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IDENTIFICATION OF REGIONAL LABOR FACTORS OF INFLUENCE ON COSTS FOR INNOVATION OF ENTERPRISES IN THE REGION

In this paper, we examined the impact of labor loyalty and the labor market situation on the costs of companies in the region on research and development. In the work was carried out the analysis of existing articles and papers on related topics. First of all, it was our task to determine the mathematical model of the concept of loyalty of the workforce, to determine from which economic indicators it can be identified. We have identified and justified the hypothesis that the loyalty of the workforce is the ratio of the following indicators: the number of unemployed and the number of free work places. In the case of such a definition of loyalty, it was important to take the indicators for one group of workers (with the same qualification) to exclude the effects of structural unemployment. So coming to understand the factors on which the loyalty of the labor force in the region is based, we included them in our model to try to establish some relationship between the above variables and the desire of employers to invest in R & D. Based on the analyzed data and the results of testing using econometric methods, the dependence of investments in innovation and labor loyalty in the regions of Russia was proved in this paper. A direct dependence was established that indicates a decrease in loyalty to the employer increases the motivation of the last one to invest in innovation.

Keywords: unemployment, R & D, need for labor, employment protection, innovations, employment protection legislation

Introduction. Theoretical Basis

The academic literature has already documented different effects of EPL, which seem contradictory enough. One strand of the literature documented a negative effect of employment protection on productivity through inefficient worker reallocation. Another strand of the literature has shown that EPL increases incentives to innovate and train. Pierre and Scarpetta [1], for example, also show that EPL incentivize firms to invest more in training. Acharya et al. [2] exploit the staged adoption of wrongful discharge laws in the U.S. to show that EPL spurs innovation and new firm creation, and Koeniger [3] shows that countries with strict EPL tend to specialize in improving existing products.

Theoretically, the positive effect on training and innovation can be explained by the decreased fluctuation of employees [4][5], the increased cost of laying off innovating and thus sometimes underperforming employees [2], and firms' interest to improve existing products in order to ensure their competitiveness [3]. All these explanations are important to understand how EPL affects the economy.

However, since they focus on how firms adjust their organization, they are not able to explain why the innovation and manufacturing sectors grow [2][6] at the expense of others [7].

Interest in issues related to employment protection from researchers in the field of labor economics can hardly be called independent, but it should be recognized that it arose in the process of studying such problems as flexibility and adjustment, the duality and segmentation of the labor market, the dynamics of unemployment and employment .

In our paper we decided to look into important factors showing the level of employment and unemployment.

Negative productivity effects from inefficient labor reallocation are found in previous researches [6][8][9][10][11]. Pierre and Scarpetta [1] report that hard influence of EPL (due to high unemployment in the region or country) particularly harms the growth prospects of medium sized firms.

Other authors also emphasize different positive aspects of EPL: Bertola [12] shows that despite EPL lowers returns to irreversible investment and thus the speed of capital accumulation, it shifts the income distribution towards workers with no capital income. This explains why trade unions often favor stricter EPL. Kessing [13] argues that firms facing EPL have a stronger average market position as they can credibly commit to fiercely defend their position against potential competitors, because EPL makes market exit very costly.

We try to expand the model of influence EPL to market legislation and look into the notion of labor loyalty and its impact on innovation.

We assume that the most significant contribution of trade unions and the law on the protection of employment is to reduce the loyalty of employees to their employers. This is due to increased expectations from working conditions, wages and other perks.

According to our assumption, the degree of loyalty of the workforce can be measured not only by the strength of the law on employment protection, but also by the de facto data on the employment structure of the population. So, with the same degree of qualification for the unemployed and the qualifications required for the vacant workplace, we can say that unemployment is provided by the employee's own reluctance to agree to the proposed working conditions. This is what we call disloyalty to the employer at the regional level. If you look at this ratio of free jobs and the number of unemployed in the region, there may be a general idea of the propensity for loyalty among workers.

As an indicator characterizing the development of R & D, we took the costs of local firms for their own research and development. Of course, we understand that the overall development of innovations in the region is not limited to this indicator, but we took it from the assumption that it is this component of investment in innovation that will be influenced most by the situation in the labor market.

The internal costs of research and development are the actual costs of performing research and development in the country (including those financed from abroad but excluding payments made abroad) expressed in monetary terms. Their assessment is based on statistical accounting of the costs of performing research and development by the organizations' own forces during the reporting year, regardless of the source of funding.

