Cross-regional Variations of Assets Lifetimes: Evidence from Russia

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Cross-regional Variations of Assets Lifetimes: Evidence from Russia

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Abstract

An important challenge in the measurement of capital input for productivity analysis is to obtain appropriate measure of depreciation. Most studies on cross-country differences of economic growth and productivity, using growth accounting approach assume a common economic depreciation rates across countries. However, there has been empirical evidence that asset lifetimes are endogenous and therefore, depreciation could vary across firms, industries, and countries. Even though existing evidence on the determinants of lifetime hints to the possible role of innovation among other factors (Erumban and Timmer 2012), the literature on what factors influence assets lifetimes is still very weak. This lack of understanding is explained by difficulties of obtaining depreciation data across countries, suitable for comparisons.

The present study exploits a new micro dataset, which is based on a survey of assets lifetimes carried by the Russian statistical office (Rosstat) in 2008 to understand cross-region variation of asset lifetime and its determinants. The survey covered 238.3 thousand assets of around 11 thousand large and medium firms and 4.5 thousand non-profit organizations in 66 Russian regions. We report large variation of assets' lifetimes across Russian regions. Using simple OLS regressions and service life regional averages we try to explain this heterogeneity with various characteristics of a region. We test if lifetimes of residential buildings, constructions, transport equipment, other machinery and ICT capital depend on gross regional product growth, quality of traffic infrastructure (for transport), R&D

expenditures and the share of innovative products in regional output (for machinery and computers). We show that machinery and transport equipment lifetimes fall with higher regional output growth, which can be explained by higher capital utilization and, consequently, higher capital renovation in more dynamic regions. At the same time the other factors seem statistically insignificant. We also compare average lifetimes of capital in market and non-market economy, considering capital of the latter as a proxy of public capital. We show that average lifetimes of all non-market economy assets, except machinery, are longer.

1. Introduction

An important challenge in the measurement of capital input for productivity analysis is to obtain appropriate measure of depreciation. Most studies on cross-country differences of economic growth and productivity, using growth accounting approach[1] assume a common economic depreciation rates across countries. However, there has been empirical evidence that asset lifetimes are endogenous and therefore, depreciation could vary across firms, industries, and countries. Even though existing evidence on the determinants of lifetime hints to the possible role of innovation among other factors (e.g. Erumban, Timmer (2012)), the literature on what factors influence assets lifetimes is still very weak. This lack of understanding is explained by difficulties of obtaining depreciation data across countries, suitable for comparisons.

Apart from many economic and innovation variables, which are highlighted in the literature, there have been a number of other variables that may have a significant role in influencing asset life time, particularly in the developing countries. For instance Bu (2006) stresses the role of corruption, government investment incentives and incompatible repair facilities, in bringing down the average lifetime of capital assets in developing countries. Pritchett (2000) speculates about differences in depreciation of public and private capital. Our dataset allows a deeper examination of all these assets, and to test these entire hypothesis as it includes both firms and non-profit organizations. Moreover, it can also be linked to various characteristics of Russian regions as well. The present paper attempts to analyze the differences in asset lifetimes across various regions in Russia. In particular, it examines the role of government policies and the presence of public sector in determining asset life time.

The present study exploits a new micro dataset, which is based on a survey of assets lifetimes carried by the Russian statistical office (Rosstat) in 2008 to understand cross-region variation of asset lifetime and its determinants. Using simple weighted OLS regressions and service life regional averages we try to explain differences in asset lifetimes with various characteristics of a region. We test if lifetimes of residential buildings, constructions, transport equipment, other machinery and ICT capital

[1] See, e.g., (Bosworth and Collins 2003).

depend on such regional characteristics as gross regional product growth, quality of traffic infrastructure (for transport), R&D expenditures and the share of innovative products in regional output (for machinery and computers). We show that machinery and ICT equipment lifetimes fall with higher regional output growth, which can be explained by higher capital utilization and, consequently, higher capital renovation in more dynamic regions. At the same time the other factors seem statistically insignificant. We also compare average lifetimes of capital in market and non-market economy, considering capital of the latter as a proxy of public capital. We show that average lifetimes of all non-market economy assets, except machinery, are longer.

This paper has been organized in the following way. The second section describes the survey dataset and key concepts of the statistical survey questionary. The third section discusses testing the influence of various regional characteristics on assets service lifetimes. The fourth section concludes.

2. Data and sources

The present study exploits a new micro dataset, which is based on a survey of assets lifetimes carried by the Russian statistical office (Rosstat) in 2008 to understand cross-region variation of asset lifetime and its determinants. The survey covered 238.3 thousand assets of around 11 thousand large and medium firms and 4.5 thousand non-profit organizations in 66 Russian regions. The asset composition consists of 2.3 per cent of residential buildings, 13.6 percent non-residential buildings, 16.3 per cent construction, 43.2 per cent of machinery and equipment, and 24.6 per cent was of transport. For each asset the survey includes data on vintage years, expected (for assets in operation) and actual (for assets, discarded in 2008) service lives, exact specification of an asset (nine digit classification code), as well as the industry and region codes. A comprehensive description of the survey and the corresponding statistical survey questionary is provided in Russian by Gordonov (2010). The questionary was filled in by a firm on the basis of the firms' records and estimations of its technical experts.

