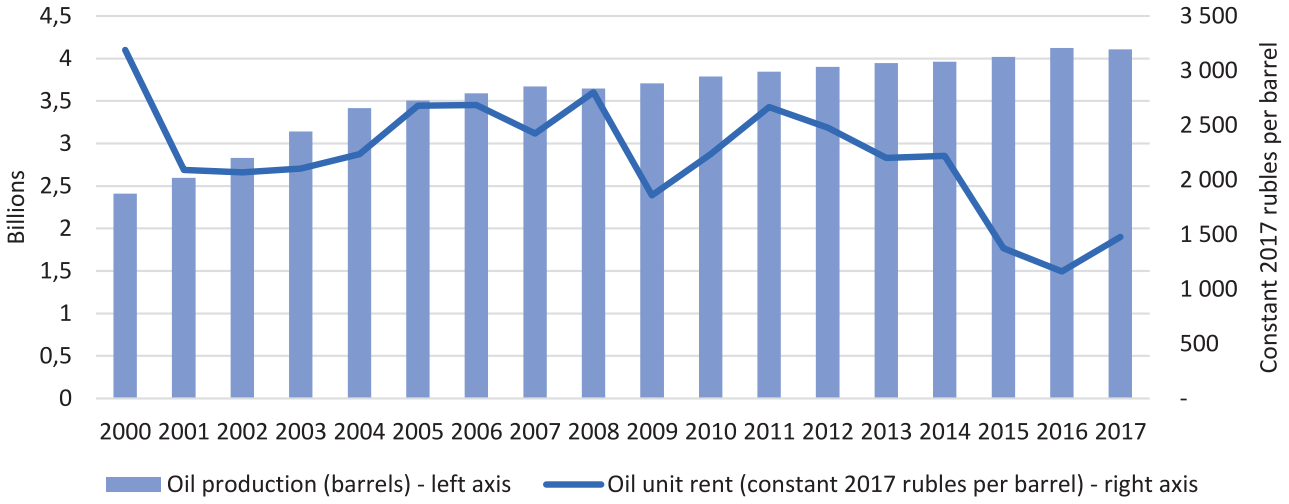
Figure 18. Russia's growth in natural capital was fueled by oil and gas
(*Natural capital per capita, 2000 to 2014, Russia and benchmark countries)*



Source: Authors' calculations.

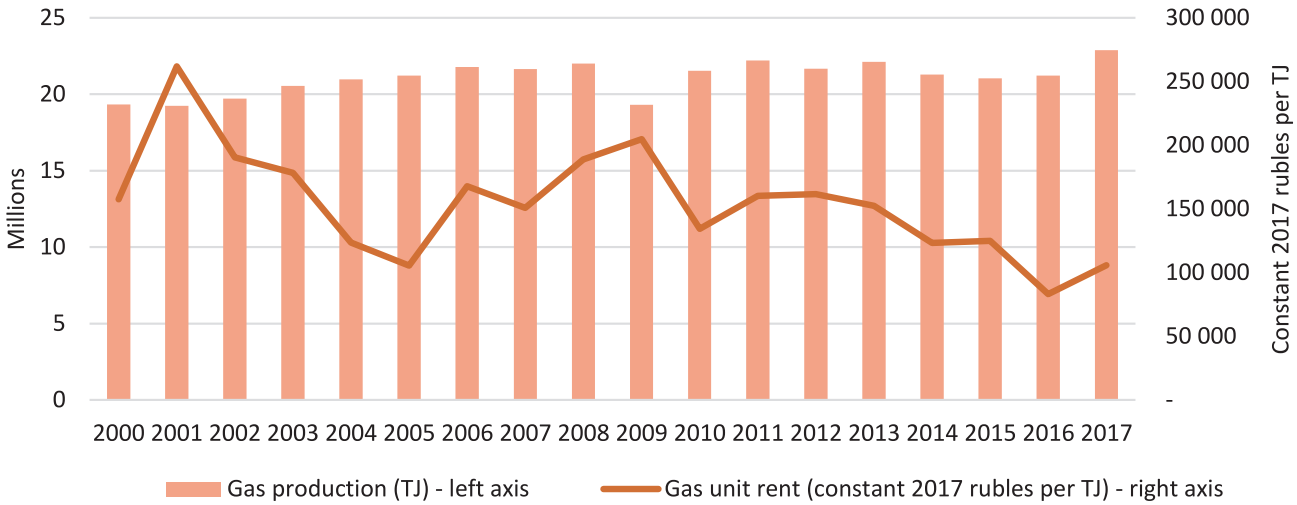
Taking a closer look at the drivers behind Russia's growth in wealth—oil and gas, Figure 19 and Figure 20 show the annual production and unit rent[14] figures underlying the oil and gas asset values. Oil production rose quickly in the early 2000s, stayed fairly constant in the late 2000s, and has been slowly rising in recent years. However, unit rent in constant rubles has been generally declining over this period after hitting its peak in the mid to late 2000s; the pronounced drop after 2014 was due to the drop in global oil prices. Gas shows similar trends in production and unit rent, albeit with some more year-to-year volatility. The trends in price and cost that underlie oil and gas rents reveal that while cost generally follows the direction of price, prices have been more volatile and are therefore the driving force behind the year-to-year changes in unit rent.

Figure 19. Russia's oil production has been increasing steadily, with unit rent decreasing over the past decade *(Oil production and unit rent in Russia, 2000 to 2017)*



Source: BP Statistical Review of World Energy; Authors' calculations.

Figure 20. Russia's gas production has been increasing steadily, with unit rent decreasing over the past decade (*Gas production and unit rent in Russia, 2000 to 2017)*



Source: BP Statistical Review of World Energy; Authors' calculations.

14 Annual unit rents are converted from current US$ to constant 2017 rubles using the market exchange rate and the GDP deflator. Note that while the annual volatility of prices (an impact of exchange rate, deflator) is shown here, the NPV calculation for oil and gas wealth uses a lagged, five-year average for total rent (to smooth for price volatility).

Russia's dependence on oil and gas has significant policy implications in light of the risks that the global low-carbon transition poses on its carbon-based assets. External impacts of the low-carbon transition on fossil-fuel dependent countries like Russia could include disruptive technologies, climate policies in the rest of the world, and imposed trade measures. Simulations based upon a forthcoming World Bank report, *Beyond Stranded Assets*,[15] show the range of subsoil asset values under various scenarios, such as the impacts of external policy and technology drivers and outline the strategies that fossil-fuel dependent countries (FFDC) can implement to cope with external policy shocks. Preliminary results find that in the worst case-scenario, an FFDC's fossil fuel asset value reduces by 18 percent compared to a business as usual scenario. GCC countries stand to lose the most – a 21 percent reduction, and Russia would see a reduction of around 14 percent.[16] For Russia, the risks vary for different commodities, and the extent of the impact depends on the policies of the rest of the world and Russia's own choices, such as its diversification and international cooperation strategies. The analysis reveals the importance of Russia's preparedness for the low-carbon transition, and points to the value of economic flexibility and reduced exposure to fossil fuels.

Turning to renewable resources, their value (agricultural land, forests, protected areas) did not change dramatically over this period. From 2000 to 2010, renewable natural capital per capita fell at an average annual rate of -0.6 percent but has since increased in the 2010 – 2017 period at a rate of 0.5 percent a year. Table 2 provides a closer look at the natural capital values from 2000 to 2017, where the dynamics of renewable resources over time can be more closely observed. Timber and pastureland values are the only components that show a consistent downward trend over this period. The trend in the value of renewable resources reflects the trend in the value of production as the underlying land area (e.g., agricultural land, forest area) did not change significantly during this period. The only land area that grew was the terrestrial protected area, which expanded almost 25 percent from 2000 to 2017.

Table 2. Russia's natural capital per capita by resource *(Constant 2017 rubles, thousands)*

Per capita	**2000**	**2005**	**2010**	**2015**	**2017**
Total Natural Capital	**1,190**	**1,985**	**2,351**	**2,102**	**1,782**
Renewable	**461**	**473**	**433**	**422**	**448**
Cropland	101	99	91	92	103
Pastureland	92	84	72	67	69
Forest - Timber	57	61	46	40	44
Forest - Nontimber	73	75	76	75	75
Protected Areas	138	153	149	149	157
Nonrenewable	**728**	**1,513**	**1,917**	**1,680**	**1,334**
Energy	716	1,474	1,745	1,530	1,216
Minerals	13	38	172	150	118

Source: Authors' calculations.

15 Peszko et al., (2019). (Forthcoming) *Beyond Stranded Assets: Climate Strategies of Fossil-Fuel Dependent Countries.* World Bank.

16 The worst-case scenario arises when the rest of the world applies a unilateral carbon tax combined with a Nordhaus tax on the border. A Nordhaus tax is a flat 10 percent tariff on all imports from non-cooperating FFDCs, irrespective of the carbon content of imported products.

Forest ecosystem services

When estimating the wealth of a nation's forests, the valuation of forest timber is a straightforward assessment given the readily available market prices and production information. But timber revenues are not the only contribution forests make. The benefits of nontimber forests such as minor forest products, hunting, recreation, and watershed protection are significant and not usually accounted for, which leads to the undervaluation of forest resources. CWON 2018 featured new estimates of nontimber forest wealth, detailed in Appendix 1. The annual value of nontimber forest ecosystem services is estimated by multiplying total forest area in a given year by the sum of the per hectare monetary values for the three benefit categories: nontimber forest products; recreation, hunting, and fishing; and watershed protection. The capitalized value of nontimber services is equal to the present value of annual services, discounted into the future. This methodology was used in the analysis thus far and for the overall total wealth figures reported.

