# Geary-Khamis Purchasing Power Parity: A Peculiar Case of the New Banana Republics

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**Abstract**

Purchasing power parity is a widely used measure to compare national GDPs. However, while this measure works well for countries which are at the same level of economic development, PPP is grossly inadequate when comparing developing and developed nations. The best example to demonstrate this is the case of the former Eastern Bloc. As a result of trade liberalization in the nineties, the economies of the Eastern Bloc countries have undergone massive deindustrialization and transformation into primitive raw materials extraction or final assembly from imported components. However, international institutions such as World Bank and International Monetary Fund provide purchasing-power parity estimates of GDP according to which the economies of these countries are on par or sometime exceeding on a per-capita basis those of the developed world. This paper explains, using simple examples, what stands behind GDP at purchasing power parity, and how, using real-world example of Japan and Russia, "on the back of an envelope," to estimate and compare the GDP based on a minimum set of publicly available data. It is shown that the well-developed infrastructure, including housing, communications, health care, education, and energy, inherited by the former planned economies, plays a crucial role in their high GDP rankings. Given this infrastructure, income from the export of raw materials is sufficient to cover the basic needs of the population for food and the means of its production, as well as essential consumer staples, and thus to create the illusion of relative well-being.

## Introduction

In a bizarre twist of economic fate, World Bank classified Russia as a high-income economy in 2023, while also placing Russia in the fourth place in terms of the size of the economy by purchasing power parity, ahead of Germany and Japan.[1] This may appear surprising for a deindustrialized county of this size even with all the wealth of mineral resources that Russia possesses. But there is another important consideration that makes a bigger contribution to the calculated income. Namely, during the years of planned economy the country has developed the infrastructure – housing and other real estate, roads and transportation, the power network, and the system of education and health care, that is largely on par with the developed world rather than with other poor nations with comparable per-capita mineral resource exports. If this infrastructure did not exist, the income from export of raw materials would barely be sufficient to cover the basic needs in food, since the country exported only 423.9 billion U.S. dollars' worth of goods,[2] which amounts to less than $3,000 per capita. The infrastructure rent, however, adds a very significant amount to the "income" of the population, and the resulting formal numbers show a very different picture. For this reason, and with no understanding of the underlying mathematics, Russian economists and government officials have been captivated by the idea of using "PPP GDP" as an indicator of "economic development."[3]

Importantly, purchasing-power parity calculations hide the distinction between advanced and primitive economic activities. A country that specializes in raw materials extraction or unskilled-labor final assembly of manufactured goods, by formal calculations may turn out to be as "wealthy" as an innovation-based economy.

In this paper, we will consider the definition of purchasing power parity, consider how, according to officially published documents, PPP GDP is calculated by international financial organizations, and analyze using simple examples how rather complex formulas consisting of many factors are applied. Ultimately, this will lead us to a mathematical demonstration of how PPP GDP can be higher in a primitive resource-based economy than in a modern industrial country.

## Results

The most commonly used approach to calculate Purchasing Power Parity is the Geary-Khamis method.[4]

Suppose *M* countries produce *N* goods. Each country *j* makes $q_{ij}$ of good *i* with the price $p_{ij}$. The price of good *i* in international dollars is given by the following formula:

$$p_i = \sum_{j=1}^{M} \left(\frac{p_{ij}}{PPP_j}\right) \frac{q_{ij}}{\sum_{j=1}^{M} q_{ij}} \qquad (1)$$

According to this equation, the price $p_i$ is a weighted average of internal prices, expressed in international dollars with the use of the coefficient $PPP_j$. $PPP_j$ in the Geary-Khamis system is determined by the following equation:

$$PPP_j = \frac{\sum_{i=1}^{N} p_{ij} q_{ij}}{\sum_{i=1}^{N} p_i q_{ij}} \qquad (2)$$

Consider a situation where one country produces only high-tech goods, and the other only primitive goods and raw materials. At the same time, the consumption of non-tradable goods (services) in both countries is the same. A good example would be the case of Japan and Russia. In this case, we have two country indices (*J* – Japan, *R* – Russia) and three types of goods:

*I* – Infrastructure (housing, health care, education, energy, services). These are non-tradable goods, the prices of which may differ in the two countries.

*M* – raw Materials

*T* – Technology products (high-tech goods)

These two groups are tradable goods, and their prices at the nominal exchange rate are the same throughout the world.

