Regularity of change in labor productivity in the agricultural sector: a regional issue

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Abstract. Labor productivity as an indicator of labor efficiency should be correlated with the human standard of living in order to show how the result of labor can affect the welfare of the population. However, the inconsistency of the proportions between effort and effect helps to reveal the economic problems of the development of the agricultural sector in Irkutsk region. Within the framework of the study, the standard of living of the population in rural areas was described, a dynamic analysis of indicators of labor productivity in the agricultural sector and the standard of living of citizens in the countryside was carried out, the factors of changes in investigated indicator were identified, the correlation between productivity and the standard of living of the population was determined, it was proved that the relationship between wages as the main source of an increase in living standards with labor productivity in the agricultural sector is not effective, just as there is no increase in living standards with an increase in the absolute value of productivity. This helps to see new ways of intensive development of the agro-industrial sector.

1. Introduction
Currently, the issue of sustainable qualitative growth of labor productivity in the Russian Federation is urgent. It includes the development of effective strategies to support productivity, the formation of conditions and prerequisites, the identification of potential, the introduction of organizational innovations in production and management processes [1].

To draw modern attention to this indicator, one would like to link it with the indicator of living standards. In our article, we will limit the area of attention to considering the main indicators of the agricultural sector. We can rely on M. Porter's statement that labor productivity in the economy determines the level of its competitiveness and directly affects the quality of life of the population. Let us accept the term “standard of living” as being less broad than the term “quality of life” implying material well-being, but sufficient for a quantitative description of conditions [3].

The standard of living is an indicator reflecting well-being (the level of income, the ability to meet the basic needs of citizens in food, clothing, medicine, travel, etc.) [4].

This is a fairly relevant indicator, especially since in the context of the country it looks ambiguous recently and Russian scientists have put forward a large number of versions to increase this index [5].

In our article, we will try to prove the relationship between the indicators of labor productivity and the standard of living in the agricultural sector, determine what nature this relationship is, how the dependence changes in the time period, what can change the current state of affairs and what reaction
should be expected or what actions should be taken in order to comply with the national direction - increasing production productivity.

The study is carried out according to the data of the Irkutsk region in the agricultural sector of the economy, which, on the one hand, can confirm the all-Russian tendency or reveal a regional feature of the development of the agrarian economic system.

2. Methods
The conducted research is based on logical and statistical research methods. The methods of grouping, comparison, multivariate comparison, detailing, correlation-regression, factor analysis, graphical method were used as statistical methods.

Analytical activities were preceded by the collection of information on federal and regional data of the body of the Federal State Statistics Service for the period 2009-2018 [6].

At the beginning of the study, a logical relationship was presented between indicators of labor productivity and the indicator of living standards in the countryside.

By minimizing the price factor of influence, the complex indicator of the standard of living is expressed by 4 particular indicators that reveal its main characteristics.

Further, using the growth rate indicators, the dynamic change in the objects of study is estimated. This leads to a more detailed factor analysis using the method of absolute differences to identify the causes of changes in labor productivity during the period under consideration.

Then a correlation analysis is carried out in order to determine the closeness of the relationship between the data on labor productivity and living standards in agriculture of the Irkutsk region.

Logical conclusions lead the authors to the perception of the indicator of the standard of living through the indicator of wages, so, practically, on average 60-65% of the source of a certain standard of living is real wages. It is also determined with the help of correlation-regression analysis that the relationship between indicators of labor productivity and wages is not effective.

All calculations were performed using the MS Excel software product.

3. Results
As an indicator of the standard of living of the rural population in the Irkutsk region, we present a complex indicator, a figure. It includes 4 components: 1) the average per capita money income of the population of the Irkutsk region, rubles per month, 2) the rating assessment of the purchasing power of the average per capita money income of the rural population, 3) the index of the physical volume of household services of the rural population of the Irkutsk region compared to the previous year, the value of the indicator for the year, in %, 4) passenger turnover, million passenger-km. The choice of these indicators was deviated to the use of indicators of different dimensions.

This is due to the desire to neutralize the influence of the price factor, which clearly entails an increase in indicators due to constant growth and thereby increases the cost value of indicators for calculating the standard of living. Figure 1 shows the dynamics of the complex indicator

![Figure 1](image_url)

**Figure 1.** Dynamics of the complex indicator of the standard of living of the rural population in the Irkutsk region for the period 2013-2018 of the standard of living of the Irkutsk region for the period 2013-2018.
The method of combining the four components into a comprehensive indicator of the standard of living was also described earlier in and supplemented with relevant data.

The labor productivity indicator is calculated according to the ratio of the regional domestic product and the number of employees. It was determined for the period from 2008 to 2018 in the context of the Russian Federation and its constituent entity - the Irkutsk region, and is shown in figure 2.