A 2015 WWF report provided specific monetary values of ecosystem services for Russia for a broad range of services including climate control, water regulation, soil protection, assimilation, bioproduction, bioresource, biodiversity protection, and recreational services. Additionally, the value of carbon sequestration is estimated using Russia's data on net emissions/removals from LULUCF (land use, land-use change, and forestry) valued at a conservative estimate of the social cost of carbon. As a point of comparison, the existing CWON values of nontimber forest products are replaced with these country estimates (which were four times higher in 2017), resulting in the stacked bar shown in Figure 21. The red line provides a reference to total natural capital using the CWON nontimber forest values. Using Russia's estimates of ecosystem service values and including the value of carbon sequestration, its natural capital would increase by 13 percent in 2017.

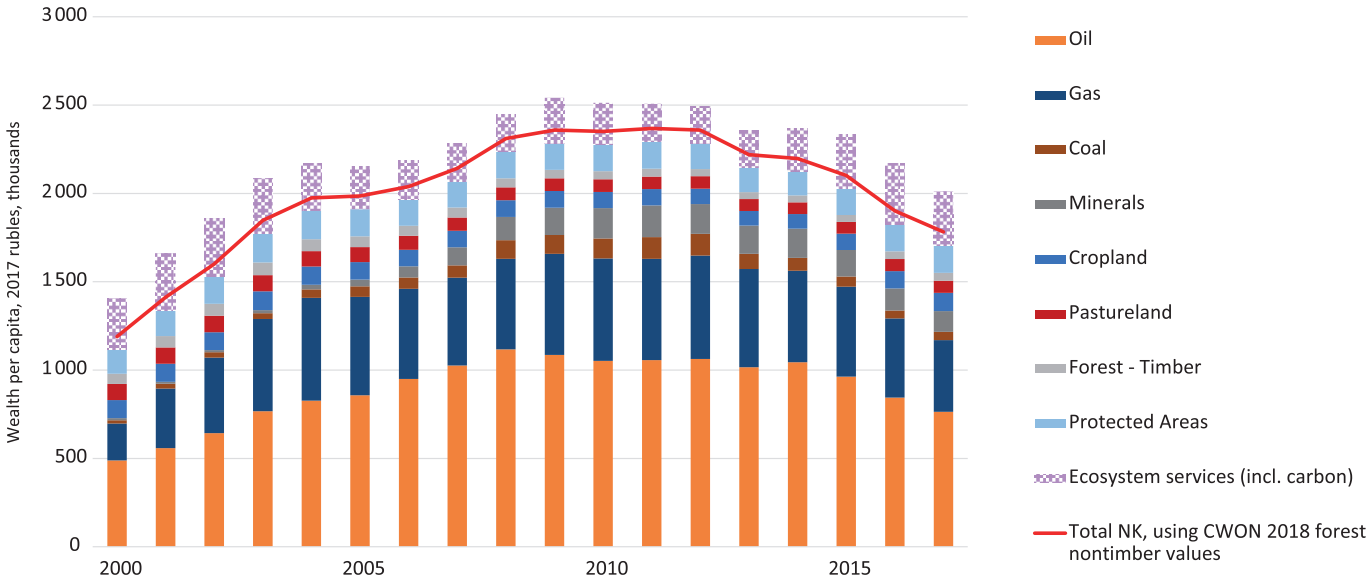
The driving factor behind the higher nontimber forest value is the value of carbon sequestration, which makes up more than 70 percent of the total ecosystem service value. The forests of the European part of Russia absorb as much CO_2 as the forests of Finland, Germany, Poland and other European countries; the absorption in the forests of Siberia are comparable to the absorption in the forests of Canada, and the estimates of absorption in the forests of the North Caucasus region even exceed the absorption in forests of the same climatic zone in the USA.[17] Russia's forests (excluding reserve forests) provided absorption of more than 638 million tons of CO_2equiv in 2017,[18] which can be roughly valued at 30,000 billion rubles.[19] While recognizing the global public good of Russia's forests for its carbon sequestration, an important caveat needs to be acknowledged: the sequestration value of Russia's forests is the value of the global public good while the economic return to Russia is only a fraction of it unless the rest of the world is willing to pay for carbon sequestration services.

17 Source in Russian: https://ria.ru/20190718/1556632466.html

18 Russian Federation, (2019), National Inventory Report (NIR), page 245.

19 This is the net present value of future annual sequestrations for the life of the forest, using a conservative social cost of carbon of US$ 33 per ton CO2 eq emitted in 2017 at 2017 prices. The estimation is sensitive to assumptions of the lifetime, discount rate, and future carbon sequestration levels and prices.

Figure 21. Including carbon sequestration and other ecosystem services, Russia's natural capital would increase by 13 percent (*Russia's natural capital per capita including a broader range of ecosystem service values*)



Source: Authors' calculations.

Though renewable resources make up a smaller share of Russia's total natural capital, and indeed they are underestimated in this analysis due to missing data on resources such as water and fisheries, they are an important asset with their own management challenges and policy applications. Recent forest fires in Russia are a case in point (Box 3).

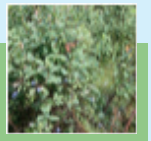
Box 3: Forest fires adversely affect Russia's health and wealth

Forest and extreme wildfires fires lead to a variety of economic, social, and environmental costs for national economies (Figure B3-1). In the wealth accounting framework used in this report, forest fires could reduce the values of timber and ecosystem services.

Figure B3-1. Economic, environmental, and social costs of forest fires

Economic costs of forest fires

- Foregone loss of timber value
- Destruction of infrastrucuture and equipment in forestry sector and other sectors (e.g. agriculture, and tourism)
- Forgeone loss in production revenue of other sectors (agriculture, tourism)
- Reduction in business transactions
- Foregeone loss of timber trade, NTFPs trade
- Reduced flights due to poor visibility
- Reduced terrestrial transport due to poor visiblity
- Fire-fighting costs
- Additional human resource mobilization
- Evacuation costs



Environmental costs of forest fires

- Biodoversity losses
- Costs of reforestation after fires
- Ecosystems services damage
- Carbon costs

Social costs of forest fires

- Health impacts (respiratory issues,chronic deseases worsen; lower foetal and infant survival rates)
- Deaths of forest guards, firefighting team members
- Anger, sadness, and fear of people affected by the forest fires
- Schools closed; lost productivity of teachers

In Russia, home to 20 percent of the world's forest resources, fires are the main factor driving forest loss. Between 2015-2018, Russia's Federal Forestry Agency reported a 2.4 fold increase in fires on both forest and non-forest lands[20]. And according to Greenpeace estimates, the average annual loss of forests due to fires is equivalent to a territory the size of Germany[21].

The critical forest fire situation emerged in Siberia and the Urals in the course of summer 2019. As of July 25, 2019, official FFA data reported that the territory affected by forest fires exceeded 3 million hectares (of which 1,259 thousand hectares are in Yakutia, 1017 thousand hectares in the Krasnoyarsk Territory, and 731 thousand are in the Irkutsk Region). According to distant monitoring data, these three subjects of the Russian Federation now account for about 95 percent of the total area of forest fires burning in Russia.

The zone of smoke caused by these fires also includes all or almost all regions of Siberia and part of the Urals. The largest Siberian cities – Krasnoyarsk, Novosibirsk, Barnaul – are covered in thick smoke. As of mid-August 2019, the situation remained critical in the regions of Irkutsk Oblast, Krasnoyarsk Territory, Buryatia, and Yakutia[22].

This situation is affecting the carbon sequestration potential of Russia's forests. According to 2017 calculations by Russian scientists[23], the forests of Chukotka, Magadan Oblast, and Tyva are characterized by low growth rates and large fire areas, causing them to become net carbon emitters rather than absorbers. In general, Russia's forests (excluding forests in protected areas) provided for the absorption of more than 638 million tons of CO2equiv in 2017.

Russian forest fires not only damage ecosystems and increase emissions, they also lead to economic losses. As of 2018, the economic damage of forest fires, as reported by the FFA, was RUB 16.9 billion (in 2017, this figure was RUB 25.2 billion and in 2016 it amounted to RUB 23.7 billion). The observed reduction of economic losses is not necessarily linked to the decrease in the number of forest fires but rather due to a change in the methodology applied by FFA to forest fire management. Overall, the forestry sector in Russia is characterized as a deficit for the federal budget. Total federal revenue in 2018 was RUB 29.5 billion, while the federal expenditures line was RUB 32 billion. Scarce financing of forest management complicates efforts to fight or prevent forest fires. A new national priority project, "Ecology", to be implemented from 2019-2024, targets forest protection. It aims to decrease losses from forest fires from RUB 32.3 billion to RUB 12.5 billion in 2024 and increase the ratio of logged/damaged forests to reforested land from 62 percent in 2018 to 100 percent in 2024.