The system of equations (1)-(2) turns into the following five equations:

$$p_I = \left(\frac{p_{IJ}}{PPP_J}\right)\frac{q_{IJ}}{q_{IJ}+q_{IR}} + \left(\frac{p_{IR}}{PPP_R}\right)\frac{q_{IR}}{q_{IJ}+q_{IR}} \qquad (3)$$

$$p_M = \left(\frac{p_{MJ}}{PPP_J}\right)\frac{q_{MJ}}{q_{MJ}+q_{MR}} + \left(\frac{p_{MR}}{PPP_R}\right)\frac{q_{MR}}{q_{MJ}+q_{MR}} \qquad (4)$$

$$p_T = \left(\frac{p_{TJ}}{PPP_J}\right)\frac{q_{TJ}}{q_{TJ}+q_{TR}} + \left(\frac{p_{TR}}{PPP_R}\right)\frac{q_{TR}}{q_{TJ}+q_{TR}} \qquad (5)$$

$$PPP_J = \frac{p_{IJ}q_{IJ} + p_{MJ}q_{MJ} + p_{TJ}q_{TJ}}{p_I q_{IJ} + p_M q_{MJ} + p_T q_{TJ}} \qquad (6)$$

$$PPP_R = \frac{p_{IR}q_{IR} + p_{MR}q_{MR} + p_{TR}q_{TR}}{p_I q_{IR} + p_M q_{MR} + p_T q_{TR}} \qquad (7)$$

With the assumption that Japan produces only technology products and Russia produces only raw materials,

$$q_{TR} = 0, q_{MJ} = 0$$

Plugging these values into equations (3)-(7), we obtain

$$p_I = \left(\frac{p_{IJ}}{PPP_J}\right)\frac{q_{IJ}}{q_{IJ}+q_{IR}} + \left(\frac{p_{IR}}{PPP_R}\right)\frac{q_{IR}}{q_{IJ}+q_{IR}} \qquad (8)$$

$$p_M = \left(\frac{p_{MR}}{PPP_R}\right) \qquad (9)$$

$$p_T = \left(\frac{p_{TJ}}{PPP_J}\right) \qquad (10)$$

$$PPP_J = \frac{p_{IJ}q_{IJ} + p_{TJ}q_{TJ}}{p_I q_{IJ} + p_T q_{TJ}} \qquad (11)$$

$$PPP_R = \frac{p_{IR}q_{IR} + p_{MR}q_{MR}}{p_I q_{IR} + p_M q_{MR}} \qquad (12)$$

Multiplying both sides of (12) by $1/PPP_R$ and plugging in $p_M$ from (9), we get:

$$p_I = \frac{p_{IR}}{PPP_R}$$

Similarly, from equations (10) and (11) we get:

$$p_I = \frac{p_{IJ}}{PPP_J}$$

The last two equations give us an important relationship between purchasing power parities and prices of untraded goods in our particular case:

$$\frac{PPP_R}{PPP_J} = \frac{p_{IR}}{p_{IJ}} \qquad (13)$$

In this case, it is very easy to understand this formula intuitively. Since the traded goods (for which prices are set on the international market at the nominal exchange rate) are different in the two countries, the only indicator by which prices can be compared are those goods and services that exist in both countries.

**Banana Federation and Technopolia**

***Calculating GDP in PPP***

For a numerical demonstration of the above formula, consider a toy example of two countries, one of which is industrial, and the other is living in the Stone Age.

Technopolia, with population of 125 million, produces high-tech goods, such as cars, electronics, and others. Assume that the value of these goods is 25,000 technollars per capita per year. The economy also provides its citizens with services – housing, education, medical services, etc. Assume that the contribution of these services to GDP is also 25,000 technollars per year. Thus, in local currency, Technopolia's GDP is 50,000 technollars per capita per year.

Now consider another country, Banana Federation. With population of 150 million people. Here, the economy provides citizens with the same services housing, education, health care, and the contribution of these goods and services to GDP is 25,000 wooden coins per year. The economy does not produce any modern goods, but the country extracts and exports gas and oil of the Ural Banana brand – for an amount also equal to 25,000 wooden coins per capita per year. The annual GDP of Banana Federation per capita in local currency is 50,000 wooden coins.