We pay particular attention to *the nine-digit classification code of the asset* of the Russian asset classification (Gosstandart 1994), which provides an opportunity of matching the assets with an international one, such as used by Fraumeni (Fraumeni 1997)[2]. We also calculate the expected lifetime of an asset as *an actual service time* by the end of the year of the survey (2008) plus *the expected remaining lifetime*. The latter is defined in the questionary as the estimated number of years the present asset remains in operation, taking into account the opinion of a technical expert. A respondent was informed that this service life could be not equal to the planned service life used in accounting for taxation purposes[3].

[2] We opt for this classification, because the series of capital services in the World KLEMS project is based on it. In turn, we use the World KLEMS data for the sensitivity analysis.

[3] The form also explicitly clustered assets passed capital repairs, which influenced the lifetime of the asset. In this study we do not take them into consideration.

Since we are interested in depreciation, it is essential if this definition of a service life is consistent with the definition in the World KLEMS data (www.worldklems.net). The latter is given by Fraumeni (1997, p. 8), who defines depreciation as the change in value associated with the decline in the asset's efficiency only, excluding obsolescence as well as other possible matters for revaluations. Although the survey definition of a lifetime is vague concerning obsolescence, we assume that the expected lifetime is related to the efficiency of the asset only.

Although the object under observation in the dataset is a capital asset, such as a truck, a hospital building or a road, there is no opportunity in this dataset to make a link between an asset and a firm the asset belongs to, or to identify a group of assets of one firm. That is why we calculate lifetime averages for regions and industries, and try to explain variations of these average lifetimes across regions. Such regional characteristics as gross regional product growth, research and development expenditures, the share of new products value and the share of hard-surfaced roads in a region are available in official statistical publications (Rosstat 2009).

3. Results and discussion

3.1. Variation of service lives in Russian regions and its determinants

Lifetime variations across Russian regions are substantial for all six major types of assets. Table 1 shows average service life values for them as well as minimum and maximum regional variances. As can be seen, the most long live assets are residential structures with the average service life 59 years. At the same time, it varies from almost 22 years in Kostroma region to 113 years in Ivanovo. Both regions are in Central Russia. The average service life of non-residential structures is almost 20 years shorter, being equal to almost 42 years. At the same time, it regional variation is also substantial – from 16 years in Nenets Autonomous Area in the north to 72 years in Ivanovo region Such variations in constructions could have not only economic nature, but also with such climate characteristics as temperature differences in winter and in summer, air humidity and depth of soil freezing in winter[4]. Differences in life time of other types of assets are also substantial. Transport equipment is younger in wealthy capitals – Sankt-Petersburg and Moscow (around 8 years) older in the Far East (Kamchatka, 21 years; Primorskii Krai 19 years; Magadan, 19 years) and South near the Kaspian Sea (Astrakhan, 22 years). Age distribution of machinery and equipment, computers and communication equipment is also different and could depend more on the industrial structure of regions.

[Tab. 1 is about here]

[4] These factors will be considered in the next version of this paper.

Why do asset lifetimes vary across regions? One of possible explanations is regional economic growth, measured by growth rates of gross regional product (GRP). Erumban and Timmer (2012) argue that higher economic activity increases capital utilization and accelerates capital renovation. One more such factor is the share of new products in total output of a region, which reflects product innovations. Introduction of a new product could lead to higher discards of equipment and, consequently, shortens their lifetimes. In addition, intensive innovations can stimulate machinery discards. Finally, low quality of road infrastructure could stimulate early discards of transportation equipment.

We test these hypotheses using a simple eclectic linear relationship with the regional average service life as the dependent variable and the potential determinants of the service life variation as independent variables. Since variances of average lifetimes also vary across regions, we use these sample variances as weights for weighted OLS estimations. Results are shown in tables 2 and 3. In particular, table 2 demonstrates the estimation of this dependence for machinery and equipment. As can be seen, average GRP growth rates are significant and influence assets' lifetime negatively. For example, from column 1 we see that one percentage point increase of GRP diminishes the average service life by more than one quarter of a year. Column 2 shows that the contribution of the share of a new product is insignificant, although the negative sign of the coefficient makes sense. Indeed, production of new goods demands a more intensive renovation and makes the assets lifetime shorter. Interestingly, R&D expenditures make this regression worse, as can be seen from the lower value of R^2 and higher p-values. Summing up, we report the evidence of positive influence of economic growth on depreciation of machinery and equipment, but no significant effect of innovations.

[Tab. 2 is about here]

The influence of output growth on lifetimes is stronger for transportation equipment. Table 3 reports this for transport equipment in total and for such assets within this group as Trucks, buses and truck trailer aggregate; and Autos. Interestingly, for zero growth the average lifetime of Autos is two years shorter (columns 1 of tables 3b and 3c) and each percentage point of growth makes the lifetimes of an auto and a truck shorter by the same value, which is around 0.27 of a year. Both types of assets are not sensitive to the quality of roads.

