EVALUATION OF A SOCIAL DISCOUNT RATE FOR THE RUSSIAN FEDERATION

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Abstract
In the public sector of economics there is a necessity to evaluate an effectiveness of government investment decisions. The most popular instrument of doing it is the cost-benefit analysis. However together with obvious advantages of application of this analysis there are difficult issues to decide. The most important one is the evaluation of a social discount rate that can be used in such analysis.

Discount rate for evaluation of programs and projects in the public sector of economy is called the social discount rate. In spite of a great number of investigations discussions about the correct method for determining discount rate continue unabated especially for developing countries.

In the research under consideration different methods of evaluation of a social discount rate which can be used for the Russian Federation are examined. The research is based on the data of Federal State Statistics Service of Russia. The result of the investigation is the expected social discount rate for the Russian Federation which can be applied practically for the medium-term government programs.

Key words: social discount rate, social rate of time preference, elasticity of marginal utility of consumption, social opportunity cost of capital, shadow price of capital.

1. Introduction
The question of determining the social discount rate for government investment decisions in Russia are examined in the given paper. More specifically a methodology of determining the rate is regarding and it is identified how we can calculate all parameters that are included in the rate. It is carried out with a glance to a present situation of economic development in the Russian Federation. Main difficulties are connected with the lack of statistical information (short time-series data because of a short period of stable economic growth) and shortcomings of theoretical investigations that can help to take into account special features of developing economy.

First of all it should be noticed that there is a continual question of evaluation of effectiveness in the public sector of economy. To do it properly it is necessary to compare costs and benefits that arise in different periods of time. Thereby it is impossible to disregard the question of temporal value of money in the public sector of economy. However the issue of determining the social discount rate for evaluation of government projects is not considered in detail in Russian literature. It refers to both normative documents and methodological guidelines. However according to the experience of developed countries examination of approaches of determining the social discount rate has theoretical and great practical importance.

In order to choose the correct method of calculation the rate for the Russian Federation it is necessary to consider existing experience of discounting in the public sector of economy. It is important to examine theoretical approaches to determination of the social discount rate and also practical experience of developing countries. Thus it is substantial to choose the method of calculation of the rate and the way of calculation of parameters that are included in the rate. Finally it is interesting to present calculations with a glance of a specificity of a developing economy.

It should be noted that the question under consideration has been discussed by economists for a long time. However existing experience refers to developed countries when this process has become well-established. Moreover there is such a good resource in developed countries as statistical information. Unfortunately we cannot say so about countries like Russia.

Generally speaking we should say that this topic is still urgent. Recently some
investigations that are dedicated to estimation of the social discount rate for such countries as Latin American countries and Asian countries have been appeared. Thus it is very appreciatively to investigate how to evaluate a social discount rate for government investment decisions in the Russian Federation.

2. Literature review


Particularly the paper “Some considerations on the social discount rate”, (Moore, 2003) should be singled out. This is because a good review with summation of existing literature is given in this paper.

Also it should be noticed that investigations which cover situation in developing countries have appeared recently. It is, for example, “Social rate of interest for India” by Kula (2004) and “The Social Discount Rate: Estimates for nine Latin American countries” by Lopez (2008).

To the point there are generally three main approaches to choosing discount rates in the public sector of economy: social rate of time preference (SRTP), social opportunity cost of capital (SOC) and shadow price of capital (SPC). It would be an appropriate thing to give a brief description of these approaches with an emphasis on their practical application.

The definition of the social rate of time preference (also known as the “consumption rate of interest”) is given in many research papers. For example, «the social rate of time preference is equal to the marginal rate of substitution between consumption in one period and the next period» (OXERA 2002, 4). It should be noticed that SRTP is the most popular and carefully examined approach among others. It is widely discussed by economists such as Ramsey, Pearce, Boardman, Zerbe, Young, Zhu, etc. Substantially this rate is used in the United Kingdom, India, New Zealand, Latin American countries.

