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ESTIMATED LOSSES OF INNOVATIVE CAPACITY OF THE PARTIES AS A RESULT OF «HYBRID» RUSSIAN AGGRESSION AGAINST UKRAINE

Об'єктом дослідження є процес оцінки втрат інноваційного потенціалу держав, що перебувають у стані «гібридного» військового протистояння. Проте, виникає проблема достовірності результатів такої оцінки. Цього можливо досягти шляхом порівняння відхилень фактичної динаміки результатів національного виробництва з урахуванням факторів фізичного та людського капіталу, а також технологічного прогресу.

У роботі проведено оцінку втрат (приросту) інноваційного потенціалу України як держави-жертви та Росії як держави-агресора у «гібридній» війні, що розпочалася з тимчасової окупації Автономної республіки Крим і триває донині. В основу результатів оцінки покладено реальні (офіційні) статистичні дані Світового Банку, наявні у публічному доступі за 1995–2017 рр. Об'єктом оцінки є динаміка результатів національних економік сторін конфлікту з урахуванням виробничих факторів і технологічного прогресу.

Реалізовано вдосконалення методичного забезпечення оцінки втрат інноваційного потенціалу на макрорівні шляхом моделювання виробничої функції Тінбергена-Солоу. В результаті чого отримано фіксовану і поточну динаміку параметра технологічного прогресу для держав-антагоністів у «гібридному» конфлікті за 2013–2017 рр. Розраховано різниці множників виробничої функції Тінбергена-Солоу з параметром технологічного прогресу – фіксованого за 2013 рік і поточного за 2014–2017 роки.

Обґрунтовано, що протягом 4 років «гібридної» агресії відновлення національної економіки України відбувається на 7,5 % повільніше, ніж Росії. Приріст інноваційного потенціалу України у період 2014–2017 рр. склав 2,1 % обсягу ВВП на кінець 2013 року. Втрати інноваційного потенціалу Росії за цей же період становили 8,5 % обсягу ВВП 2013 року.

Результати вдосконалення методичного забезпечення процесу оцінки втрат інноваційного потенціалу сторін «гібридної» агресії закладають основу для моделювання динаміки реального ВВП та його фізичного обсягу, що значно розширить базу майбутніх досліджень.

Ключові слова: *інноваційний потенціал, виробнича функція, макроекономічна динаміка, «гібридна» агресія, ВВП у фактичних цінах.*

1. Introduction

Having started from 20 of February of 2014 and till today, the Ukrainian national economy develops under conditions of Russian «hybrid» aggression that creates essential obstacles for its real growth. Under conditions of the modern globalized society the formation of effective contra-arrangements by Ukraine (both internal and external ones) is impossible without most developed countries and international associations. As a result – both the victim and the aggressor suffer from real and potential losses. So, there appears a necessity of the qualitative and quantitative estimation of innovation potential losses of the parties as a result of «hybrid» aggression of Russia against Ukraine.

2. The object of research and its technological audit

The object of the research is the process of estimation of losses of the innovation potential of the states that are in «hybrid» military confrontation.

There appears a necessity of the effective and reliable audit of losses of the innovative potential of both the state-victim and the state-aggressor under conditions of the «hybrid» conflict. It may be achieved by checking deviations of the real dynamics of gross domestic product (GDP) taking into account factors of physical and human capital and also technological progress. At that the base assumption is that the innovative potential of the conflicting parties will be lost as a result of their lag from the technological progress – the victim faster and in more volumes than the aggressor. The calculation of innovation potential losses is offered to measure in % of GDP.

3. The aim and objectives of research

The aim of the research – elaboration of a methodical approach to estimation of innovation potential losses of the conflicting parties as a result of Russian «hybrid» aggression against Ukraine taking into account the factor of technological progress.

The following scientific tasks were set for attaining this aim:

1. To elaborate main requirements that must be realized at estimating losses (increment) of the innovation potential of the states – parties of «hybrid» aggression.

2. To offer an economic-mathematical model that will satisfy set requirements as completely as possible.

3. To study the dynamics of the technological progress parameter of the states-antagonists in the «hybrid» conflict for 2013–2017.

4. To estimate volumes of losses of the innovation potential of the states – parties of «hybrid» aggression.

4. Research of existing solutions of the problem

Many scientists and practicians study economic and social problems of the Russian «hybrid» war against Ukraine. Work [1], prepared by specialists of the National institute of strategic studies for the first time studies a phenomenon of World «hybrid» war in the perspective of Russian aggression against Ukraine in detail. Work [2] separates and explains important theoretical methodological and adjacent ideological questions of further elaboration of the system of Ukrainian national safety under conditions of external aggression and loss of a part of the state territory. Work [3] grounds priorities of the development of the real sector of the Ukrainian economy in 2016–2017 under conditions of the exhaustive confrontation between Ukraine and Russian Federation in the «hybrid» war. Work [4] analyzes diverse aspects of modern hybrid wars, interpreting the meaning of information confrontation with an accent on Russian hybrid aggression against Ukraine. Work [5] considers Russian military aggression as a stress-test for global and national safety and catalyzer of rebooting of the Ukrainian external policy.