Assume, for an illustration, that the exchange rate is 3 wooden coins per technollar. That is, every 3,000 wooden coins of oil, gas and other raw materials can be exchanged for 1,000 technollars of goods produced in Technopolia. Then, at the market exchange rate, the GDP per capita of Banana Federation is obviously 16,667 technollars, or 3 times less than the GDP of Technopolia.

But in terms of purchasing power parity, the GDP of the Banana Federation could be higher than the GDP of Technopolia. According to **Equation (13)**, the ratio of the PPP coefficients in our two countries (BF, T)

$$\frac{PPP_{BF}}{PPP_T} = \frac{p_{I\,BF}}{p_{I\,T}}$$

Let's take the price of a unit of non-tradable goods/services as the volume of these goods and services per year per capita in both countries. The price of a conventional unit of infrastructure (non-tradable goods) in Technopolia is 25,000 technollars, and in Banana Federation – 25,000 wooden coins. Thus, the ratio of the purchasing power parity coefficients is 1. Accordingly, the GDP per capita at purchasing power parity in Technopolia and Banana Federation is the same and equals 50,000 international technollars.

The exchange rate that ensures the parity of purchasing power of currencies is 1.0 wooden coin per technollar.

We can also calculate the GDP of the two countries at PPP. Technopolia's GDP per capita is 50,000 technollars. And the total GDP is 6.25 trillion technollars. The Banana Federation's GDP per capita in local currency is 50,000 wooden coins. The country's total GDP is 7.5 trillion wooden coins or 7.5 trillion technollars in PPP.

Our calculations can be summarized in **Table 1**.

***Balassa-Samuelson effect***

At the market exchange rate of 3:1, the incomes of the population in Banana Federation are, accordingly, 3 times lower than in Technopolia. It would be tempting to think that the huge difference in GDP/income of the population at the official exchange rate does not reflect the real situation in the two economies, since in Banana Federation not only salaries are lower, but also prices, and that this is precisely why we compare incomes "at purchasing power parity." But this is not correct.

Can prices for the same services be the same at the nominal exchange rate in Banana Federation and Technopolia? For example, a waiter in a restaurant does the same job in both countries. Does this mean that prices in restaurants and the salaries of waiters and hairdressers will be the same at the exchange rate?

**Table 1.** Estimated GDP at nominal exchange rates and in PPP in Technopolia and the Banana Federation.

| | **Technopolia** | **Banana Federation** |
|---|---|---|
| **Population** | 125 million | 150 million |
| **Per capita** | | |
| **Technology goods** | 25,000 technollars | 0 |
| **Raw materials** | 0 | 25,000 wooden coins |
| **Non-traded goods** | 25,000 technollars | 25,000 wooden coins |
| **GDP in local currency** | 50,000 technollars | 50,000 wooden coins |
| **GDP at exchange rate 3:1** | 50,000 technollars | 16,667 technollars |
| **GDP at PPP** | 50,000 technollars | 50,000 technollars |
| **National GDP** | | |
| **GDP at exchange rate 3:1** | 6.25 trillion technollars | 2.5 trillion technollars |
| **GDP at PPP** | **6.25 trillion technollars** | **7.5 trillion technollars** |

The average production of services per capita in BF is 25,000 wooden coins, and in Technopolia – 25,000 technollars. What could be a possible relationship between these two figures? Services are non-tradable goods, and the only thing that Banana Federation can offer Technopolia is goods that can be exported, that is, crude oil. However, according to our assumption, the 25,000 wooden coins that Banana Federation earns per capita for oil can only be exchanged for 8,333 technollars. Therefore, accordingly, in the service sector, 25,000 wooden coins cannot be equal to the 25,000 technollars that people in Technopolia earn in the service sector.

This phenomenon is known as the Balassa-Samuelson effect. In less developed countries, according to this effect, both wages and prices for non-tradable goods and services are lower, at the nominal exchange rate, than in developed economies.

In connection with these results, it would be incorrect to say, “in Banana Federation, despite much lower incomes, the living standard is comparable to that of Technopolia, since prices are correspondingly lower.” In fact, the opposite is true – in developing countries, prices and incomes are lower, because the economies are backward compared to the industrial world.

## Real world example: Russian Federation vs Japan

### *Intuitive considerations*

According to the World Bank and IMF reports, the Russian economy is almost on par with Japan in terms of purchasing power parity, 5.99 trillion international dollars versus 5.86 in 2022.[5]

Which may raise a very natural question: how is this possible? After all, Japanese goods and technologies are known throughout the world, and of course in Russia. Automobiles, machinery and equipment, household appliances and electronics, computer chips and robotics. None of this is produced in Russia.