Another area that can help build Russia's natural capital is green finance.[24] The green finance agenda has been gaining momentum in Russia with various approaches and instruments being discussed by groups of public and private stakeholders. A dedicated working group on green finance and ESG investing was established under the Central Bank of Russia. More recently, the Moscow Exchange established a dedicated Sustainable Development segment with three sub-sections, including (i) green bonds, (ii) social bonds and (iii) national projects, to support financing under the national priority projects, including the one on Ecology. While these are very important steps towards developing markets for green finance, these efforts remain fragmented and do not fully contribute to a coherent development of green finance in Russia. While the importance of installing green finance in Russia has been well established, the holistic approach towards market development is still

20 Ministry of Natural Resources and Ecology of Russia, (2019), State Environment Council Report, pages 178-182.

21 Greenpeace, "Forest Fires in Russia." Source in Russian: https://greenpeace.ru/projects/pozhary-na-prirodnyh-territorijah/

22 Source in Russian: https://ria.ru/20190818/1557604418.html

23 Source in Russian: https://ria.ru/20190718/1556632466.html

24 'Green finance' is defined as "financing of investments that provide environmental and climate benefits in the broader context of environmentally sustainable development" (G20 Green Finance Group). These environmental benefits include, for example, reductions in air, water, and land pollution; improved energy efficiency; and mitigation of and adaption to climate change. Green finance involves efforts to internalize externalities and adjust risk tolerance in order to boost environmentally-friendly investments and reduce those that are environmentally damaging.

lacking Development of green finance requires a set of national strategic documents, special policies, and implementing rules that will encourage market stakeholders to advance the transition towards greening the economy.

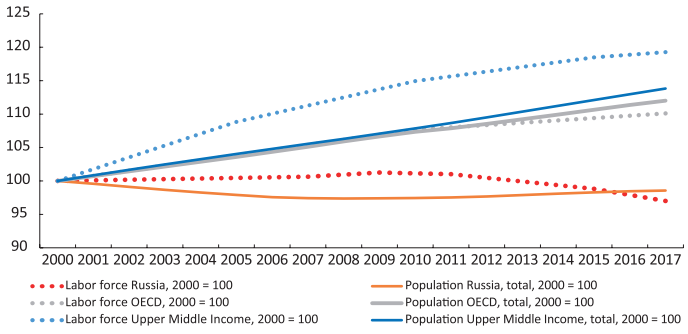
To address existing impediments to green finance development, Russia should consider a more comprehensive, consistent, and coordinated approach. This includes the following key elements, which are essential building blocks for wider action: (i) revisiting climate change commitments, environmental and sector-specific targets, and assessing financing needs by sector (e.g. green buildings, clean transport, renewable energy, waste management, sustainable agriculture, etc.); (ii) identifying a national green finance champion and establishing a coordination body represented by the key stakeholders; (iii) developing a green finance roadmap and corresponding action plan; (iv) exploring the potential impact of climate change and the low-carbon transition on macroeconomic and financial stability; (v) incorporating a green agenda in public policy institutions' mandates and public procurement; (vi) establishing an evaluation and measurement system, and tracking progress towards objectives; and (vii) raising awareness about green finance and building capacity at all levels (federal and regional policy makers, financial sector participants, etc.). [25]

Renewable resources are unique in that, if managed sustainably, they can produce benefits in perpetuity. Improvements in the productive use of renewables can increase the benefits they generate and consequently increase the value of these assets even if the land area does not increase or even decreases. Also, one of the characteristics of renewable natural assets is that they often provide multiple services such as crop pollination or protection from natural hazards. The sustainable management of renewable resources ensures that these assets can continue to produce these important ecosystem services for years to come.

Human Capital

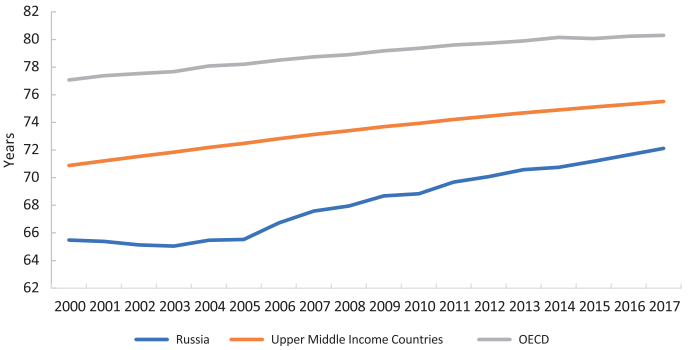
Demographic trends in Russia have been worse than in other upper middle-income countries. In the period 2000 – 2017, Russia's population decreased by 1.4 percent, although the declining trend ended in 2009 and the population has stabilized since then (Figure 22). Meanwhile, OECD and upper middle-income countries registered an increase in population numbers in that period. Population mortality is relatively high in Russia: life expectancy is lower than in upper middle-income countries and OECD countries (Figure 23). The working-age population in Russia slightly increased in 2000 – 2009, resulting in a certain demographic dividend for Russia. Yet, the working-age population has been decreasing since 2010. This, combined with an ageing population (the share of the population above 65 years has been growing since 2012), are projected to weigh on Russia in the medium to long term.

Figure 22. Population in Russia decreased in the period 2000 – 2017



Source: WDI, World Bank.
Note: 2000 year = 100%.

Figure 23. Life expectancy in Russia, though increasing, remains lower than in other upper middle-income countries



Source: WDI, World Bank.

25 World Bank, (2018), *Russia Green Finance: Unlocking opportunities for green investments*.

Human capital wealth is defined as the present value of future earnings for the labor force, explained in more depth in CWON 2018. The concept of human capital wealth differs from that of human development or human capabilities. The term "capital" denotes a resource that can be used for economic production. A good education has an intrinsic value apart from the fact that it helps workers be better paid. Good health is also beneficial in itself, independent of its impact on production and wages. While these important benefits are acknowledged, they are not part of the accounting methodology. The emphasis is deliberately and solely on the economic benefits of a productive labor force.

The CWON estimates of human capital wealth implement the well-known Jorgenson-Fraumeni lifetime earnings approach (Jorgenson and Fraumeni 1989, 1992a, 1992b)[26]. This factors in education and skills as well as experience and the likelihood of labor force participation at various ages. The estimates rely on data from national household surveys provided to the World Bank's International Income Distribution Database, and they use regression analysis to compute expected earnings for the labor force (ages 15 to 65). These estimates are calibrated to compensation of employees in the national accounts. The detailed information available in household surveys and the Penn World Table 9.1[27] estimates of labor share of GDP allow for the disaggregation of human capital wealth by gender and employment status over more than 30 years. For this analysis, Russia's household surveys from 2010-2016[28] are used, where the maximum number of years of schooling is 21. Underlying these human capital wealth estimates are estimations of the returns to education and experience (Mincer coefficients), derived from Russia's household survey data. The Mincer earnings function is a very simple model that explains wage income as a function of schooling and experience. In 2016, the returns to education were estimated at a little over 7 percent for both males and females; this was down from the 8 percent estimated in 2010.

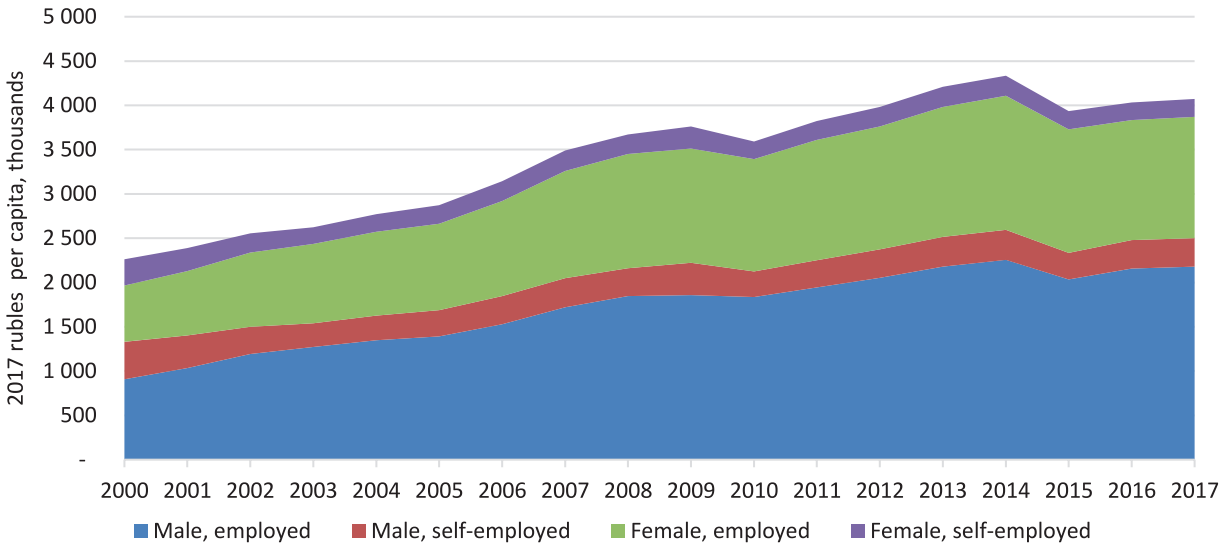
Figure 24 shows Russia's human capital wealth per capita from 2000 to 2017. Overall, with the exception of a few drops or slowdowns (such as during the global financial crisis), Russia's human capital has grown steadily over this period. Its human capital wealth per capita increased by 80 percent from 2000 to 2017, but the more rapid growth occurred in the first decade: From 2000 to 2010, the average annual growth rate of human capital wealth per capita was 4.7 percent, but the average annual growth rate dropped to 1.8 percent from 2010 to 2017. Human capital wealth per capita dropped by 9 percent in 2015 on the back of the economy's adjustment to the new norm of lower oil prices and economic sanctions. In 2016 – 2017, human capital wealth recovered somewhat, but its level was still 6 percent lower than in 2014.