When it is impossible to calculate SRTP or results seem to be unreliable then the social opportunity cost of capital should be calculated. «The social opportunity cost is the rate that reduces the net present value of the best alternative private use of the funds to zero. Thus the government takes into account what “similar” projects would provide in returns if undertaken in the private sector» (OXERA 2002, 3). However, we don't have a formula for calculating a social opportunity cost. Therefore application of this method for developing countries involves difficulties.

This approach is very popular in the United States. In other words SOC is used as the social discount rate. And this rate is calculating for the whole country (the rate is determined in guidelines of different government agencies and organizations). Decision maker should use this rate for each government program in a particular sector.

Another approach is to calculate a weighted rate. From a view point of the author it is not an independent approach because it is a combination of two previous approaches. In that case the social opportunity cost of capital and the social rate of time preference are included additively into the social discount rate with proper weights. Main difficulties are connected with assessment of these weights.

The formula with necessary description is given in many research papers such as “A Social Time Preference Rate for Use in Long-Term Discounting” (OXERA 2002), “Determining the Discount Rate for Government Projects” (Young, 2002), “Evaluation of a Social Discount Rate for the United Kingdom” (Pearce and Ulph, 1995) and others.

An alternative is to use the shadow price of capital. Shadow price is a price which replaces the observed market price of a good or a service. This method involves converting all costs and benefits into their corresponding changes in consumption. Then the social rate of time preference is used as the discount rate. The conversion of costs to changes in consumption, which may reduce either
consumption or private investment in the first instance, requires finding the shadow price of capital» [OXERA 2002, 7]. And also it should be noticed that calculations used to derive an estimate are complicated and subjective. This approach has been considered by such economists as Moore, Boardman, etc.

It is described in the Pearce’s paper (Pearce and Ulph, 1995) that this rate is not used in the calculations for the United Kingdom. This is because of considerations of practicability. Moreover there are no implications of this method in the existing literature dedicated to evaluation of the social discount rate.

To sum up then we should say that in spite of a great number of researches a discussion about the correct method for determining of a social discount rate still exists. Moreover there is an unabated discussion of what methods should be used for developing countries.

Main highs and lows of each approach are given in the table below.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Highs</th>
<th>Lows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social rate of time preference</td>
<td>Based on the available statistic data</td>
<td>Difficulties of determination of parameters that should be included into this rate</td>
</tr>
<tr>
<td>Social opportunity cost of capital</td>
<td>Options of using resources in the private sector are considered</td>
<td>Difficulties of finding an appropriate indicator which can reflect a social opportunity cost of capital.</td>
</tr>
<tr>
<td>Weighted rate</td>
<td>Two approaches are taken into account</td>
<td>Uncertainty of determining weights in the final formula</td>
</tr>
<tr>
<td>Approach which is based on determining shadow price of capital</td>
<td>It is taken into account that government program influences on both private investment and consumption</td>
<td>There are difficulties of determining of parameters in the shadow price of capital formula</td>
</tr>
</tbody>
</table>

Since we don’t have a formula for the social opportunity cost of capital and there is no extensive experience of estimating the shadow price of capital it is reasonable to dwell upon a social rate of time preference and a possibility of its application.

3. Theoretical Background

Overall, when a government program is conducted there is an objective of maximizing utility of consumption in different periods of time. Utility function should have two main characteristics: if consumption increases utility of consumption should also increase; the law of decreasing marginal utility is satisfied. In researches of Ramsey, Stern, Pearce and others the function is given:

$$U = \frac{1}{1 - \mu} \cdot C^{1-\mu},$$

where C – consumption;

$$\mu$$ – unknown parameter of the function.

Let’s now determine the objective of maximizing utility taking into account a constraint connected with consumption. This task is given for two periods. But the same computations can be made for any other number of periods.

$$\begin{align*}
U(C_1) + \frac{U(C_2)}{1 + \delta} & \rightarrow \max (C_1, C_2) \\
C_1 + \frac{C_2}{1 + r} & = 1
\end{align*}$$

where

- $C_1$, $C_2$ – consumption in different periods;
- $U(C_0)$ – function of utility of consumption;
- $\delta$ – individual discount rate;
- $r$ – social discount rate.