![Figure 2. Dynamics of the labor productivity indicator in agricultural sector for the period 2008-2018, million ruble /person.](image)

Finding out the relationship between productivity and living standards, let us compare the growth rates of the living standards indicator and the growth rates of labor productivity, table 1.

| Indicators                        | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------------------------------|------|------|------|------|------|------|
| Growth rate of living standards  | -0.1 | 0.1  | -0.3 | 0.7  | -0.4 |      |
| Productivity growth rate         | 21.0 | -1.3 | 6.5  | 5.5  | 11.5 | 16.7 |
| Leading (lagging) coefficient    | -0.08| 0.015| -0.05| 0.06 | -0.02|

Table 1 shows some inverse relationship between the indicators, which is confirmed by the leading coefficient: the percentage increase in the living standard indicator by one percent of the productivity gain. It turns out that with a positive change in productivity by 1 percent, the standard of living falls by 0.02 percent in 2018, and a similar dynamics persists throughout the entire period under consideration since 2014 to 2018 [7].

Analyzing the rate of growth of the indicator of the standard of living, we find out that a steadily growing state of the indicator is not typical. The growth rate of living standards fluctuated from 2014 to 2018, and the change occurs at the level of 0.4% in 2018 towards a decrease [8].

The rate of productivity growth is increasing from year to year. The factorial analysis of productivity carried out shows that in 2018 relative to 2017, the index increased due to a decrease in the number of employees by 136.76 % and only by 36.76 % due to an increase in the amount of gross value added. The preponderance of the reasons for the change in productivity towards a decrease in the number of employed remains also when comparing the data for the period 2013-2017, table 2.
Table 2. Factor analysis of labor productivity in agricultural sector in the Irkutsk region for the period from 2014-2018.

| Years | 2013   | 2014     | 2015     | 2016     | 2017     | 2018     |
|-------|--------|----------|----------|----------|----------|----------|
| GRP, million rubles | 61194.9 | 58644.29 | 59101.30 | 59719.52 | 66901.63 | 82183.1 |
| Employed (HR), thousand people | 28.564  | 27.745   | 26.264   | 25.161   | 25.283   | 26.613   |
| Productivity, thousand rubles / person | 2142.4  | 2113.7   | 2250.3   | 2373.5   | 2646.1   | 3088.1   |

Performance deviation, incl. due to changes in GRP, % -211.22 87.94 80.9 -4.71 -36.76
Performance deviation, incl. due to changes in HR, % 311.22 12.06 19.1 104.71 136.76

Data on changes in the domestic regional product and the number of employed in the Irkutsk region and the Russian Federation in the period from 2008-2018 are shown in figure 3.

Figure 3. Dynamics of the domestic regional product and the number of employees in agricultural sector in the Russian Federation and the Irkutsk region in the period 2008-2018.

Analyzing the data of the graphs in figure 3, we can conclude that the situation in agriculture in the Irkutsk region does not repeat the change in the indicators of the same name in the Russian Federation. The growth of the added value of agricultural products in Russia in general and fluctuations in this indicator in the Irkutsk region, although the dynamics of the number of people employed in the agricultural sector has the same downward trend.

To identify a stable relationship between indicators of labor productivity and living standards in agricultural sector, we will analyze their relationship in the Irkutsk region for the period from 2013 to 2018. For this we will use the method of correlation analysis.

The correlation coefficient provides information according to the Chaddock's school about a moderate inverse statistical relationship between the indicators under consideration, since is equal to -0.4.

This proves that labor productivity indicators today are not tied to indicators characterizing the standard of living of the population, and more often even their change is contradictory, i.e. with an
increase in productivity, the standard of living of villagers in the region at least remains the same. We can talk about random processes of their growth. The growth in living standards is tied to a greater extent to the fight against inflation, and labor productivity indicators are improving due to an increase in proceeds from the sale of extractive industry products [9].

Since the growth of wages as a source of income for the majority of the population opens up an opportunity to raise the standard of living of the population, the existence of a relationship and its degree between indicators of labor productivity and real wages is of interest.

Information on the required indicators can be summarized in table 3.

Table 3. Dynamics of the growth rates of labor productivity and real average monthly wages in agricultural sector in the Irkutsk region for the period 2009-2018.

| Indicators                        | Years |
|----------------------------------|-------|
|                                  | 2009  | 2010  | 2011  | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  |
| Russia                           |       |       |       |       |       |       |       |       |       |       |
| chain rate of productivity gain  | 9.0   | -3.9  | 7.9   | -6.6  | 4.5   | 19.2  | 5.1   | -2.1  | 4.8   | -6.8  |
| chain rate of growth of real average monthly wages | -3.5 | 5.2  | 2.8  | 8.4  | 4.8  | 1.3  | -9.3  | 0.8  | 2.9  | 8.5  |
| Irkutsk region                   |       |       |       |       |       |       |       |       |       |       |
| chain rate of productivity gain  | -8.10 | 14.10 | 11.80 | 36.70 | 21.00 | -1.30 | 6.50  | 5.50  | 11.50 | 16.70 |
| chain rate of growth of real average monthly wages | -4.70 | 4.90 | 1.30 | 8.40 | 5.30 | 0.40 | -9.10 | -0.20 | 3.50 | 8.40 |

We observe from table 3 a rather positive mass of changes both in the context of the territorial and in the context of the indicators of the growth rates of wages and labor productivity.