26 Employing the same Jorgenson-Fraumeni lifetime income approach, a study provided the domestic literature's first valuation of Russia's human capital (Kapeliushnikov 2015). The author estimated Russia's human capital was more than 600 trillion rubles (6 million rubles per capita) in 2010; this exceeded the country's GDP by a factor of 13 and its physical capital by a factor of 5.5. In real terms, human capital doubled from 2002 to 2010. These numbers are higher than the value of human capital estimated in this CWON-based report.

27 Robert C. Feenstra, Robert Inklaar, and Marcel P. Timmer, (2015), «The Next Generation of the Penn World Table,» American Economic Review, 105(10), 3150-3182, available for download at www.ggdc.net/pwt

28 Russia's household surveys for the years prior to 2010 were dropped due to the questionnaire not including post-secondary years of education.

Figure 24. Russia's human capital per capita increased by 80 percent over the past two decades but has slowed down in recent years (*Russia's human capital wealth per capita, constant 2017 rubles, thousands*)



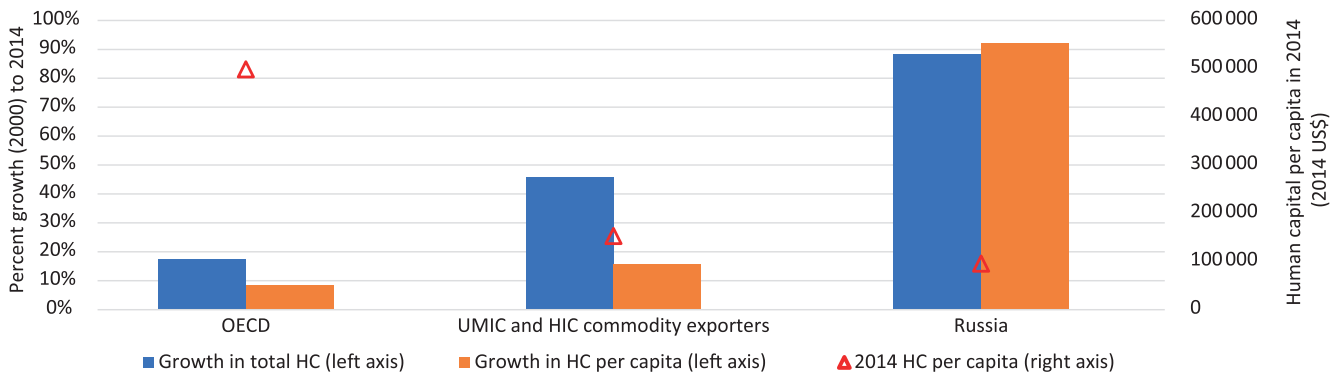
Source: Authors' calculations.

As is the case in other upper middle-income and high-income countries, Russia's formal labor sector comprises the largest portion of human capital wealth. The self-employed share of total human capital decreased from over 25 percent in 2000 to around 13 percent in 2017; the estimate of self-employed human capital is derived from the mixed income data in Russia's national accounts and the Penn World Table methodology.

The share of female human capital remains a steady portion of total human capital wealth, around 39-41 percent over this period. This result is on par with the averages in other upper-middle and high-income countries.

Figure 25 compares the growth in Russia's human capital, both in total and per capita terms, to OECD countries and commodity exporters from 2000 to 2014. Russia's growth in human capital dwarfed the levels among OECD countries and other commodity exporters during this period, with growth in human capital per capita at 92 percent compared to the OECD average of 9 percent and the 16 percent among commodity exporters. However, despite Russia's impressive growth in human capital, its level of human capital wealth per capita was more than five times smaller than the OECD average in 2014.

Figure 25. Despite significant growth in human capital, Russia's human capital wealth per capita is one-fifth the OECD average
(*Growth and per capita levels of human capital, Russia and benchmark countries, 2000 to 2014*)



Source: Authors' calculations.

Box 4: World Bank's Human Capital Index: How does Russia fare?

The World Bank Group has launched the Human Capital Project (HCP)[29] to raise awareness and increase demand for interventions to build human capital. It aims to accelerate investments in people. The Project has three elements: (i) the Human Capital Index, (ii) a program to strengthen research and measurement on human capital; and (iii) support to countries to accelerate progress in raising human capital outcomes. The Human Capital Index (HCI) is a composite of the following indicators: probability of survival to age 5, expected years of school, harmonized test scores, learning-adjusted years of school, adult survival rate, and fraction of children under 5 not stunted. HCI does not measure actual earnings; rather, it captures factors that are important for labor productivity and can be seen as complementary to the economic value of human capital reported in the wealth accounts.

Russia's overall HCI rank is 34 out of 157. The HCI results for Russia place the country consistently in the top quartile of all countries for all indicators *except for adult survival rate*, where Russia's rate is well below its peers and income group, and it lies in the bottom quartile.

Impact of higher adult survival rates

Considering the HCI findings in the context of the CWON human capital methodology, the implications of lower adult survival rates mean that Russia's human capital wealth, as measured by lifetime earnings, is lower than it could be if the appropriate investment and actions that lengthen the average lifespan are made. In order to understand the impact of survival rates in human capital wealth calculations, Swiss survival rates are hypothetically imposed on all other countries (Swiss life expectancy is among the highest globally). As expected, the impact is minimal for high-income countries, as well as the East Asia, Europe, and Central Asia regions (less than 2 percent).

However, for Russia, the impact of replacing its survival rates with Swiss data results in human capital wealth that is 6 percent higher – a much higher impact than its regional and income group averages. Though this analysis is a simple exercise, it clearly points to health policy applications; policies targeted at increasing adult health outcomes and thus increasing life expectancy could increase Russia's human capital and overall total wealth.

What can be done to improve Russia's human capital wealth?
The following policy measures could increase Russia's human capital:

Further develop the country's university education potential. Russia possesses a strong cadre of university-educated professionals, but Russian universities lag behind those in other countries. For instance, Russia does not yet have a university in the top 100 in the world. Although the situation is improving, with some department and discipline level rankings now including Russian universities, the potential is high for Russia given its strong K-12 education system. Primary school level rankings (PIRLS) show Russia at the top and high school rankings (PISA) place Russia around the OECD average. The Russian Government has long invested in programs to support quality improvements in universities, and these programs need to be continued and deepened. The National Research University – Higher School of Economics (NRU-HSE), a fast-rising Russian university that has established a name for itself within about two decades, is a case in point.

Improve the quality and relevance of vocational education and support stronger relationships with employers. Vocational education continues to attract a large stream of Russian students – post-secondary vocational programs enrolled about 40 percent of graduates in 2018 (compared to about 60 percent students in university programs). Improving the quality and relevance of vocational education can help. This includes not only updating the curriculum and providing relevant infrastructure, but also supporting stronger relationships with employers. The motivation and selection of students into vocational programs is an important factor determining the future productivity of workers. The Russian Government has made a significant push with support for the World Skills Program, which seeks to enhance the public image of vocational skills for young people through prestigious domestic and international competitions.

29 The World Bank, "Human Capital Project": www.worldbank.org/humancapitalproject

Reform the education system towards so-called 21st century skills such as collaborative problem-solving skills, communication, and creativity. Russia may have a significant advantage in this regard due to significant endowments and government expenditures in the field of extra-curricular education; for instance, in Kvantoriums and technoparks. Extra-curricular education already incorporates the model of interest-based learning and project-based learning that is at the core of 21st century learning. Coding and robotics are avenues to develop computational thinking abilities that some experts say will be fundamental in the future.

Reduce high mortality rates in Russia, in particular among working-age adults who are most at risk from cardiovascular diseases and cancer. Despite recent gains in life expectancy, Russia trails countries with lower income levels. In Russia, life expectancy at birth was 72.1 years in 2017—below that of Brazil (75.7) and China (76.4), countries with lower per capita incomes. Male life expectancy is only 67.1 years, and there is a 10-year gap between male and female life expectancy. Currently, Russia has an ambitious goal of raising life expectancy to 78 years by 2024 and 80 years by 2030. Perhaps the greatest improvement would come from increasing reliance on primary health care and emphasizing disease detection, prevention, and management (for example, by improving access to out-patient drugs for high blood pressure and cholesterol). Continuing efforts to encourage healthier behavior through health promotion efforts and higher tobacco and alcohol taxes would also contribute to this goal. At the same time, better coordination between professionals and organizations working in primary, secondary, and tertiary care could improve outcomes for patients with chronic diseases.

Increase health care efficiency and financing. In 2017, public health spending in Russia was 3.1 percent of GDP, significantly lower than the OECD average of 6.5 percent. Russia's health care delivery system needs to be adequately and efficiently funded, but that cannot come at the expense of fiscal sustainability. It will thus be vital for Russia to allocate increased financial resources for health spending more efficiently, with a focus on preventive care and outpatient services. Given the uneven health outcomes between genders and across regions, progress will require targeted measures, greater attention to improving local capacity for service delivery, and more equitable health financing.