Indeed, let's take three major high-tech industries as an example, and compare the production volume in these industries in Russia and in developed countries.

### *Commercial aircraft*

In commercial aviation, the largest manufacturer is Sukhoi Civil Aircraft. In the most successful years, the company produced 20-30 aircraft.[6] With a unit price tag of 30-40 million dollars, sales of commercial aircraft amounted to 1 billion dollars per year. For comparison, Boeing Commercial Aircraft sales amounted to 45 billion,[7] with comparable numbers for its European rival Airbus.

### *Automotive industry*

AvtoVAZ, the largest Russian manufacturer, assembled only 374,000 cars from imported components in 2023.[8] Considering that all the equipment at AvtoVAZ is imported, and most of the components are also foreign, the Russian added value in these cars can be estimated at 1-2 billion dollars. For comparison, Hyundai, which is not the largest by global standards, sells cars worth 90 billion dollars a year,[9] and most of the components in these cars (and equipment at Hyundai plants around the world) are Korean.

### *Machinery and equipment*

The largest machine tool manufacturer in Russia, STAN, “boasts” revenue of 30 million dollars a year.[10] Even if we take all the remaining equipment manufacturers in Russia together, and if all together they sell 10 times more equipment, we will get 300 million dollars a year. For comparison, the import of foreign machinery and equipment in Russia is 40 billion dollars a year.[11] Thus, the Russian machine tool industry is a tiny share of even the Russian equipment market, not to mention the global one.

### *Comparison of the largest companies in Russia and developed countries*

Have we missed any important industries? What are the largest companies in Russia and what do they do?

Let's look at the first three. Predictably, oil and gas. According to the latest available data from RosBusinessConsulting, the three largest companies in Russia are (data for 2017):[12]

| Company | Industry | Annual revenue, US Dollars |
|---|---|---|
| Gasprom | Oil and gas | 112.2 billion |
| Lukoil | Oil and gas | 93.84 billion |
| Rosneft | Oil and gas | 86.21 billion |

And the three largest companies in Japan:[13]

| Company | Industry | Annual revenue, US Dollars |
|---|---|---|
| Toyota | Automotive | 279.377 billion |
| Mitsubishi | Conglomerate | 153.690 billion |
| Honda | Automotive | 129.546 billion |

The only large technology companies in Russia are Rosatom, the United Aircraft Corporation (which carries out part of the export deliveries through the military-industrial complex) and the United Shipbuilding Corporation. Their revenues are 19.65, 7.75, and 5.59 billion dollars respectively, or 33.99 billion dollars in total. Which is almost 17 times less than the combined revenue of only three Japanese companies – Toyota, Mitsubishi, and Honda.

***Comparison of GDP of Russia and Japan by purchasing power parity – an estimate "on the back of an envelope."***

To estimate GDP by PPP, consider the economy through the prism of several main areas of consumption.

– Vital goods and services

• Food

• Housing

• Medicine

• Education

– Other consumer staples (cars, smartphones, etc.)

Now compare the availability and consumption of these main sections in Russia and Japan.

Intuitively, the reader will probably agree that the availability of food in Russia and Japan is almost the same.

Similarly, in general, Russians are provided with housing. According to statistics, in terms of the amount of housing per capita, Russia and Japan have approximate parity.[14,15]

Also, Russia inherited from the Soviet Union a developed infrastructure (roads, railways, airports), and medicine and education, which, in general, are on par with developed countries.

Thus, if we sum up the vital goods and services and infrastructure, then the availability and consumption per capita in the two countries are indeed comparable.

Now consider the fact that expenses in these categories make up most of the average person's expenses.

At the same time, with goods from the last combined category, which we called "other consumer staples," the situation is entirely different. The production of goods in this category determines the level of technological development of the country. Although in Russia the "consumption" of smartphones, electronics, cars, and other items is far from zero, this consumption is determined not by production, but by purchases abroad in exchange for raw materials. By analogy with our model in **Table 1**, we will estimate the volume and contribution to GDP of non-tradable goods (housing, education, health care, food) and tradable goods (raw materials, cars, electronics, etc.).

For non-tradable (vital) goods and services, we can estimate the share of these goods in GDP from open sources.

