

Regional Growth and Investment Behavior: the Case of the Russian Far East

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Abstract— According to the dominating paradigm of regional growth, the movement of capital is based on the well-known postulates of the neoclassical theory. Less attention is given to the dynamic properties of the regional economic system itself, and the role they play in the process of regional capital formation is relatively neglected. On the basis of flexible accelerator model the relationship between capital formation and indicators of regional economic conditions in the Far Eastern Federal District are examined over the period 2000-2016. The results indicate that only 36% of the gap between desired and actual level of capital stock is closing within one period.

Keywords— *Far Eastern Federal District, Investment, Flexible Accelerator, Regional Growth*

1. INTRODUCTION

Currently, the Far East is an object of priority attention of the federal government. The interest in the region is associated with the holding of the APEC summit in Vladivostok in September 2012, where barriers for private investment attraction to the Far Eastern economy were identified, such as weak infrastructure, high out-migration and energy tariffs, lack of tax preferences, etc.

It is widely recognized that capital stock expansion is the main stimulus of regional economic growth. Capital investment therefore is in the focus of economic analysis. Nevertheless, at the sub-national level empirical analysis of investment processes is difficult, mainly due to the scarcity of data. This is particularly true for the regional fixed capital statistics. Some studies [1] suggest indirect methods of parameters estimation of regional production function not requiring data on the volume of fixed capital, but for the studies concerning demand side of investment processes the availability of such data is highly desirable.

The aim of the paper is to examine the relationship between capital formation and indicators of regional economic conditions in the Far Eastern Federal District (FE). The paper is organized as follows. The next section provides a brief description of the dynamics of capital investment in the Far Eastern economy for the last decade. The theoretical basis and econometric specification of the model are then presented. Data construction and estimation results are discussed in Sections 4 and 5. Finally, Section 6 concludes.

2. CURRENT TRENDS IN THE INVESTMENT PROCESSES OF THE RUSSIAN FAR EAST

A distinctive feature of the Far Eastern investment activity, both private and public, is the redistribution of national capital

resources in favor of the region. The share of total investment in the economy of the FE in the 2000s exceeds its contribution to the formation of a gross national product. In 2005-2016, the share of the gross added value created in the region averaged 4.7% of the national total, whereas the share of investments was 8% of public and 7.6% of private total.

In 2016, the volume of capital investment in FEFD amounted to 903 billion rubles. Dynamics of investment in the region during the period of 2005-2016 was generally positive (an increase of 25.4%), but two differently directed periods can be clearly distinguished. Prior to 2011 investments grew at a high rate (195% in 2005-2011), but after 2011 there was a sharp decline of investment activity (64% in 2016 against the level of 2011). The main factor that triggered the recession was the completion of two large infrastructure projects: a) the oil pipeline "Eastern Siberia - Pacific Ocean", and b) the facilities of APEC-2012 Summit in Vladivostok.

By the end of the 2010s FE has become a region with a mining specialization. Capital investments were directed mainly to resource-producing sectors and infrastructure. In 2011, investments in mining accounted for 20.5% of the total, in the transportation sector - 47.6%. However, by 2016 the situation has changed. After a drastic reduction of investments in the transportation sector (by 65.8% during the 2011-2016 period), the latter accounted for 25.3% of the total volume of capital investments, whereas the share of the mining sector investment increased to 39.3%. The mining industry is the only capital-intensive sector in FE, experienced steady growth of investments for the period 2011-2016 (by 23.3%). In other capital-intensive sectors - processing industries, production and distribution of electricity, gas and water, - investment declines after 2013 (by 28.6%) and 2012 (by 59%) respectively.

A sharp reduction in investment after 2011 was accompanied by slowdown of the overall regional economic dynamics: in 2005-2011, the growth rate of the FE total GDP was 35.9%, but in 2011-2015, it was less than 1%. Despite the growth of value added after 2011 in majority of capital-intensive activities (mining - 5.8%, transportation and communications - 4.4%, manufacturing - 4.1%), almost a double fall in the construction sector (by 47.6%) was observed. If the share of the latter in FE total GDP in 2011 was 13%, it decreased to 6.8% by 2015.

Thus, the lion share of investments in the FE are directed to sectors that have a time-limited (construction) or geographically localized (mining) multiplier effects.

Consequently, the long-run effect of capital investment on regional economic growth is determined (and, correspondingly, limited) by their structure. The further analysis is aimed to figure out the quantitative relationship between investment and their determinants in the FE economy.