It is interesting to evaluate the rule of the “effective wage” mechanism, which consists in outstripping the growth rate of labor productivity over the growth rate of the average wage.

The graphs in figure 4 give an idea that of the 3 possible combinations of the ratio of productivity growth rates and wage growth rates:

- the growth rate of productivity is higher than the growth rate of wages,
- the growth rate of productivity corresponds to the growth rate of wages,
- the growth rate of productivity is lower than the growth rate of wages - it is possible, in most years, the third.

As can be seen from table 4, the growth of labor productivity in the Russian Federation did not outstrip the increase in average wages in the country as a whole (1.12-0.93) = 0.19. But in the Irkutsk region the level of growth of the average annual output exceeds the level of the average annual wages in the Irkutsk region: (1.12-1.11) = 0.01, which is a positive fact and this picture can be seen throughout the entire period of analysis.

However, these indicators reflect only the size of the gap, but do not characterize the relationship between labor productivity and average wages. To characterize the relationship between these two indicators, it is necessary to calculate the percentage of growth in average wages for each percentage of growth in productivity. To do this, it is necessary to divide the percentage of growth in average wages by the percentage of growth in labor productivity and find the advance coefficient.

With the outstripping growth rates of labor productivity in comparison with the growth of average wages, the region receives a relative effect in the form of an increase in the regional product and savings for their redistribution to development funds [10].
Figure 4. The ratio of the growth rate of labor productivity and the growth rate of real average monthly wages in agricultural sector for the period 2009-2018.

Table 4. Analysis of the ratio of wages and labor productivity of agricultural sector in the Russian Federation and the Irkutsk region for the period 2009-2018.

| Years | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|-------|------|------|------|------|------|------|------|------|------|------|
| Wage growth rate | | | | | | | | | | |
| Russia | 1.08 | 1.12 | 1.12 | 1.14 | 1.12 | 1.09 | 1.05 | 1.08 | 1.07 | 1.12 |
| Irkutsk region | 1.07 | 1.13 | 1.11 | 1.14 | 1.12 | 1.08 | 1.04 | 1.09 | 1.07 | 1.12 |
| Labor productivity | | | | | | | | | | |
| Russia | 258.4 | 281.6 | 270.8 | 292.1 | 272.7 | 285.0 | 339.6 | 356.9 | 349.6 | 366.5 |
| Irkutsk region | 1104.3 | 1015.1 | 1158.3 | 1295.5 | 1771.1 | 2142.4 | 2113.7 | 2250.3 | 2373.5 | 2646.1 |
| Productivity growth rate | | | | | | | | | | |
| Russia | 1.09 | 0.96 | 1.08 | 0.93 | 1.05 | 1.19 | 1.05 | 0.98 | 1.05 | 0.93 |
| Irkutsk region | 1.08 | 0.92 | 1.14 | 1.12 | 1.37 | 1.21 | 0.99 | 1.06 | 1.05 | 1.11 |
| Difference between Russian Federation and Irkutsk region productivity growth rates | -0.17 | 0.18 | 0.04 | 0.43 | 0.16 | -0.20 | 0.01 | 0.08 | 0.07 | 0.23 |
| Difference between productivity growth rate and wage growth rate in Irkutsk region | 0.01 | -0.21 | 0.03 | -0.02 | 0.25 | 0.13 | -0.05 | -0.03 | -0.02 | -0.01 |
| Leading coefficient (increase in wages by 1% increase in productivity) | 1.013 | 0.817 | 1.031 | 0.980 | 1.221 | 1.119 | 0.951 | 0.976 | 0.979 | 0.991 |
Otherwise, the overrun of the payroll is allowed, and the efficiency of the sector is reduced. According to table 4, the growth rate of productivity in 2018 does not outstrip the growth rate of wages in this sector, but is 1% behind.

This picture has been going on for 4 years since 2016, so there is no advance of productivity over wages in agriculture in the Irkutsk region, the connection is very weak and, therefore, the motivational function of wages in the direction of labor productivity growth is not effective enough.

4. Conclusions

The above calculations prove that [11]:

- there is an increase in productivity without an increase in the standard of living in the agricultural sector of the economy of the Irkutsk region;
- the existing productivity growth is not sufficient for healthy growth of the agricultural sector of the Irkutsk region;
- the existing wage growth in the agricultural sector is not sufficient to increase the qualitative growth of labor productivity in this part of the regional economy. The increase in salary does not motivate people to work harder and better;
- in agriculture of the Irkutsk region, wage growth significantly outstrips the growth of labor productivity - this is the result of insufficient analysis of statistical data and their interpretation [12];
- The mechanism of "effective wages" does not work. An employee's salary increase does not lead to an increase in his labor productivity and does not set him up for more efficient and intensive work;
- other incentives should be developed to increase productivity, for example, to accelerate the growth rate of agricultural modernization, to be flexible in personnel policy: to regulate the number of employees, their motivation, work schedule, it is necessary to adjust the organization of processes;
- dominant productivity can be obtained through organizational and investment measures, which will increase wages, on the basis of which the standard of living of citizens will rise in the countryside.

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