Let’s solve this system using the Lagrange function.

$$L = U(C_1) + \frac{U(C_2)}{1 + \delta} - \lambda \left( C_1 + \frac{C_2}{1 + r} - 1 \right)$$

$$\begin{align*}
\frac{\partial L}{\partial C_1} &= U'(C_1) - \lambda = 0 \\
\frac{\partial L}{\partial C_2} &= \frac{U'(C_2)}{1 + \delta} - \frac{\lambda}{1 + r} = 0 \\
\frac{\partial L}{\partial \lambda} &= 1 - C_1 - \frac{C_2}{1 + r} = 0
\end{align*}$$

Expressing from the first and the second equalization parameter $\lambda$ we have:

$$U'(C_1) = \frac{1 + r}{1 + \delta}$$

We know the type of utility function. Therefore we can determine the following expression (7):
described in the paper “Social Rate of Interest model. For example, exponential trend is  
that there is a trend and try to construct a 
It is rather easy to determine  
all parameters. 

If the expression  
then Ramsey’s formula is right.  

Let us notice that this formula differs from  
the formula which was given by Ramsey (SRTP  
= δ + μγ). This is so because in the derivation of  
Ramsey’s formula some assumptions have been made. 

Then it is interesting to examine a  
question how we can derive SRTP formula  
from the formula (1).

Put the expression (1+μx)μ in Taylor series in a neighborhood of a point O (O=x):  
\[ f(x) = f(x_0) + f'(x_0) \frac{x-x_0}{1!} + \ldots \]  
If x=0 we get: 
\[ (1+μ)^μ = (1+μ)^2 * \frac{x-x_0}{1!} = 1+μ*0 = 1+μ \] 
Then it is correct:  
\[ \left( \frac{\Delta N}{C_1} + 1 \right)^μ = (1 + g)^μ = 1 + μg \]  
If the expression  
\[ \frac{1+r}{1+δ} ≈ r - δ + 1 \]  
is correct  
then Ramsey’s formula is right.

The main problem with formula of SRTP is to determine all parameters. 

Let’s start with the rate of growth in consumption (g). It is rather easy to determine  
it, just using econometric methods. We assume 
that there is a trend and try to construct a model. For example, exponential trend is  
described in the paper “Social Rate of Interest  
for India”. It is also rather suitable for the 
Russian Federation. After estimating a model  
we get results that are enough to judge about  
the rate of growth in consumption. 

The second unknown parameter is an  
individual discount rate (δ). According to  
Pearce (Pearce and Ulph 1995, 6) this rate is divided into two parts. These parts are the 
true rate of time preference (is going to be zero  
because we shouldn’t make differences between generations) and the rate of life chances (it is  
determined as the death rate). All these  
Moments are fully described in the paper “Social discount rate for the United Kingdom”  
(Pearce and Ulph, 1995).

And finally it is necessary to define the  
elasticity of marginal utility of consumption.  
But we have to admit that there is much controversy on how to determine this  
parameter and what range is appropriate for it. Different values for elasticity are given in  
the table below (the source is own review of different papers on this problem).

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Range</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977</td>
<td>Stern</td>
<td>1 – 10</td>
<td>UK</td>
</tr>
<tr>
<td>1989</td>
<td>Scott</td>
<td>1 – 2</td>
<td>UK</td>
</tr>
<tr>
<td>1994</td>
<td>Blundell, Browning, Meghir</td>
<td>0,83</td>
<td>UK</td>
</tr>
<tr>
<td>1995</td>
<td>Pearce and Ulph</td>
<td>0,7 – 1,5</td>
<td>UK</td>
</tr>
<tr>
<td>1999</td>
<td>Cowell, Gardiner</td>
<td>0,5 – 1,2</td>
<td>UK</td>
</tr>
<tr>
<td>2004</td>
<td>Evans and Sezer</td>
<td>1,3 – 1,7</td>
<td>Developed countries</td>
</tr>
<tr>
<td>2004</td>
<td>Kula E.</td>
<td>1,64</td>
<td>India</td>
</tr>
<tr>
<td>2005</td>
<td>Evans</td>
<td>1,4</td>
<td>20 OECD countries</td>
</tr>
<tr>
<td>2008</td>
<td>Humberto Lopez</td>
<td>around 1,5</td>
<td>Latin American countries</td>
</tr>
</tbody>
</table>