Study [6] is devoted to lessons, obtained by Europe during the war in Ukraine, especially safety ones, economic and politic. Theoretical and applied aspects of the Russian «hybrid» war that is an asymmetric conflict are considered in work [7]. Scientific work [8] starts debates about hybrid war in the wider analytic and historical context, and also generalizes a discussion about asymmetric strategic conceptions. Work [9] studies the development of the Russian military strategy and how its elements may be used in Ukraine. Study [10] proves that «hybrid» challenges and threats must widen the Asian and European interest for international cooperation, especially by accepting correspondent conceptions of safety and power instruments. The geopolitical distribution of forces the day before and at the first year of the «hybrid» war, and also possible confrontations between NATO, Russia and Ukraine are considered in [11]. Work [12] grounds that a tendency to «hybrid» war is not only for conceptualization of the development of the Russian military and external policy; it may result in serious unpredictable consequences for the whole world. Works [13–15] make a detail analysis of a role of the European union and causes of Russian hybrid aggression against Ukraine, in which result the Crimean Autonomous republic was occupied and military actions at Donbas were started.

But the problem of functioning of the methodical support of estimating innovation potential losses of the parties as a result of Russian «hybrid» aggression against Ukraine, started in [16–18], remains little-studied, so needs substantial studies; because under modern conditions just the macroeconomic development on innovative bases becomes a key factor of overcoming war results.

5. Research methods

General scientific and special research methods were used at the work:

– analysis and synthesis – for the preliminary analysis with forming a problem, determination of aims, main assumptions and requirements to estimation of innovation potential losses of the parties as a result of Russian «hybrid» aggression against Ukraine;
– analogues and comparative collation – for determining main characteristics of the countries-antagonists in «hybrid» aggression and for elaborating criteria for estimating innovation potential losses;
– method of correlation-regression analysis – for formalizing the influence of base speeds of the growth of gross fixed capital formation and the number of employed population, and also dynamic component on the dynamics of GDP in real prices;
– method of factor analysis – for calculating volumes of innovation potential losses of the states taking into account the technological progress factor.

6. Research results

Under modern conditions the technological progress is a key factor of forming the innovation potential of the national economy. So, there appears a necessity to take into account its influence on the dynamics of GDP of a state. The crucial value at improving the methodical support for estimating innovation potential losses of the parties as a result of Russian «hybrid» aggression against Ukraine is to take into account correspondence of their national economies to the technological progress. It is understood as an objective factor of the macroeconomic development on innovative principles [18].

Main methodological bases of estimating the technological progress are given in works [19–21]. Ideas about estimating the innovative potential of the national economy remain important for today. But scientists-economists have yet insufficiently studied problems of estimating innovation potential losses of the state-victim and state-aggressor under conditions of «hybrid» war.

Realization of the reliable estimation of innovation potential losses of the state is possible only at observing a series of requirements:

– methodical support of such estimation must be based on real (official) statistical data, accessible freely [16];
– studies must include an essential time lag, no less 10 years and to reflect the dynamics [22];
– an estimation object must be a subject of the innovation process at the same time [18].

Correspondence to all requirements to the methodical support of estimating the innovation potential of the state, including its losses, is provided by the multiplicative dynamic economic-mathematical model of the production function, offered by the authors of works [23, 24], that in the research context looks as:

$$GDP = A \cdot GFCF^{\alpha} \cdot NE^{\beta} \cdot e^{\gamma t}, \quad (1)$$

where *GDP* – basis speed of GDP growth of the state in real prices (in % to the index of the first year of the dynamics); *GFCF* – physical capital factor – basis growth speed of gross fixed capital formation, %;

NE – human capital factor – basis growth speed of the number of whole employed population, %;

parameter *A* – free member (numerical value of *GDP*, if $\alpha = \beta = \gamma = 0$);

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parameter α – elasticity coefficient of GDP by the physical capital factor (by what % *GDP* increases at growing *GFCF* by 1 %);

parameter β – elasticity coefficient of GDP by the human capital factor (by what % *GDP* increases at growing *NE* by 1 %), at that $\beta = 1 - \alpha$;

parameter γ – technological progress parameter – elasticity coefficient of GDP by the technological progress;

e – Euler number (natural logarithm base);

t – technological progress factor (year sequence number).