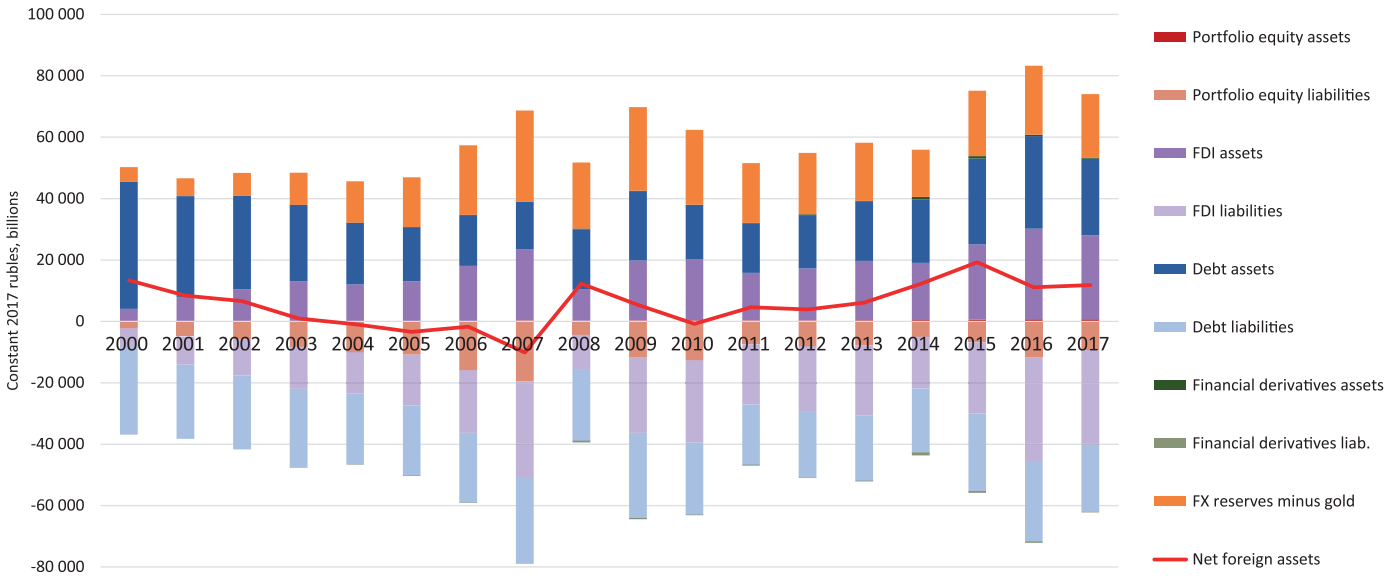
Net Foreign Assets

Net foreign assets (NFA) are a measure of the cross-border assets and liabilities held by a country's residents, both private and public sector. NFA captures a country's external asset position and is calculated as total foreign assets minus total foreign liabilities. Total foreign assets include portfolio equity assets, foreign direct investment (FDI) assets, debt assets, financial derivative assets, and foreign exchange reserves (excluding gold); similarly, total foreign liabilities include portfolio equity liabilities, FDI liabilities, debt liabilities, and derivative liabilities. Estimates of NFA are obtained from the updated and extended version of the IMF's External Wealth of Nations Mark II database developed by Lane and Milesi-Ferretti (2018).[30] For Russia, the Lane and Milesi-Ferretti database draws on International Investment Position data as reported by the IMF's Balance of Payments Statistics and International Financial Statistics.

Figure 26 shows the estimates of Russia's net foreign assets from 2000 – 2017, with the bar graphs providing the assets and liabilities and the line graph showing the resulting net foreign assets of the country. NFA was declining and even negative in the late 2000s, but it has been steadily increasing from 2011 to 2017. In 2017, total NFA was estimated at 11,800 billion rubles and NFA per capita was 80 thousand rubles. Regarding the drivers of NFA growth, while debt assets used to be the largest asset in the early 2000s, recent years show a more balanced composition between FDI assets (dark purple), debt assets (dark blue), and FX reserves minus gold (orange).

30 Philip R. Lane, and Gian Maria Milesi-Ferretti, (2018), «The External Wealth of Nations Revisited: International Financial Integration in the Aftermath of the Global Financial Crisis,» IMF Economic Review 66, 189-222. Data edition: January 11, 2019.

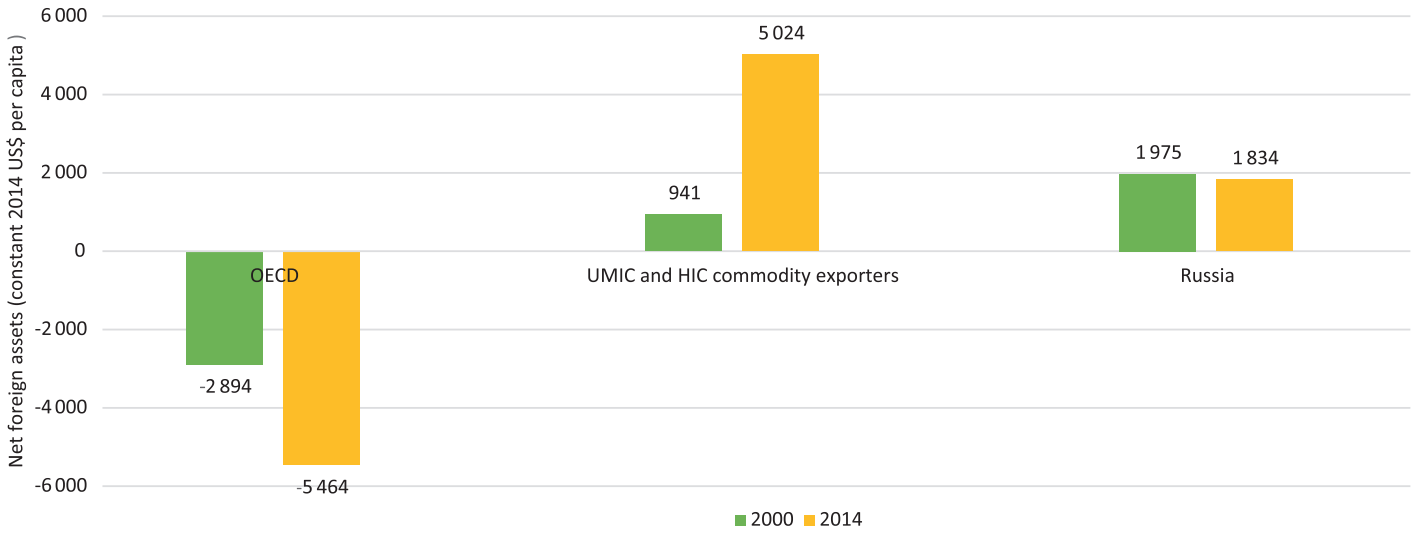
Figure 26. Russia's net foreign assets have been positive and steadily increasing in recent years
(*Russia's net foreign assets, constant 2017 rubles, billions)*



Source: IMF, External Wealth of Nations database.

Net foreign assets are generally negative in countries of all income groups except high-income non-OECD countries, reflecting the predominance of the oil producers as net creditors to the world. Russia certainly fits into this trend. Shown in Figure 27, while OECD countries on average are net borrowers to the rest of the world, both Russia and other commodity exporters have positive net foreign assets.

Figure 27. Similar to other commodity exporters, Russia is a net creditor to the rest of the world
(*Net foreign assets, Russia and benchmark countries, 2000 to 2014)*



Source: Authors' calculations using the IMF's External Wealth of Nations database.

IV. Discussion and Directions for Future Work

In summary, Russia experienced strong growth in wealth from 2000 to 2017. However, its total wealth per capita is more than three times lower than the OECD average and even lags the averages of other upper middle-income and high-income commodity exporters. Additionally, Russia's total wealth per capita has fallen from its 2014 peak and leveled off in recent years, primarily due to stagnant growth in human capital and a large decline in the value of oil and gas, resulting from the fall in global prices.

Russia's dependence on its nonrenewable assets as a driver (or drag) on wealth creation poses a specific development challenge: Carbon-based wealth (oil, gas, and coal) is facing increased risk due to future price uncertainty, advances in alternate energy technologies, and large-scale attempts at global decarbonization to slow climate change. These risks may diminish the value of carbon-based assets and undermine traditional development pathways for carbon-rich nations. Mitigating these risks will require countries like Russia to diversify their total wealth portfolio and large investment choices away from carbon, including belowground natural capital (oil, gas, coal) and the associated aboveground physical and human capital, towards other productive assets.

To maximize the return on wealth, policies to rebalance Russia's wealth portfolio are needed. Specifically, given the significance of human capital in Russia's overall wealth, a sustained policy focus on both increasing its share (by reducing the share of nonrenewables) and increasing returns on the stock of human capital wealth will help. And even though renewable resources make up a smaller share of Russia's natural capital (they are also underestimated), they are unique in that, if managed sustainably, they can produce benefits in perpetuity. This is important for future generations especially because wealth and income in Russia are at risk from the low-carbon transition. Thus, polices that address the problematic issue of stranded assets of Russia's fossil fuel sector become imminent.

This work just scratches the surface of the amount of data collection and analysis that could be carried out for a country like Russia—large in its economy, population, and physical land. Given Russia's spatial disparities, analysis at the regional level would provide deeper insight into the challenges and policy applications for specific regions. The wealth data and methodology could also be more customized to Russia's national sources and context, although this would make international comparisons less relevant.