Method and Data

In our paper we used methods of econometrics modeling to describe observed regions data and to find the evidence of our hypothesis due to interpretation of results.

For better evaluation of the model we used panel data that help to describe individual effects of observations groups. The panel data combines both cross-sectional data and time-series data: at each time there is spatial type data by economic units, and for each such object, the data corresponding to it form one or more time series.

Due to the special structure, panel data allow to build more flexible and meaningful models and to receive answers to questions that are not available only within the framework of, for example, models based on cross-sectional data.

In particular, it becomes possible to take into account and analyze individual differences between economic units, which can not be done within the framework of standard regression models. It's certainly crucial when research includes regional data.

So, based on statistical data for the 81 regions of the Russian Federation in dynamics over 5 years[1] - from 2011 to 2014, an econometric research was conducted. The Chukotka region, the Jewish Autonomous Okrug, and the Crimea and Sevastopol were excluded from the observations due to the lack of open access to the necessary information.

[1] Governmental statistic database www.gks.ru

This period (2011-2014) was chosen due to the availability of the necessary data retrieval. This helped to create a balanced panel that allows to build estimates with the greatest accuracy.

As an explicable variable, reflecting the degree of interest in innovation among companies in the region, we chose the indicator of the **R&D costs**. First of all, we are talking about developments regarding the development of technological aspects of fixed capital and improving production efficiency by improving technology, when we mentioned this variable.

To describe the situation on the labor market, we chose two key indicators:

1) The **unemployment** rate among the population with higher education

2) The **need of companies** in qualified personnel with higher education, expressed as the number of vacancies.

Here it should be explained why the above indicators were taken.

First of all, we understand unemployment as a factor that can show us the overall situation in the region's economy (it is well known that high unemployment provides problems in the economy).

Among other things, according to the law of supply and demand, a high level of unemployment tells us that labor in the region will be very cheap, or already is at a low level.

As a second regressor, we took the labor demand indicator. It shows the degree of interest in qualified employees, as well as the company's desire to develop its production (not so important extensively or intensively). In addition, the need for staff indicates that the company has free money, which they are ready to invest in a new employee, provide him with training and salary in the future.

However, the most interesting situation consists of both these indicators, connected in one model. Speaking about the delta between the number of unemployed and vacant jobs, we can explain such an unclear, but very important indicator of employee loyalty at the regional level.

Loyalty of employees determines the degree of their desire to be held in the workplace and with great enthusiasm in the job search. In the case of a large ratio of the number of vacant seats to the level of unemployment (always in the same categories of labor) we can think about the low level of loyalty.

Direct analysis of the data array was carried out in the Stata program.

We derived descriptive statistics for a more complete description of the collected data.

Table 1.

Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
R&D costs	8468.243	30170.96	6.068	298249
Unemployment	15266.65	19567.16	70	149549
Need of companies	55755.56	41411.51	1000	238000

So, we went on to direct regression modeling. Such results were obtained:

Table 2.

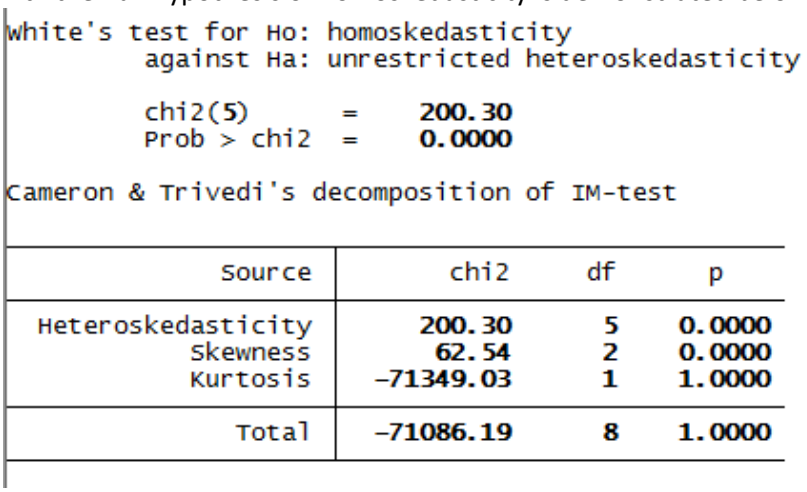
Linear regression

Variable	Coefficient
Unemployment	1.405*** (0.044)
Need of companies	-0.117*** (0.02)
Constant	-6439.557*** (1314)
R-Squared	0.7345

The explanatory power of the model is shown by R-squared, which in our case is equal to 73.5%. This is a fairly good level of the explanatory ability of the model provided that only 2 factors are included in it (as it is known, with the number of regressors, R ^ 2 also grows).