In formula (1) a multiplier $e^{\gamma t}$ is the most suitable for estimating losses or increment of the state innovative potential, it reflects the influence of the technological progress on GDP dynamics as following:

– when $\gamma = 0$, $e^{\gamma t} = 1$, and formula (1) looks as the two-factor multiplicative production function of Cobb-Douglas [25]. Then it is possible to talk about the neutral influence of the technological progress or simple recreation, because Cobb-Douglas production function is one with the constant return from the production volume. In this case the summary growth of factors of physical and human capitals by 1 % results in growing GDP by 1 %;

– when $\gamma < 0$, $e^{\gamma t} < 1$. It means that as a result of lagging from the technological progress, the state suffers from innovation potential losses $(e^{\gamma t} - 1)$ % of GDP. So, the summary growth of factors of physical and human capitals by 1 % results in growing GDP less than by 1 %;

– when $\gamma > 0$, $e^{\gamma t} > 1$. It means that as a result of correspondence of the national economy to the technological progress, the state gains the additional increment of the innovative potential $(e^{\gamma t} - 1)$ % of GDP. In this case the summary growth of factors of physical and human capitals by 1 % results in growing GDP more than by 1 %.

For the further use in modeling, let's sign formula (1) in the logarithm form, having expressed the parameter β by $(1 - \alpha)$:

$$\ln GDP = \ln A + \alpha \ln GFCF + (1 - \alpha) \ln NE + \gamma t. \quad (2)$$

Having analyzed a series of algebraic transformations as it is suitable for modeling the dependence of GDP on the technological progress, let's sign Tinbergen-Solow function as follows [26]:

$$\ln GDP - \ln NE = \ln A + \alpha (\ln GFCF - \ln NE) + \gamma t. \quad (3)$$

Losses or increment of the innovative potential of the national economies of the states – parties of the «hybrid» conflict are calculated, according to formula (3). This formula helps to find values of the technological progress parameter γ for each year of the confrontation, and it is compared with the year before military actions.

Then there is calculated the numerical value of the expression $e^{\gamma t}$ for finding GDP increment, which negative value testifies to innovation potential losses of the states-antagonists as a result of «hybrid» aggression.

Based on given formulas (1)–(3), let's form the initial data for the state-victim of «hybrid» aggression – Ukraine in Table 1, for the state-aggressor – Russia – in Table 2.

Table 1

Initial data of modeling of Tinbergen-Solow production function for Ukraine in 1995–2017

Years	GDP in real prices (*GDP*)		Gross fixed capital formation (*GFCF*)		Number employed population (*NE*)	
	Mln USD	in % to 1995	Mln USD	in % to 1995	Thousand persons	in % to 1995
1995	48213.9	100.0	11224.3	100.0	24125.1	100.0
1996	44558.1	92.4	9232.6	82.3	24114.0	100.0
1997	50150.4	104.0	9946.3	88.6	23755.5	98.5
1998	41883.2	86.9	8204.1	73.1	22998.4	95.3
1999	31580.6	65.5	6084.3	54.2	19947.8	82.7
2000	31261.5	64.8	6144.4	54.7	20175.0	83.6
2001	38009.3	78.8	7485.2	66.7	19971.5	82.8
2002	42392.9	87.9	8126.9	72.4	20091.2	83.3
2003	50133.0	104.0	10327.8	92.0	20163.3	83.6
2004	64883.1	134.6	14630.6	130.3	20295.7	84.1
2005	86142.0	178.7	18921.1	168.6	20680.0	85.7
2006	107753.1	223.5	26509.7	236.2	20730.4	85.9
2007	142719.0	296.0	38649.3	344.3	20904.7	86.7
2008	179992.4	373.3	47493.5	423.1	20972.3	86.9
2009	117227.8	243.1	21517.1	191.7	20191.5	83.7
2010	136013.2	282.1	23169.9	206.4	20266.0	84.0
2011	163159.7	338.4	28792.0	256.5	20324.2	84.2
2012	175781.4	364.6	33386.9	297.5	20354.4	84.4
2013	183310.1	380.2	30908.8	275.4	20404.1	84.6
2014	133503.4	276.9	18872.1	168.1	18073.3	74.9
2015	91031.0	188.8	12333.5	109.9	16443.2	68.2
2016	93270.5	193.5	14129.6	125.9	16276.9	67.5
2017	112154.0	232.6	17949.1	159.9	16156.4	67.0

Note: formed and calculated by data, given in [27]

The data, given in table 1, demonstrate that in the last 23 years Ukrainian GDP in real prices, calculated in USA dollars, grew annually in average by +3.7 %. At that having achieved the least value 31.3 bil USD in 2000 year, and the biggest one – 183.3 bil USD – in 2013. The calculated dynamics of GDP was accompanied by the average annual increment of gross fixed capital formation +2.1 % and annual average reduction of the number of employed population –1.7 %.