1. **Housing** According to the latest data for 2022, added value amounted to 11.6% of GDP in Japan.[16] In Russia, we could not find data on the share of added value in GDP, but in 2016, the gross added value in the real estate sector amounted to 10.145 trillion rubles[17], and nominal GDP was 85.64 trillion,[18] that is, the share of the real estate sector in GDP was 11.8%.
2. **Food** 32.2% in Russia[19] and 25.8% in Japan.[20]
3. **Health care** 7% in Russia[21] and 11.5% in Japan.[22]
4. **Education** 3.6% in Russia (2022)[23] and 5.5% in Japan (2020).[24]

In total, the contribution of consumption of vital services and non-tradable goods in Russia is 54.6% of GDP, in Japan – 54.4% of GDP.

Just as we introduced advanced and primitive goods (raw materials) in the Technopolia and Banana Federation example in **Table 1**, we will evaluate the role of high-tech goods in Japan and primitive goods in Russia. The total income of the 45 largest companies in Japan is $2.948

trillion,[13] which is $23,267 per capita. In Russia, the income of the 45 largest companies is $801.34 billion,[12] or $5,489 per capita.

Let us now assume that the total income of the 45 largest companies is equivalent to what we called high technology in Technopolia in **Table 1** and, correspondingly, raw material extraction in the Banana Federation. Everything else in the economy is services and non-tradable goods. We calculated that the total contribution to GDP of the four main types of services/non-tradable goods in Japan is 54.4% and in Russia – 54.6%. Let us again make a simplifying assumption that almost the entire non-tradable part of GDP consists of the above four areas, and almost the entire tradable part of GDP is accounted for by the income of the largest companies. We will discuss the validity of this assumption later. If we take this assumption as a basis, we can calculate the corresponding volume of GDP created by non-tradable goods and services in both countries. Thus, in Japan, the total contribution to GDP of non-tradable goods is 54.4%, therefore the contribution of tradable goods is 45.6%. But the latter, by our assumption, corresponds to the income of the 45 largest companies and equals $23,267 per capita. Thus, the volume of non-tradable goods and services in Japan is $27,758 per capita. Similarly, tradable and non-tradedable components of GDP are calculated in Russia. For simplicity of calculations, let's take the dollar to ruble exchange rate of 1:100. As a result, we get the following table:

| | **Japan** | **Russian Federation** |
|---|---|---|
| **Population** | 125 million | 147 million |
| | **Per capita** | |
| **Technology goods** | 23,267 dollars | 0 |
| **Raw materials** | 0 | 5,451.29 dollars<br>(545,129 rubles) |
| **Non-traded goods** | 27,758 dollars | 6,555.96 dollars<br>(655,596 rubles) |
| **GDP** | 51,025 dollars | 12,089.86 dollars<br>(1,208,986 rubles) |

According to **Equation (13)**, the ratio of purchasing power parity coefficients in Russia and Japan is equal to the ratio of prices of non-tradable goods, i.e. 655,596/27,758 = 23.62. The exchange rate that ensures purchasing power parity is 23.62 rubles per dollar.

Now we only need to add the missing rows to obtain a table corresponding to **Table 1**:

**Table 2.** Estimate "on the back of the envelope": GDP of Japan and the Russian Federation.

| | **Japan** | **Russsian Federation** |
|---|---|---|
| **Population** | 125 million | 147 million |
| **Per capita** | | |
| **High-tech goods** | 23,267 dollars | 0 |
| **Raw materials** | 0 | 545,129 rubles |
| **Services** | 27,758 dollars | 655,596 rubles |
| **GDP in local currency** | 51,025 dollars | 1,200,725 rubles |
| **GDP at exchange rate 100:1** | 51,025 dollars | 12,007 dollars |
| **GDP PPP** | 51,025 dollars | 50,835 dollars |
| **Total GDP** | | |
| **GDP at exchange rate 100:1** | 6.466 trillion dollars | 1.765 trillion dollars |
| **GDP PPP** | **6.466 trillion dollars** | **7.473 trillion dollars** |