The main problem with calculations of the  
rate for Russia is the lack of statistical data.  
That’s why it is difficult to use econometric methods as it is described in the Kula’s paper  
or methods which are based on trends of parameters. It does not mean that we should  
reject these methods. It means that the result  
of estimation will only be suitable for short-term and medium-term projects. To the point,  
according to three-year budget planning it is very important to derive a social discount rate  
which can be used for projects which are kept  
within this period.
So, in this paper it is used the well-known method of elasticity calculation. Implication of this method is described in Kula’s paper (Kula, 2004). Important assumption is that food and non-food are considered to be complementary goods with a homogeneity restriction.

\[ e = b \frac{y}{p^*} \]  \hspace{1cm} (2)

where \((b)\) is the average propensity to spend money on non-food, 
\((p^*)\) is the relative price elasticity of food (relative to all other goods)
\((y)\) is the income elasticity of food.

It is recommended to use the following formula (for the full explanation of this formula see the Kula’s paper):

\[ S = a \frac{Y^*}{(P^1)} \left( \frac{P}{P_2} \right)^{p^*} \]

where \((S)\) is spending on food per capita, 
\((a)\) is constant, 
\((Y)\) is per capita income, 
\((P1)\) is price of food, 
\((P2)\) is price of non-food 
\((p^*)\) is the relative price elasticity for food.

It is described in Kula’s paper that this model is the best model for India according to time series data from 1965 till 1995. In Russia we don’t have such a long time series data. And it is interesting to try to examine whether this model gives us reliable results in basis of available Russian statistics. We can use time series data only from 1999 till 2008. Owing to great economic instability till 1999 and crisis in 1998 statistical information is not reliable in this period.

So, after taking the logarithm we get the resulting formula for determining elasticity:

\[ \ln(S) = \ln(a) + y \ln(Y) + p^* \ln \left( \frac{P}{P_2} \right) + \varepsilon \]  \hspace{1cm} (3)

Then this model should be estimated with a help of a method of least squares to find unknown parameters \((y\) and \(p^*)\).

After specifying of main problems of evaluation of the social discount rate for the Russian Federation and indicating of main findings of determining the rate we should set out to calculations.

4. Paper Content

So, main difficulties that are arising when determining the social discount rate for the Russian Federation are the following:

- In spite of the fact that the social discount rate is determined for the whole country it cannot be so if we deal with such countries as Russia because of a great regional and geographical diversity. Some regions are economically developed, others are not. Therefore we are forced to determine the rate for each region. We should determine the common procedure of calculation which can be used for determining the social discount rate in every particular case. Only if a government project has a broad scope and spreads to different regions of a country the social discount rate for the whole country should be calculated;

- In the Russian Federation we don’t have long historical data and that’s why we can’t fully rely on indicator’s trends. Thereby it cuts our planning horizon;

On the assumption of the above we determine in this paper a social discount rate not for the whole country but for one region which is a representative one according to economic development, geographical position, availability of resources, etc. More particularly it is Perm region. Available statistical data from 1999 till 2007 was derived from Federal Agency of Statistics, Perm Branch. Our purpose is to estimate an appropriate discount rate for a medium-term period (three – five years) in real terms.

However there is a problem and we cannot fail to take it into account. Statistical information that we have covers the period before present crisis in the world. If we fully rely on trends of parameters that it could lead to errors in our forecast. That is why we should remember this fact when calculate parameters of the social discount rate.

As we have determined the formula for calculation of a social discount rate and formulas for all parameters that are included in the rate we can estimate all components and derive the final result.

**Rate of life chances** is estimated as an average death rate in the region. Average death rate for the Perm region is 1,7%.