Wealth can change for many reasons a deeper analysis of why and how asset values change over time would provide more guidance on how to interpret these changes. Two such analytical approaches include:

- Decomposition analysis disaggregates changes in asset value change in volume and change in unit value. The World Bank is currently developing an online tool for decomposition analysis as a companion to the wealth database, which will be available in 2020.
- Total Factor Productivity (TFP) is useful to assess whether growth is the result of real productivity gains or not. OECD has developed a TFP approach that goes beyond the usual 2-factor (produced capita and labor) approach to include natural resources (OECD 2017). Some OECD countries grew almost exclusively through productivity gains, while others have relied much more on increased use of labor, produced capital and natural capital.[31]

Future work would also benefit from the results of the next CWON 2020 report, allowing for the benchmark assessment to include the year 2017, therefore capturing the impact and comparisons of the drop of oil prices on other commodity exporters. Additionally, the ongoing research and efforts to improve the valuation and measurement of renewable assets in CWON 2020 would help inform the current methodology used in this study.

31 In CWON 2018 (op. cit.), the World Bank applied the OECD methodology. Over the period 2004 to 2014, annual productivity gains in Russia averaged 3.4%, but only 3.2% when natural capital was included in the TFP analysis. However, the 2018 analysis does not make use of the detailed country-specific data developed for this report.

V. Appendices

Appendix 1. Summary of Methodology and Data Sources

This appendix summarizes the data and methods behind the comprehensive wealth estimates. The methodology builds on the foundation laid in previous work by the World Bank, including *Expanding the Measure of Wealth* (World Bank 1997), *Where Is the Wealth of Nations?* (World Bank 2006), *The Changing Wealth of Nations* (World Bank 2011), and *The Changing Wealth of Nations 2018* (Lange et al., 2018).

The following sections provide an overview of the methodology and data sources for estimating wealth as reported in CWON 2018, as well as additional information relevant to the calculations of Russia's wealth estimates. Detailed documentation of the data and methodology for CWON 2018 are available on the wealth accounting page of the World Bank website: https://datacatalog.worldbank.org/dataset/wealth-accounting

The results for Russia (years 2000-2017) are reported in constant 2017 rubles, at market exchange rates. For international comparisons, Russia's results are reported in constant 2014 US dollars, at market exchange rates.

Total wealth

A nation's wealth consists of a diverse portfolio of assets, which together form the productive base of the national economy. These assets include:

Natural capital—comprising energy (oil, natural gas, and coal), minerals, agricultural land (cropland and pastureland), protected areas, and forests (timber and some nontimber forest products);

Produced capital—comprising machinery, structures, equipment, and urban land;

Human capital—including the knowledge, skills, and experience embodied in the workforce;

Net foreign assets—including portfolio equity, debt securities, foreign direct investment, and other financial capital held in other countries.

Total wealth is calculated by summing up each component of wealth:

$$Total\ wealth = Natural\ capital + Produced\ capital + Human\ capital + Net\ foreign\ assets$$

Natural capital

A few assumptions are applied to the valuation of natural resources that should be highlighted up front. First, in calculating the net present value, a discount rate of 4 percent is used across all resources and years. Additionally, resource rents are assumed to remain constant in future years unless otherwise specified. This approach is supported by the System of Environmental-Economic Accounting (SEEA) in the absence of the ability to project future prices and extraction paths.

Second, a country-specific GDP deflator is used for all wealth components to bring the values to constant terms. The GDP deflator is a broad deflator that reduces price effects but may not eliminate all capital gains (or losses) that would be captured if a commodity-specific price deflator were to be applied.

Finally, the comprehensive wealth database draws on publicly available, global data sets. Although this approach has its limitations compared with country-specific assessments, it allows for consistency in cross-country analyses. Also, to maximize country coverage and gap-fill missing data, regional averages are often applied (specified below).

Energy and mineral resources

Nonrenewable resources valued in the World Bank wealth accounts include fossil fuel energy and mineral resources. The value of a nation's stock of a nonrenewable resource is measured as the present value of the stream of expected rents that may be extracted from the resource until it is exhausted. This value, V_t, is given as

$$V_t = \sum_{i=t}^{t+T-1} \frac{\overline{R_t}}{(1+r)^{i-t}}$$

where $\overline{R_t}$ is a lagged, five-year moving average of rents in years t (the current year) to t – 4; r is the discount rate (assumed to be a constant 4 percent), and T is the lifetime of the resource. Rents in the current year are calculated as

$$R_t = \pi_t q_t$$

where π_t denotes unit rents, equal to revenues less production costs including a "normal" rate of return on fixed capital and the consumption of fixed capital; and q_t denotes the quantity of the resource extracted. Rents are converted into constant US dollars at market rates using country-specific GDP deflators before averaging to obtain $\overline{R_t}$. The present value of rents from energy and mineral resources is estimated under the restrictive assumption that rents remain constant in future years.

The fossil energy resources valued in the World Bank wealth accounts are petroleum, natural gas, and coal. Metals and minerals valued in the wealth accounts comprise bauxite, copper, gold, iron ore, lead, nickel, phosphate rock, silver, tin, and zinc.

Data sources

As noted, the value of a nation's stock of energy resources is calculated as the present value of expected rents that could be obtained over the lifetime of the resource. Calculating the present value of future rents requires data for annual production, prices, production costs, and reserves. From existing reserves and current rates of production, the time to exhaustion of the resource is assumed. Data sources for implementing and estimating each of these elements are listed in Table A.1.

Table A.1 Data sources for energy and mineral resources

Resource	Indicator	Data sources and notes
Oil and natural gas	Production	Rystad Energy, UCube (upstream database) International Energy Agency (IEA) BP, Statistical Review of World Energy US Energy Information Administration, International Energy Statistics UN Statistics Division, UN Monthly Bulletin of Statistics Production data from different sources are selected following a few decision rules such as best coverage over time and median values among estimates. For Russia, BP's data on production were used.
Oil and natural gas	Unit rent	Rystad Energy, UCube (upstream database) The country data from Rystad Energy on unit revenues and costs for oil and natural gas are used to calculate average rental rates by region. Average rental rates are weighted by production.
Oil and natural gas	Proven reserves	BP, Statistical Review of World Energy US Energy Information Administration, International Energy Statistics For Russia, BP's data on proven reserves were used.
Coal	Production	IEA, World Energy Statistics US Energy Information Administration, International Energy Statistics UN Statistics Division, UN Monthly Bulletin of Statistics Coal production is standardized on the basis of heat content and is broken down into two general categories: hard coal and brown coal. For Russia, IEA's data on production were used.
Coal	Unit cost	Wood Mackenzie, Global Economic Model database Case studies from various sources World Bank, Manufactures Unit Value Index, Global Economic Monitor Commodities database
Coal	Unit price	World Bank, Global Economic Monitor Commodities database Government of Australia, Office of the Chief Economist, Department of Industry, Innovation and Science, "Resources and Energy Quarterly" IEA, Coal Information (Paris, OECD: various years) Country-level estimates of unit production costs and prices are then used to calculate average rental rates by region for thermal and metallurgical (coking) coal. Average rental rates are weighted by production.
Coal	Proven reserves	US Energy Information Administration, International Energy Statistics BGR (German Federal Institute for Geosciences and Natural Resources), "Reserves, Resources, and Availability of Energy Resources" (2015) For Russia, US EIA data on proven reserves were used.
Metals and minerals	Production	US Geological Survey (USGS), Minerals Yearbook USGS, Mineral Commodity Summaries British Geological Survey, World Mineral Statistics
Metals and minerals	Unit cost	Country-specific case studies from various sources; assumed to be representative for the region World Bank, Manufactures Unit Value Index, Global Economic Monitor Commodities database

Resource	Indicator	Data sources and notes
Metals and minerals	Unit price	World Bank, Global Economic Monitor Commodities database Unit rents are calculated directly per country.
Metals and minerals	Proved reserves	USGS, Mineral Commodity Summaries and Minerals Yearbooks, various years

Forest resources: Timber

The predominant economic use of forests has been as a source of timber. Timber resources are valued according to the present discounted value of rents from the production of roundwood over the expected lifetime of standing timber resources. This value, V_t, is given by the following equation:

$$V_t = \sum_{i=t}^{t+T-1} \frac{\bar{R}_t}{(1+r)^{i-t}}$$

where $\overline{R_t}$ is a lagged, five-year moving average of rents from timber in years t (the present year) to t – 4; r is the discount rate (assumed to be equal to 4 percent), and T is the lifetime of timber resources. Unlike metals and minerals, timber is a renewable resource, so the concept of sustainable use of forest resources is introduced through the choice of T. The lifetime of timber resources is determined by the rate of timber extraction (Q) relative to the rate of natural growth (N). If Q > N, then current rates of extraction are unsustainable, and the lifetime of the resource is limited. If Q ≤ N, then extraction is assumed to be sustainable, and the lifetime of the resource is taken as infinite. Rents from timber in year i are calculated as follows:

$$R_i = \pi_i Q_i$$

where Q_i denotes unit rents, equal to revenues less production costs, and denotes the quantity of roundwood extracted. Data and methods for estimating timber wealth are described in Table A.2. Rents are converted into units of constant US dollars at market rates using country-specific GDP deflators before averaging to obtain $\overline{R_t}$.