Both indicators are also significant. Nevertheless, it makes sense to test heteroscedasticity in a model that can cause estimates to shift and create an incorrect impression of their effect on the endogenous variable.

White's test with the null hypothesis of homoskedasticity is demonstrated below:



```
white's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(5)      =    200.30
         Prob > chi2  =    0.0000

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	200.30	5	0.0000
Skewness	62.54	2	0.0000
Kurtosis	-71349.03	1	1.0000
Total	-71086.19	8	1.0000

Fig. 4. *White heteroskedasticity test*

It was found heteroscedasticity, accordingly, it is necessary to correct errors. Let's do this manipulation.

Table 3.

Corrected error estimates

Variable	Coefficient
Unemployment	1.405*** (0.16)
Need of companies	-0.117*** (0.033)
Constant	-6439.557*** (1396)
R-Squared	0.7345

Further, it is necessary to assess the possibility of multicollinearity between the unemployment rate and the need for workers. We carried out this action with the help of the VIF-test in Stata program.

Table 4.

VIF-test

Variable	VIF
Unemployment	1.21
Need of companies	1.21

The value of VIF <4, multicollinearity between the indicators is absent.

Now that we are convinced of the adequacy of the indicators. It is necessary to make sure of the correct specification of the model. This will help us to understand whether it is worth looking for some other form of dependence, or the linear model best describes the existing dependence.

For this reason, Ramsey's test was done.

```
. ovtest

Ramsey RESET test using powers of the fitted values of in_costs
       Ho:  model has no omitted variables
                  F(3, 399) =     167.55
                   Prob > F =     0.0000

.
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Fig. 5. *Ramsey test*

Probability is less than significance level so it means the right specification of our model.

The last but not least is to understand which kind of individual effects data have.

In addition to pooled model that doesn't count individual effects of observations we should also model options with that.

Between- and within-group regression modelling augments cross-sectional analysis of epidemiological data by supporting the unmasking of non-causal associations arising from hidden confounding at different levels.

The "between" regression is the original model rewritten in terms of the time-averaged values of the variables:

In this case, the value of R-sq between reflects the quality of the regression fit and is large enough (0.7220), i.e. the change in time averages for each region has a more significant effect on each variable than the time variation of these indicators relative to the average.

So it is a result of between regression:

Table 5.

Between regression

Variable	Coefficient
Unemployment	1.48*** (0.09)
Need of companies	-0.149*** (0.044)
Constant	-5819.788** (2735)
R-Squared	
within	0.05
between	0.77
overall	0.73

Our regression and indicators are still relevant, it's a good sign. Now we are going to make models with fixed and random effects and choose the best model.

Table 6.

Model with Fixed effects

Variable	Coefficient
Unemployment	0,156** (0.0789)
Need of companies	-0.085*** (0.0264)
Constant	10824***

	(2275)
R-Squared	
within	0.069
between	0.2843
overall	0.2573

Table 6.

Model with Random effects

Variable	Coefficient
Unemployment	0,7245*** (0.062)
Need of companies	0.001 (0.0234)
Constant	-2659*** (2476)
R-Squared	
within	0.0387
between	0.7461
overall	0.7122

First of all, compare pooled regression model with random effects model.

```
Breusch and Pagan Lagrangian multiplier test for random effects

        in_costs[region,t] = Xb + u[region] + e[region,t]

        Estimated results:
                         |       Var      sd = sqrt(Var)
                ---------+------------------------------
                in_costs |   9.10e+08        30170.96
                       e |   2.69e+07        5190.778
                       u |   1.98e+08        14072.19

        Test:   Var(u) = 0
                                 chi2(1) =    487.99
                              Prob > chi2 =    0.0000
```

Fig. 6. *Breusch and Pagan test*

Since the p-level is <0.01, the main hypothesis is rejected. Thus, the model with random effects better describes our data than the pooled regression model.