[Tab. 3 is about here]

Finally, we present results of comparison of lifetimes in market and non-market sectors of the economy. The non-market sector includes mostly Education (Healthcare and Public Administration have not been covered or representative by our dataset). We compare lifetimes running a simple weighted OLS regression of regional average lifetimes on a dummy, which equals 1 for industries of a non-market sector and 0 for the market sector ones. As can be seen in table 4, the lifetimes for the market economy are significantly shorter for all types of assets except Machinery and Equipment. For example, average lifetime of residential buildings in market economy is almost 31 years, which is 54 years lower than in the non-market sector. Such sorter lifetime or, in other words, higher depreciation of market capital can be explained by a long period of underinvestment in the non-market sector even in years of high growth.

[Tab. 4 is about here]

4. Conclusion

The present study exploits a new micro dataset, which is based on a survey of assets lifetimes carried by the Russian statistical office (Rosstat) in 2008 to understand cross-region variation of asset lifetime and its determinants. The survey covered 238.3 thousand assets of around 11 thousand large and medium firms and 4.5 thousand non-profit organizations in 66 Russian regions. Using simple weighted OLS regressions and assets lifetime regional averages we try to explain differences in asset lifetimes with various characteristics of a region. We test if lifetimes of residential buildings, constructions, transport equipment, other machinery and ICT capital depend on such regional characteristics as gross regional product growth, quality of traffic infrastructure (for transport), R&D expenditures and the share of innovative products in regional output (for machinery and computers). We show that machinery and ICT equipment lifetimes fall with higher regional output growth, which can be explained by higher capital utilization and, consequently, higher capital renovation in more dynamic regions. At the same time the other factors seem statistically insignificant. We also compare average lifetimes of capital in market and non-market economy, considering capital of the latter as a proxy of public capital. We show that average lifetimes of all non-market economy assets, except machinery, are longer.

These results should be considered as preliminary. Further research is needed to shed light upon the nature of assets lifetimes divergence across Russian regions. For buildings and infrastructure climate characteristics could be important. In turn, machinery and transport equipment average lifetimes strongly depend on industrial structure of the region. Finally, a more accurate split of public and private capital could improve accuracy of our results in this area.

Figures and tables

Tab. 1. Lifetime variation for various types of assets across Russian regions in 2008 (years)

Types of capital	Average service life for total economy	Minimum	Maximum
Residential structures	59.1	21.5	113.0
Non-residential structures	41.7	16.1	71.9
Transport equipment	11.3	8.0	21.8
Machinery and Equipment	12.1	7.6	19.0
Computing Equipment	5.9	3.0	9.3
Communications Equipment	10.1	3.0	14.8
Total	20.4	12.2	35.0

Tab. 2. Determinants of *Machinery and Equipment* expected lifetimes across regions

	1	2	3
GRP av. growth rates in 2000-2007	-26.5 (0.068)*	-26.6 (0.070)*	-24.5 (0.100)*
Share of new products	-	-0.022 (0.834)	0.023 (0.851)
R&D expenditures	-	-	-0.012 (0.454)
Intercept	14.9 (0.000)***	15.0 (0.000)***	14.9 (0.000)***
R^2 (%)	5.1	5.2	1.5
Observations	66	66	66

Notes: Weighed OLS estimations with sample variances of regional means as weights. P-values are in brackets.

Tab. 3. Determinants of *Transport Equipment* expected lifetimes across regions

Tab. 3a. Total Transport Equipment

	1	2
GRP av. growth rates in 2000-2007	-53.1 (0.000)***	-57.3 (0.000)***
Share of hard-surfaced roads in a region	-	-0.029 (0.510)
Intercept	16.9 (0.000)***	19.7 (0.000)***
R^2 (%)	19.2	19.8
Observations	65	65

Tab. 3b. Trucks, buses and truck trailer aggregate

	1	2
GRP av. growth rates in 2000-2007	-26.5 (0.037)**	-22.7 (0.087)*
Share of hard-surfaced roads in a region	-	0.039 (0.345)
Intercept	14.5 (0.000)***	10.74 (0.010)***
R^2 (%)	6.8	8.1
Observations	65	66

Tab. 3c. Autos

	1	2
GRP av. growth rates in 2000-2007	-27.4 (0.009)***	-22.7 (0.087)*
Share of hard-surfaced roads	-	0.039 (0.345)
Intercept	12.3 (0.000)***	10.8 (0.010)***
R^2 (%)	10.6	8.1
Observations	64	65

Notes: Weighed OLS estimations with sample variances of regional means as weights.

Tab. 4. Lifetimes of market and public capital by types of assets

Types of capital	Residential structures	Non-residential structures	Transport equipment	Machinery and Equipment	Computing Equipment	Communications Equipment
Non-market dummy slope	53.6 (0.000)***	16.3 (0.000)***	1.2 (0.000)***	-0.06 (0.708)	0.99 (0.000)***	1.12 (0.070)*
Intercept (average service life in market economy)	30.5 (0.000)***	39.4 (0.000)***	11.5 (0.000)***	12.4 (0.000)***	5.6 (0.000)***	10.3 (0.000)***
Observations	4327	55377	47418	72785	15143	3525

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