Table A.2 Data sources of forest timber resources

Indicator	Data sources and notes
Production	UN Food and Agricultural Organization (FAO), FAOSTAT database Roundwood production is the sum of coniferous industrial roundwood, nonconiferous industrial roundwood, and woodfuel.
Unit price	FAOSTAT database Unit price is proxied by export unit value. Regional averages are then used to help correct the observed volatility in prices at the country level.
Rental rate	Estimates by Applied Geosolutions (2016) A regional rental rate is applied to total revenues in the absence of country-specific production cost data. This rental rate additionally accounts for the price differential between export prices and domestic stumpage prices.
Life of resource	FAO, Global Forest Resources Assessment for data on total forest area and its breakdown, net annual increment, and growing stock of timber For Russia, forest area data from Rosstat were used.

Forest resources: Nontimber

Timber revenues are not the only contribution forests make. Nontimber forest benefits such as minor forest products, hunting, recreation, and watershed protection are significant benefits not usually accounted for, which leads to the undervaluation of forest resources. The Changing Wealth of Nations 2018 featured new estimates of nontimber forest wealth, based upon a meta-analysis study that predicts annual, per hectare values for each service category per country based upon a spatially explicit meta-regression model.

The annual value of nontimber forest ecosystem services is estimated by multiplying total forest area in a given year by the sum of the per hectare monetary values for the three benefit categories (nonwood forest products; recreation, hunting, and fishing; and watershed protection). The capitalized value of nonwood services is equal to the present value of annual services, discounted into the future. The present value of nontimber services is given by the following equation:

$$\mathrm{PV}(S) = S + \frac{S}{r}$$

where S is the sum of per hectare service values for the three benefit categories and r is the discount rate of 4 percent. Services received during the present year are not discounted. No distinction is made between natural and planted forest. Per hectare monetary values estimated for 2013 are assumed to be constant over time and are adjusted for inflation using country-specific GDP deflators. Also, values are estimated for the given year's forest area, assuming no change in forest cover in the future (see Table A.3).

Table A.3 Data sources for forest nontimber resources

Indicator	Data sources and notes
Total forest area	UN Food and Agricultural Organization, Global Forest Resources Assessment For Russia, forest area data from Rosstat were used.
Annual service values per hectare of forest	Unit values are as estimated by Siikamäki, Santiago-Ávila, and Vail (2015). Annual values equal the sum of recreation, hunting, and fishing; nonwood forest products; and watershed protection. For Russia, additional analysis was carried out using data on LULUCF net emissions (source: OECD), social cost of carbon (US$ 33 per ton CO2eq emitted in 2017), and preliminary specific monetary valuation of ecosystem services of natural landscapes in Russia presented in the 5th Russia National Biodiversity Project. (https://wwf.ru/upload/iblock/6d3/www_natdoklad_final.pdf)

Agricultural land

Agricultural land constitutes a considerable portion of total wealth in developing countries, particularly in the low-income group. For the purposes of the World Bank wealth accounts, agricultural land is conceptually divided into cropland and pastureland. There are potentially two alternative methods for estimating land wealth. The first method uses information from sales of land. The second method uses information on the annual flow of rents the land generates and takes the present value of such rents in the future. Given that information on land transactions is often missing, the second method is used. The value of cropland and pastureland, V_t, is calculated as the present value of returns to land using the following equation:

$$V_t = \overline{R_t} + \frac{\overline{R_t}}{(r-g)}$$

where $\overline{R_t}$ refers to the lagged, five-year moving average of the total value of rents from crop and livestock products in the present year t to year t – 4; r is the annual discount rate of 4 percent, assumed for all countries and years; and g is the annual rate of growth in agricultural productivity. For crops, a rate of 1.94 percent is assumed for g for all low- and middle-income countries, and a rate of 0.97 percent is assumed for g for all high-income countries. For livestock products, 2.95 percent is assumed for low- and middle-income countries and 0.89 percent for high-income countries (Rosengrant, Agcaoili-Sombilla, and Perez 1995). For Russia, the growth rates for developed (i.e., high-income) countries were used. Total rents R are converted

into units of constant US dollars at market rates using country-specific GDP deflators before averaging to obtain $\overline{R_t}$. The area of agricultural land is assumed to be constant; that is, wealth is estimated for the current area of land, not taking into account changes in the area of land (or land degradation) that may affect rents in the future (see Table A.4).

Table A.4 Data sources for cropland and pastureland

Item	Indicator	Data sources and notes
Primary crop and livestock	Production	FAO, FAOSTAT database Crop products span the categories of cereals, fibers, fruits, nuts, oil crops, pulses, roots, spices, stimulants, sugar, and vegetables. Livestock products span the categories of meats, milks, and other (for example, hides).
Primary crop and livestock	Prices	FAO, Value of Agricultural Production, Production, FAOSTAT database FAO, Producer Prices – Annual, Prices, FAOSTAT database Unit prices as reported in the FAO's estimates of the value of agricultural production are given priority, followed by the FAO estimates of producer prices. If country-specific data on prices are unavailable for a certain product, then regional or world averages are applied. Regional and world averages are weighted by production.

Rental rates

Rents are estimated for crops as

$$R_{c,k,t} = q_{c,k,t} \times p_{c,k,t} \times a_g$$

where $R_{c,k,t}$ represents rents in country c from crop k harvested in year t; $q_{c,k,t}$ denotes production for that individual country, crop, and year; $p_{c,k,t}$ denotes the unit price; and a_g is the average rental rate assumed for all countries and crops grown in region g. The rental rate a is equal to the ratio of (price – cost) / price. The rental rate is not given a t subscript because it is assumed to be constant over time. Estimates of rental rates are provided by Evenson and Fuglie (2010).

Rents from livestock products are different for livestock raised in extensive versus intensive production systems. Intensive systems are characterized by high output of animal products per unit surface area, and extensive systems use land areas of low production and under conditions of moderate grazing. Livestock rents are calculated as

$$R_{c,k,t} = \left(q_{c,k,t} \times p_{c,k,t} \times 2a_g\right)e_c + \left(q_{c,k,t} \times p_{c,k,t} \times a_g\right)(1 - e_c)$$

where R, q, p, and a are as defined above for crops; e_c is the share of livestock production in extensive systems for livestock products in country c; and $(1 - e_c)$ is the share of livestock production in intensive systems. For livestock raised in extensive production systems, the rental rate is assumed to be twice that for intensive systems. The same rental rates assumed for crop products are assumed for livestock products in intensive systems.

The share of livestock produced in extensive versus intensive systems is apportioned according to the percentage of ruminant meat produced in grazing systems, as estimated by the FAO for its Global Livestock Environmental Assessment Model. The FAO estimates the percentage of meat produced in grazing systems for 228 countries and other administrative regions. Where country-level estimates of meat production in grazing systems by the FAO are not available, regional averages of e are applied (weighted by the total area of pastureland).

Once rents are estimated for each crop and livestock product k produced by country c in year t, total rents from agricultural land are estimated by summing rents for all products k.

Protected areas

Areas protected for conservation and preservation of ecosystems provide a range of services to the country. For instance, wildlife reserves can generate significant revenues for developing countries, in particular from international tourism activities. And about one-third of the world's big cities get their drinking water from sources in or downstream of protected areas, saving billions of dollars in supply and treatment costs thanks to forests and wetlands that regulate the flow of water and remove contaminants (Dudley et al. 2010). Valuing such ecosystem services on a global basis, however, is difficult. For this reason, protected areas are valued in the World Bank wealth accounts using a simplified approach. Under this approach, the quasi–opportunity cost of protection per unit area of land contained in terrestrial protected areas is estimated as the lower of returns to cropland and pastureland. This is likely to be a lower bound on the true value of protected areas. Returns are capitalized over an infinite time horizon as

$$V_t = \left(\overline{R_t} + \frac{\overline{R_t}}{r}\right) A_t$$

where V_t is the value of protected areas in year t; $\overline{R_t}$ is the minimum of total rents per square kilometer of cropland and total rents per square kilometer of pastureland, averaged over a five-year period from year t to year t−4; and A_t is the area of land under protection in year t.

Data sources for the area of cropland, pastureland, and protected areas are listed in Table A. 5.

Table A. 5 Data sources for agricultural land and terrestrial protected land area

Element	Data sources and notes
Area of cropland and pastureland	World Bank, "Land area (square kilometer)" (AG.LND.TOTL.K2), World Development Indicators (WDI) database World Bank, "Agricultural land (% of land area)" (AG.LND.AGRI.ZS), WDI World Bank, "Arable land (% of land area)" (AG.LND.ARBL.ZS), WDI World Bank, "Permanent cropland (% of land area)" (AG.LND.CROP.ZS), WDI
Terrestrial protected area	World Bank, "Terrestrial protected areas (% of land area)" (ER.LND.PTLD.ZS), WDI World Bank, "Land area" (AG.LND.TOTL.K2), WDI database For Russia, protected area data from Rosstat were used.

Produced capital

Produced capital consists of manufactured or built assets such as machinery, equipment, and physical structures. Estimates of produced capital stocks in the World Bank wealth accounts also include the value of built-up urban land, which is valued as a mark-up on other produced assets.

Several estimation procedures can be considered for the calculation of physical capital stocks. Some of them, such as the derivation of capital stocks from insurance values or accounting values or from direct surveys, entail enormous expenditures and face problems of limited availability and adequacy of data. Other estimation procedures, such as accumulation methods and the perpetual inventory method in particular, are cheaper and more easily implemented since they require only investment data and information on the assets' service lives and depreciation patterns. These methods derive capital series from the accumulation of investment series and are the most popular. The perpetual inventory method is, indeed, the method adopted by most OECD countries that estimate capital stocks (Bohm et al. 2002; Mas, Perez, and Uriel 2000; Ward 1976). This method is also used in the estimates of capital stock.