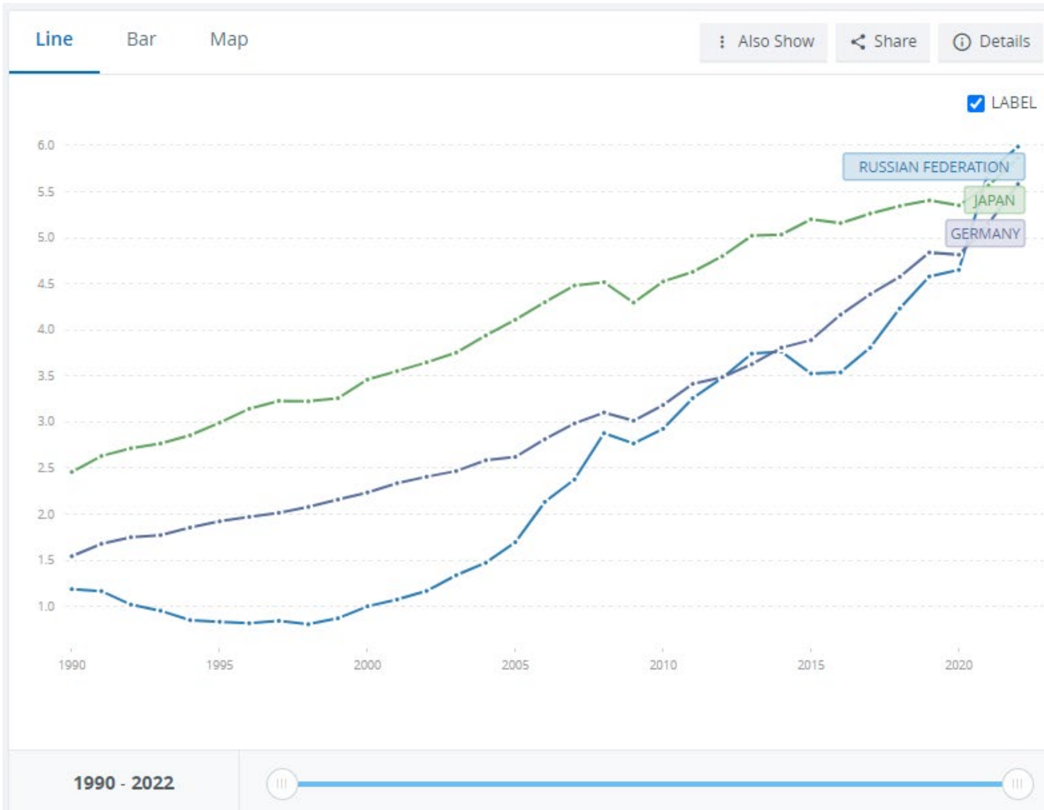
For comparison, we present the GDP data according to the World Bank PPP for Russia and Japan (**Figure 1**).[25]

**Remarks**

We have proposed a greatly simplified model for calculating GDP at PPP based on only two types of goods and services – non-tradables (infrastructure in the broad sense) and tradables, for which we took the total income of a certain number of the largest companies as a proxy. Our GDP estimate assumes that the four areas of non-tradables reflect almost the entire service sector, and the remaining industries, such as, for example, entertainment/travel, are relatively small and can be neglected.

We also assume that the income of the 45 largest companies we selected includes almost all tradable goods, even though this list does not include hundreds and thousands of smaller companies and suppliers. But most small companies and small businesses are suppliers and subcontractors of the largest companies that produce the final products. For example, all small and medium-sized participants in the Toyota supply chain contribute to GDP. However, to include Toyota's contribution to GDP, we need to subtract payments to suppliers from the company's income. Thus, the total revenue of Toyota is a good proxy of the contribution to GDP of Toyota

**Figure 1**. GDP at purchasing power parity, Russia, Japan, Germany. World Bank data.




Selected Countries and Economies

| Country | Most Recent Year | Most Recent Value (Millions) |
|---|---|---|
| Germany | 2022 | 5,582,288.43 |
| Japan | 2022 | 5,862,116.60 |
| Russian Federation | 2022 | 5,987,861.45 |

itself *and* all its smaller suppliers. Similarly to this specific example, the combined income of the largest companies reflects the contribution to GDP of virtually the entire industry.

We also assumed that the traded goods are completely different in the two countries. Russia does produce high-tech goods, but the volume of this production is negligible. For example, as we showed earlier, the income of the Russian nuclear, aviation (UAC), and shipbuilding industries (UEC) is almost 17 times smaller than the income of just three Japanese companies. On the other hand, developed countries also extract raw materials, but their raw material extraction is many times smaller in added value than their high-tech industries. Therefore, in fact, including the tiny volume of high-value-added goods production in Russia and including the extraction of raw materials in the GDP of developed countries will change virtually nothing in our model. Overall, our estimates of GDP in PPP terms for Russia and Japan turned out to be quite close to the figures obtained by the World Bank, which also confirms the validity of our simple approach.