3. INVESTMENT AND CAPITAL FORMATION: THEORY AND ESTIMATION ISSUES

In the bulk of research regarding regional growth and convergence, the capital movement is based on the well-known postulates of neoclassical theory. In fact, the mobility of capital and spatial equality of prices of capital goods is constrained by a number of factors, among which as outlined in [2] are: 1) the ratio of enterprises of different sizes, localized in a certain territory, 2) the shift in investment flows from regions with a potentially high rate of return towards more traditional growth poles, 3) 'industrial inertia', linking investments to already created capacities and slowing the mobility of capital.

Jorgenson [3] proposed an investment model in neoclassical framework in which firm maximizes the present value of its future revenues stream. He demonstrated that the firm will adjust its capital stock in each period in order to remain on the optimal trajectory of capital services given their changing rental value. Jorgenson also demonstrated that the flexible accelerator model is a special case of the neoclassical model.

The model of investment behavior is derived from the flexible accelerator model. The latter states that desired stock of fixed capital K^* at any time t is proportional to the volume of output (or income) Y . Following [4] we define \mathbf{m} as a row vector of variables (along with Y) that influence the cost and revenues of capital:

$$K_t^* = \mathbf{m}_t \gamma \quad (1)$$

Where γ is a column vector of unknown parameters.

Firms invest in order to adjust their actual capital stock K to the desired level K^* . However, it is practically unlikely to achieve the desired level during the one time period (say, a year). It is possible to approach this level at a certain speed of adjustment λ whose value is expected to lie between 0 and 1. Then we can define investment as:

$$I_t = K_t - K_{t-1} = \lambda(K_t^* - K_{t-1}) \quad (2)$$

Substitution of (2) into (1) gives a model where capital stock in period t is a function of its own lagged level, output and the values of other variables included in vector \mathbf{m} :

$$K_t = (1 - \lambda)K_{t-1} + \lambda \mathbf{m}_t \gamma. \quad (3)$$

Adding the error term u_t to the right-hand side of (3) gives us the equation that can be estimated to obtain the values of the parameters λ and γ .

The presence of the lagged dependent variable among regressors of (3) raises a well-known problem of serial correlation in the error term. It means that ordinary least squares provides inconsistent estimates of the parameters of (3). In order to eliminate serial correlation in the error term, the first order autoregressive (AR1) generalized least squares estimator is used.

4. SPECIFICATION OF INDEPENDENT VARIABLES, DATA AND VARIABLE CONSTRUCTION

The vector \mathbf{m} of independent variables includes the following elements:

$$\mathbf{m} = [Y, W, R, P] \quad (4)$$

As was mentioned before, Y is a measure of regional income (or output). The corresponding coefficient of variable represents accelerator effect and is expected to have positive value.

The second variable, W is the price of labor, which can have either negative or positive effect on investment. Investment is negatively related to production costs, which are affected by wages. On the other hand, if labor may be substituted for capital, increasing wages may stimulate investment. The sign of the parameter relating the price of labor depends upon which of the effects is dominant. R is the price of capital services and is expected to have negative effect on investment.

P is a variable representing the effect of regional policy initiatives undertaken by federal government in order to stimulate economic development of the Russian Far East. As shown in Section 2 above the last decade is marked by significant investment in transport and social infrastructure financed primarily by federal budget and state-owned enterprises. Because the region is in focus of the state regional policy it is expected that this variable will show a positive influence on investment in FE.

All the data for dependent and independent variables for FE are obtained from the official site of the Federal State Statistics Service [5]. Data are used for the years 2000 through 2016. All monetary measures are in constant prices of 2008.

The main problem is the lack of regional data on capital stock growth rates. Some empirical studies based on flexible accelerator model, as in [6], [7] and [8], use the investment variable instead of capital stock variable. Another studies (e.g. [4]) construct capital stock data using perpetual inventory method. The latter required long time series on investment and assumptions on physical depreciation of capital function for assessment of the rate of depreciation δ . Then K may be estimated as:

$$K_t = (1 - \delta)K_{t-1} + I_{t-1}. \quad (5)$$

Another way to construct regional capital stock time series is to use the flexible accelerator model. Let α be the accelerator parameter for output Y . It can be shown (see [9]) that:

$$I_t = \alpha \lambda Y_t - \alpha \lambda (1 - \delta) Y_{t-1} + (1 - \lambda) I_{t-1} \quad (6)$$

Using the parameters α , δ and λ it is possible to obtain an estimate for the capital stock for period $t-1$:

$$K_{t-1} = \frac{\alpha \lambda}{\lambda - \delta} Y_t - \frac{1}{\lambda - \delta} I_t \quad (7)$$

For the parameters estimation of (6) panel data on investment and value added were used for the period 1998 through 2016 in constant 2008 prices for every of 9 regions included in FE. The estimation was carried out by generalized method of moments due to the presence of lagged dependent variable among the explanatory variables (the details on the estimation results and on the capital stock data construction are omitted due to the lack of space). On the next stage time series of the aggregate capital stock data for FE was constructed using equations (7) and (5) (it should be noted that the estimation of parameter λ in (6) is NOT used as the estimation of the same parameter in equation (3) because of the different data sets and estimation methods used). Finally, the constructed data on the aggregate capital stock was adjusted by linear approximation of the second order to obtain the smoothed time series of K for the period 2000-2016 (in billion rubles) for use in equation (3).