For most countries, estimates of physical capital are obtained directly from the Penn World Table 9.0 database (Feenstra, Inklaar, and Timmer 2015). The Penn World Table authors use the perpetual inventory method to estimate produced capital stocks for 172 countries from 1970 to 2014.

For Russia, capital stock value data and asset structure were provided by Rosstat for the period 2011 – 2017 in the balance sheet and capital account with regards to fixed assets, compiled within the System of

National Accounts 2008 framework. Produced capital real growth rate time series was constructed on the basis of the Russia KLEMS database, which covers the period 2000 – 2014; for years 2015 – 2017, Rosstat real growth rates were used.

Urban Land

The produced capital estimates include the value of structures, machinery, and equipment, since the value of the stocks is derived (using the perpetual inventory method) from gross capital formation data that account for these elements. In the investment figures, however, only land improvements are captured. Thus, the final capital estimates do not entirely reflect the value of urban land.

Drawing on Kunte et al. (1998), urban land is valued as a fixed proportion of the value of physical capital. Ideally, this proportion would be country specific. In practice, detailed national balance sheet information with which to compute these ratios was not available. Thus, as in Kunte et al. (1998), a constant proportion equal to 24 percent is assumed:

$U_t = 0.24K_t$, where U is the value of urban land and K is the produced capital stock.

Human capital

The measures of human capital wealth rely on estimations conducted using household surveys; calibration of the results is based on the share of labor earnings in GDP in the national accounts. The first step in the analysis consists of estimating earnings regressions. An individual's age is denoted by a (from age 15 to 64) and years of schooling by e (from 0 to 24). Years of experience are approximated as $x = \max(0, a - e - 6)$ Mincerian wage regressions are estimated as

$$\ln(y_i) = \alpha + \beta_1 e_i + \beta_2 x_i + \beta_3 x_i^2 + \varepsilon_i.$$

On the basis of these regressions, a matrix of expected earnings is constructed. Each cell in the matrix accounts for wages earned by the population of age a and education level e. If is the number of workers of age and years of schooling , each cell in the matrix is defined as

$$H_{ae} = n_{ae}\exp(\beta_1 e + (\beta_2 + \beta_3 x_{ae})x_{ae}).$$

Total expected earnings from the survey are estimated as $T = \sum_a \sum_e H_{ae}$. For consistency with the national accounts, all cells in the matrix of expected earnings from the survey are scaled up or down by the ratio of labor earnings in the national accounts W to labor earnings in the survey. This generates a set of wages by age group and education level $w_{ae} = (W/T)H_{ae}$. The data are disaggregated by sex as well as by type of employment.

For notation purposes, only the disaggregation into self-employed workers and wage earners are considered here. The employed workers are denoted by w_{ae}^m a cell in the remuneration matrix, and the corresponding cell in the matrix for self-employed by w_{ae}^s . Similarly the number of workers of both groups are denoted by n_{ae}^m and n_{ae}^s and the population of age a and education level e by pop_{ae} Probabilities of being employed or in self-employment are estimated as $p_{ae}^m = n_{ae}^m/pop_{ae}$ and $p_{ae}^s = n_{ae}^s/pop_{ae}$.

Two additional parameters are used in the estimations. First, since estimates are provided for the adult population aged 15–64, a probability is computed, denoted by r_{ae}^{e+1}, that a person of age a and education will undertake an extra year of education (and thereby not work during that year). Second, age cohort survival rates are computed from life tables, denoted as $v_{a,a+1}$.

Total human capital is calculated as the discounted value of lifetime earnings of two population subgroups, those aged 25–65 (assumed to have finished schooling), and those aged 15–24 who have some probability of still being in school. The discount factor is denoted by d. For an individual with age a and education e randomly drawn from the subpopulation aged 25–65, the discounted lifetime income is estimated based on the following recursion:

$$h_{ae} = p_{ae}^m w_{ae}^m + p_{ae}^s w_{ae}^s + d \times v_{a,a+1} \times h_{a+1,e}.$$

This expression states that the lifetime income of a representative individual aged 25–65 is the sum of two parts: current labor income taking into account the probabilities of being either employed or self-employed, plus lifetime income in the next year, adjusted by a discount factor and the corresponding survival rate.

For an individual between ages 15 and 24, the expression is slightly more complex to allow for the possibility of continuing one's education. In the next year, the individual must choose between two courses of action: the first is to continue their work (holding the same education level as before) and earn income of $d \times v_{a,a+1} \times h_{a+1,e}$ with the probability $d \times v_{a,a+1} \times h_{a+1,e}$; the second is to undertake one more year of education and (after finishing) to receive income $d \times v_{a,a+1} \times h_{a+1,e+1}$, with the probability of r_{ae}^{e+1}. In each case a proportion $v_{a,a+1}$ is assumed to survive. The recursive relationship is therefore

$$h_{ae} = p_{ae}^{m} w_{ae}^{m} + p_{ae}^{s} w_{ae}^{s} + (1 - r_{ae}^{e+1}) \times d \times v_{a,a+1} \times h_{a+1,e} + r_{ae}^{e+1} \times d \times v_{a,a+1} \times h_{a+1,e+1}.$$

When adding disaggregation by sex, the approach results in a measure of human capital wealth with four components, namely the present values of future earnings by sex and by type of employment (wage earners versus self-employed). Table A.6 provides the data sources used for the analysis.

Table A.6 Data sources for the estimation of human capital

Indicator	Data source(s)
Annual earnings (by age, gender, educational attainment)	International Income Distribution Database (I2D2)
Returns to schooling (Mincer equation)	Updated estimates, based on Montenegro and Patrinos (2016) derived from I2D2
Educational attainment (by age, gender)	I2D2
Population (by age, gender)	United Nations Population Division
Mortality rates (by age, gender)	Global Burden of Disease Study 2017
Labor share of GDP (employed and self-employed)	United Nations National Accounts, Penn World Table For Russia, labor share data from PWT 9.1 were used.

Net foreign assets

Net foreign assets (NFA) are a measure of the cross-border assets and liabilities held by a country's residents. A country's external asset position, or NFA, is calculated as

$$NFA = FA - FL$$

where FA are total foreign assets and FL are total foreign liabilities. Total foreign assets are

$$FA = equity_a + FDI_a + debt_a + derivatives_a + forex$$

where $equity_a$ is portfolio equity assets, FDI_a is foreign direct investment assets, $debt_a$ is debt assets, $derivatives_a$ is financial derivatives assets, and $forex_a$ is foreign exchange reserves (excluding gold). Similarly, total foreign liabilities are

$$FL = equity_l + FDI_l + debt_l + derivatives_l$$

where $equity_l$ is portfolio equity liabilities, FDI_a is foreign direct investment liabilities, $debt_a$ is debt liabilities, and $derivatives_l$ is derivatives liabilities.

The primary data source for NFA is the updated and extended version of the External Wealth of Nations Mark II database developed by Lane and Milesi-Ferretti (2007). This database, last updated in early 2019, provides estimates of NFA for over 200 economies for 1970 – 2017. Where estimates of NFA and its components are not available in the Lane and Milesi-Ferretti database, additional data are obtained from various sources to extend the country coverage.

Appendix 2. Countries Included in the OECD and Upper Middle-income / High-income Commodity Exporter Groups

OECD countries

Australia	Greece	Poland
Austria	Hungary	Portugal
Belgium	Iceland	Slovak Republic
Canada	Ireland	Slovenia
Chile	Italy	Spain
Denmark	Japan	Sweden
Estonia	Korea, Rep.	Switzerland
Finland	Luxembourg	United Kingdom
France	Netherlands	United States
Germany	Norway	

Commodity exporters, upper middle-income and high-income countries
Inclusion of countries determined by IMF's World Commodity Exporters Database

Country	Income Group (as of 2014)	Region
Australia	High-income: OECD	East Asia & Pacific
Canada	High-income: OECD	North America
Chile	High-income: OECD	Latin America & Caribbean
Norway	High-income: OECD	Europe & Central Asia
Bahrain	High-income: non-OECD	Middle East & North Africa
Kuwait	High-income: non-OECD	Middle East & North Africa
Oman	High-income: non-OECD	Middle East & North Africa
Qatar	High-income: non-OECD	Middle East & North Africa
Saudi Arabia	High-income: non-OECD	Middle East & North Africa
United Arab Emirates	High-income: non-OECD	Middle East & North Africa
Venezuela, RB	High-income: non-OECD	Latin America & Caribbean
Azerbaijan	Upper middle-income	Europe & Central Asia

Botswana	Upper middle-income	Sub-Saharan Africa
Colombia	Upper middle-income	Latin America & Caribbean
Ecuador	Upper middle-income	Latin America & Caribbean
Gabon	Upper middle-income	Sub-Saharan Africa
Iraq	Upper middle-income	Middle East & North Africa
Kazakhstan	Upper middle-income	Europe & Central Asia
Mexico	Upper middle-income	Latin America & Caribbean
Mongolia	Upper middle-income	East Asia & Pacific
Peru	Upper middle-income	Latin America & Caribbean
South Africa	Upper middle-income	Sub-Saharan Africa
Suriname	Upper middle-income	Latin America & Caribbean

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