In different research papers there are results which are very similar to this level. For instance, it is determined that the average level of this parameter for India is 1,3%. For United Kingdom it is 1,1%. For Germany and Italy it is 1%. For the Russian Federation this level is higher (it is about 1,5%). The reason is in the shorter time-series data that are used for analysis and perhaps in the quality of medical care.
**Elasticity of marginal utility of consumption** can be determined as described in the theoretical background.

To determine elasticity we need to know the average propensity to spend money on non-food (b). This parameter has been found on the basis of available information about structure of consumers' expenditure of households. Thereby the average propensity to spend money on non-food is 62% for the Perm region (for example, it is 48% for India, as determined in the Kula's paper and 54% for Russia). This parameter for the Perm region and for the whole country remains steady.

The model (3) has been estimated with a help of a method of least squares. The results of estimation are the following.

\[
\ln(S) = 0.8 + 0.758\ln(Y) - 0.281\ln(P_1/P_2)
\]

Coefficient of determination of this model is 0.98. Moreover we can insist that the model is significant and all parameters are significant too (according to all necessary tests of hypothesis).

Thus, results for the Perm region are the following. The relative price elasticity for food \( p^* \) equals -0.281. The income elasticity of food \( (\gamma) \) is 0.758.

After insertion of these values in the formula (2) we derive \( e = 1.67 \) for Perm region. This estimation is very close to others that are determined in research papers. For example, it is 1.8 for Brazil, 1.3 for Argentina, 1.3 for Mexico, 1.9 for Peru, 1.3 for Chile, 1.64 for India. However it should be noted that these values are derived with a help of different methods of calculation.

Confidence intervals for parameters \( (p^*) \) and \( (\gamma) \) are the following.

\(-0.451 \leq p^* \leq -0.112;
0.6515 \leq \gamma \leq 0.865\)

That's why we can state that elasticity might be in the interval from 0.896 to 4.8. However the value 4.8 seems to be extremely high.

Due to the short time series the rate of growth in consumption tends to overestimate the positive effect of economic development on growth opportunities. The nominal rate of growth per capita consumption for Perm region is 21.7% and the real rate is 10.76%. According to the present situation of crisis this rate of growth in consumption seems to be too high. It won't be so in next years.

That is why it is necessary to use proxies. We make an assumption that it is reasonable to estimate this parameter as the rate of growth of gross regional product. For Perm region it is 4.5%. For the Russian Federation as a sum of all regions it is 6%.

**Estimation of the social discount rate**

Taking into account all results that are given above we can calculate the final value of the social discount rate for Perm region.

\[
R = (1 + 0.045)^{1.62} \times (1 + 0.017) - 1 = 9.5\%
\]

Calculations for the whole country are the following: \( p^* = -0.2; \gamma = 0.6 \). Elasticity equals 1.62. Rate of life chances is 1.5%. The rate of growth of gross regional product (as a sum of GRP of all regions) is about 6%. Thus the social discount rate is

\[
R = (1 + 0.06)^{1.62} \times (1 + 0.015) - 1 = 11.5\%
\]

The rate for the whole country is higher. But there are many apprehensions about the correctness of calculations for the whole country.

5. Conclusions and implications

So, the main findings as it is represented in this paper are the following. On the basis of literature review main approaches for determining of the social discount rate have been singled out. We have described an appropriate formula of the rate for the Russian Federation and have chosen methods of calculation of parameters that are included in this rate.

Consequently we have derived a value for the social discount rate. It is 9.5% in real terms for Perm region and 11.5% for the Russian Federation. We recommend application of this rate for different investment decisions in the public sector of economy. But once again there are no guidelines for evaluation of effectiveness in the public sector in the Russian Federation and then we can't compare our result with other results. We can only assert that this value is very close to others derived for developing countries.

Evaluation of the social discount rate for the Russian Federation is a process that is far from certainty. There are still many questions about an appropriate method of calculation and determination of parameters of the rate. That is why there is a broad scope for other investigations and scientific researches.
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