Then, compare fixed effects model with random effects model.

```
    Test:  Ho:  difference in coefficients not systematic

                  chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        26.15
                Prob>chi2 =       0.0000
                (V_b-V_B is not positive definite)
```

Fig. 7. *Hausman test*

Since the p-level is <0.01, the main hypothesis is rejected. Thus, the model with fixed effects is better than the model with random effects.

According to the data for 81 regions in Russia for a five-year time interval, we obtained the following quantitative dependencies:

- Direct dependence on the number of vacancies for people with higher education.
- Inverse dependence on the number of unemployed.

With an increase in the need for labor in 1 workplace, enterprises are ready to spend 15.96 thousand rubles for research instead of attracting an employee to this place.

However, with an increase in unemployment (for example 1 additional unemployed), investments in R & D from enterprises are reduced by 3,34 thousand rubles.

Results

In the research process, the hypothesis was confirmed that the situation in the labor market was related to the desire of companies in the region to invest in the The opposite direction of the effects of unemployment and the number of vacant jobs is easily explained. First of all, when we talk about the impact of unemployment, the higher its rate, the less investment in innovation is prepared for the companies of the region.

So, according to a number of studies of the above-mentioned, unemployment is an indicator that worsens the overall economic environment in the region, and also promises low subsidies for the development of innovations. This is due, above all, to the law on the protection of employment. Trade unions are campaigning for less efficient use of the labor force, imposing greater involvement of labor capital in production than is necessary. Despite all the rhetoric associated with looking at the business as a source of jobs, no one businessman will not want to expand his staff without a good reason - he will do it only if there is no other choice. This is precisely what happens when unemployment in the region is high: the obstacles on the part of the law and the high labor supply make investing in innovative development less profitable for the entrepreneur. Also a couple of words in addition is worth mentioning about the supply of labor. With a high supply on the labor market, the price of these resources falls, making the costs of attracting labor capital lower than the marginal costs of fixed capital and, consequently, the costs of research and development.

As for the indicator reflecting the need for workers, it has a positive correlation with investments in R & D in the region. This is due to the understandable inability to provide the necessary amount of labor resources to the work of enterprises, which makes it necessary to invest in capital (and increase its efficiency through innovative developments). This approach has been proved by many venerable scientists [1][3].

After all, according to the hypothesis that the production function in most industries is described by the Cobb-Douglas function, such behavior of firms is quite clear.

But besides the above-described reason, there is one more. It takes place under the coexistence and simultaneous fulfillment of 2 conditions:

1) Simultaneous coexistence of unemployment and the need for cadres

2) The absence or minimization of the fact of structural unemployment (which we ensured, taking the unemployment rate and the demand for personnel only for the population with higher education)

If these conditions are met, we can say that there is some disloyalty of employees to enterprises. This may be due to inadequate fair wages or inadequate conditions and strong protection of trade unions. Either way, low employee loyalty makes investment in the workforce less attractive, which creates an additional incentive for innovation and development in terms of fixed capital.

Of course, when it comes to the impact of the situation on the labor market on innovation, it is logical to assume some endogeneity, especially if we believe the hypothesis of technological unemployment, which is generated by technological changes, creating a loss of jobs.

Nevertheless, this hypothesis was repeatedly argued by leading economists as early as the 1930s (for example, John Maynard Keynes). Among other things, the reduction of the workforce in the name of increasing investment opportunities is excluded due to the actions of trade unions.

In order to make sure that there is no endogeneity, we ran the reverse regression, which turned out to be insignificant, as well as the coefficient at the cost of investments in R & D.

Conclusion

Based on the analyzed data and the results of testing using econometric methods, the dependence of investments in innovation and labor loyalty in the regions of Russia was proved in this paper. A direct dependence was established that indicates a decrease in loyalty to the employer increases the motivation of the last one to invest in innovation.

Of course, there are many more indicators that affect innovation, even considering only the aspect of the labor market, we will be able to name some other factors. Thus, the number of trade unions in the region certainly acts as another indicator of the loyalty of the population and describes the degree of protection of workers. In addition, it is possible to introduce an additional adjustment to the level of structural unemployment, in order to finally clear the results of our model from the suspicion of the discrepancy in the unemployment rate and the demand for employees at the enterprises.

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