**Conclusion**

It is extremely important to understand the limits of the Purchasing Power Parity GDP calculations. The current approaches, while doing a reasonable job comparing GDP of equally developed economies, are grossly inadequate when applied to calculation of GDP of underdeveloped vs industrial countries. The purchasing-power parity measures totally miss the difference in the structure of the economies, and do not make distinction between advanced industries and primitive ones like raw materials extraction or final assembly from imported components. Another important aspect, especially for former planned economies, is that very well-developed infrastructure plays a key role in increasing GDP in PPP terms. It is infrastructure that distinguishes, for example, Russia from the poorest raw material exporters in the third world. As we have seen, the income of the largest Russian companies in total amounts to just over $5,000 per year per capita, before subtracting the contribution of importing components and equipment. Now imagine that Russia did not have all that housing, roads, power plants, railways, ports, airports, and the education and health care system created in Soviet times did not exist. These $5,000 (minus payments for imported components and equipment) per year would be all that the country earns. Obviously, this money would not be enough to buy abroad and build even part of the infrastructure that we just listed. Russia's standard of living would be at the level of the poorest third world countries.

Our estimate of GDP in PPP is extremely simple and is based on a very small amount of publicly available data. In addition, we made several assumptions that greatly simplify the analysis. However, regardless of the validity of the assumptions that we used for our simple estimate of GDP, the fact remains that the former planned economies of Russia and Eastern Europe have no industry and no production (on a significant scale) of any high-added value goods. It would be naive to consider it an achievement that even in the absence of industry, the GDP by PPP is comparable to industrial countries. It is also very important to understand that even if the standard of living is currently relatively high, there is no guarantee that this level can be maintained in the future. The fact is that Russia and Eastern European economies specialize in industries that not only have no growth prospects. These industries inevitably become less valuable in comparison with innovation-based ones. Accordingly, even if the infrastructure does not collapse, the amount of goods that these countries will be able to buy abroad in exchange for raw materials or the output of primitive economic activities will inevitably decrease. Why is this so? Two simple examples.

In a book devoted to issues of economic development, Eric Reinert examines the case of a garment factory in Guatemala that supplies garments to the United States. The material is purchased in the United States, and Guatemalan seamstresses earn money by cutting and sewing. What are the long-term prospects for this Guatemalan export-oriented "non-raw material, non-energy" "development?"[26]

> *In the 1980s, pajamas sold in the United States had a label sewn on them: "Fabric made in the USA, cut and sewn in Guatemala." Textile production is a mechanized industry, so the fabric is made in the United States. Cutting was also a mechanized process, but it required small batches, otherwise the accuracy of the cut and the quality of the product suffered. Therefore, the same low-paid workers were engaged in cutting out the details and sewing the pajamas. In the 1990s, new labels appeared on the pajamas: "Fabric manufactured and cut in the USA, sewn in Guatemala." Laser technology made it possible to cut fabric in large batches with high precision, and the need for cheap labor in Guatemala disappeared.*

Another example is the final assembly (misleadingly called "production") of foreign brands in Russia and Eastern Europe. Very often, this is structured so that underdeveloped countries specialize only in the areas of the "production" that consists of non-mechanized final assembly. Can such joint projects bring sustained economic growth? The answer is the same as in the case of Guatemalan seamstresses. Take an example from the automotive industry – engine production. While modern internal combustion engines require a fair amount of manual labor for final assembly, electric vehicles, contain far fewer moving parts[27] and require 30% fewer labor hours during assembly.[28] The inevitable mass transition to electric vehicles will obviously significantly reduce the demand for low-skilled final assembly, and accordingly, will significantly reduce the income of industries that specialize only in primitive operations. It is obvious that continuing technological progress will increasingly separate those at the top of the value chain from those at the bottom and that rely on foreign "investments."

Reliance on purchasing-power parity GDP as an indicator of economic development can lead to a sense of complacency. Meanwhile, free trade and the invisible hand of the market work in favor of developed countries, leaving Russia and other underdeveloped nations of Eastern Europe and elsewhere in the world with only those economic activities in which economic growth and sustainable development is impossible in principle.

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