Regional output Y is measured as aggregate value added for FE by summing up gross domestic products of all 9 regions included in FE. Remaining variables for year t are also the sum of 9 variables for that year.

The price of labor W is defined as the ratio of total wages to value added Y . The mean value of the variable for the period 2000-2016 is 0.5. The price of capital services R calculated by dividing payments to capital by the capital stock K and is measured as rubles per one ruble of fixed capital stock. The mean value of R for the period under study is 0.17.

Regional policy variable P represents policy instruments. In this study they are treated in rather simple form, measuring degree of state attention toward FE. Capital investments are funded from different sources, such as private, state-owned, municipal, foreign, etc. P is defined as share of FE in national capital investment funded from state-owned sources (federal and regional budgets along with state-owned enterprises). In the period under study this share fluctuated from its lowest level of 6.8% in 2003 to its highest level of 14.2% in 2011. This is a somewhat crude indicator, but it can be considered acceptable taking into account the availability of data.

5. ESTIMATION RESULTS

Table 1 present the results of AR1 estimation of the following equation:

$$K_t = c_0 + \theta K_{t-1} + \beta_1 Y_t + \beta_2 W_t + \beta_3 R_t + \beta_4 P_t + u_t \quad (8)$$

where $\theta = 1 - \lambda$, $\beta_i = \lambda \gamma_i$. Each parameter estimate is accompanied by its t -statistics in parentheses. In autoregressive models the values of R^2 are very close to 1. Therefore it is accompanied in parentheses by the ratio of the standard error of the regression to the mean value of the dependent variable.

Table 1. Estimation Results for the Far Eastern Federal District

Independent variable	Dependent Variable = K_t
<i>Constant</i>	9588.1 (14.2)
K_{t-1}	0.6408 (6.94)
Y	2.7490 (11.8)
W	-9829.9 (-15.9)
R	-25570.4 (-23.3)
P	2.5155 (0.37)
R^2 (S/ K_{mean})	0.99 (0.0062)

The parameters associated with K_{t-1} , Y and R are of expected sign. The increase of wage ratio W tends to have disincentive effect on investment in FE. Regional policy tends to have no influence on regional capital formation, despite the trends outlined in Section 2. The reason may be inappropriate selection of proxy for P , but the result may reflect the fact that state-owned investment have a time-limited effect on acceleration of economic activity in the region.

From equation (8) partial adjustment parameter λ is obtained by subtracting the coefficient on the lagged capital stock from 1. It follows that in the case of FE only 36% of the adjustment to the desired level of capital stock takes place during the one investment period. Relatively low adjustment parameter can be explained by the technological structure of investment. In general, the values are lower for structures than for machinery and equipment. The former are more time-consuming and impose higher adjustment costs. For the period 2000-2016 investments in structures in FE were 53% on average from total amount, while machinery and equipment share was only 25%. Further work is required to identify the impact of different types of investment on economic performance of the region.

6. CONCLUSION

In the study the assessment was made of the relationship between the dynamics of capital stock formation and factors influencing it in the case of the Russian Far East. The model includes a dynamic investment function in which investment is endogenous. The results indicate significant influence of capital and labor costs on investment. Although the regional policy variable employed in this study doesn't indicate significant effect of state-owned financial injections on capital formation in the region.

Despite the positive dynamics in a number of capital-intensive sectors, after 2011 the inflow of investments into the Far East declined sharply and the overall growth rate of the economy slowed. Further reduction of investment/output ratio will inevitably lead to economic stagnation and subsequent reduction of the region's value added produced in the long run (according to Melnikova [10] during the period 2001-2007 in the Russian Far East the investment/output ratio was on average the highest among Russian Federal Districts (30,6%). Of course, these arguments are valid provided the current structure of investment is preserved, which is conditioned by economic specialization of the region.

The results point the way for further research. Estimates on the base of aggregate capital stock impose certain limitations on investment behavior forecasts. This also limits the analysis of the regional output response given actual and target indicators of investment dynamics. In this case the quality of forecast is determined by the fixed structure of investment. Therefore, structural analysis of investment is required and industry investment functions should be estimated to allow economic performance forecasting on the basis of structural changes in the Far Eastern economy.

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