The data, given in table 1, demonstrate that in the last 23 years Russian GDP in real prices, calculated in USA dollars, grew annually in average by +6.2 %. At that having achieved the least value 195.9 USD in 1999 year, and the biggest one – 2297.1 bil USD – in 2013. The calculated dynamics of GDP was accompanied by the average annual increment of the gross fixed capital formation +6.3 % and the number of employed population of Russia +0.5 %.

It must be also noted, that in 2015 comparing with 2014 GDP volume of Ukraine in real prices of USD decreased by –31.8 %, and Russia – by –33.8 %. Thus, we can make a conclusion that the results of «hybrid» aggression for Russia in 2015 were worse than for Ukraine, because its GDP reduction was by 2 % more.

According to the initial data, collected in Tables 1, 2, using formula (3), there were successively realized 5 iterations of modeling of Tinbergen-Solow function for Ukraine and Russia, as a result of which, there were obtained the correspondent parameters of the equations for 2013–2017 (Table 3).

Table 3

Results of modeling of Tinbergen-Solow production function for the states-antagonists of «hybrid» aggression

Parameter of function*	2013 year	2014 year	2015 year	2016 year	2017 year	Changes (+/–) in 2017 comparing with 2013
Ukraine						
A	0.896	0.876	0.884	0.901	0.913	+0.017
α	0.683	0.660	0.670	0.692	0.702	+0.019
β	0.317	0.340	0.330	0.308	0.298	–0.019
*MRTS***	–2.155	–1.941	–2.030	–2.247	–2.356	–0.201
γ	0.038	0.042	0.040	0.037	0.035	–0.003
R^2***	0.987	0.986	0.987	0.985	0.985	–0.002
Russia						
A	1.034	1.036	1.058	1.080	1.092	+0.058
α	0.801	0.801	0.817	0.832	0.839	+0.038
β	0.199	0.199	0.183	0.168	0.161	–0.038
MRTS	–4.025	–4.025	–4.464	–4.952	–5.211	–1.186
γ	0.014	0.014	0.011	0.008	0.006	–0.008
R^2	0.996	0.996	0.996	0.995	0.995	–0.001

Note: * – symbols of parameters are taken from formula (1); ** – maximal rate of technological substitution: $MRTS = -\frac{\alpha NE}{\beta GFCF}$; *** – R^2 – coefficient of plural determination that demonstrates for how much percent the substitution of the resulting sign is conditioned by the change of factor signs, interprets the reliability of formalization

Table 2

Initial data of modeling of Tinbergen-Solow production function for Russia in 1995–2017

Years	GDP in real prices (GDP)		Gross fixed capital formation (GFCF)		Number employed population (NE)	
	Mln USD	in % to 1995	Mln USD	in % to 1995	Thousand persons	in % to 1995
1995	395531.1	100.0	83370.3	100.0	64149.0	100.0
1996	391720.0	99.0	78351.8	94.0	62928.0	98.1
1997	404926.5	102.4	74070.9	88.9	60021.0	93.6
1998	270953.1	68.5	43760.9	52.5	58437.0	91.1
1999	195905.8	49.5	28184.4	33.8	63082.0	98.3
2000	259708.5	65.7	43796.7	52.5	65070.4	101.4
2001	306602.7	77.5	57912.2	69.5	65122.9	101.5
2002	345110.4	87.3	61860.1	74.2	66658.9	103.9
2003	430347.8	108.8	79248.7	95.1	66339.4	103.4
2004	591016.7	149.4	108660.2	130.3	67318.6	104.9
2005	764017.1	193.2	135654.3	162.7	68339.0	106.5
2006	989930.5	250.3	183170.9	219.7	69168.7	107.8
2007	1299705.0	328.6	272876.5	327.3	70770.3	110.3
2008	1660844.0	419.9	370210.2	444.1	71003.1	110.7
2009	1222644.0	309.1	268922.3	322.6	69410.5	108.2
2010	1524916.0	385.5	329769.2	395.6	69933.7	109.0
2011	2051662.0	518.7	440843.7	528.8	70856.6	110.5
2012	2210257.0	558.8	476306.6	571.3	71545.4	111.5
2013	2297128.0	580.8	500221.4	600.0	71391.5	111.3
2014	2063663.0	521.7	438480.8	525.9	71539.0	111.5
2015	1365864.0	345.3	283341.8	339.9	72323.6	112.7
2016	1283163.0	324.4	270109.0	324.0	72392.6	112.9
2017	1577524.0	398.8	342228.1	410.5	72315.9	112.7

Note: formed and calculated by data, given in [27]

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The data of Table 3 reflect GDP dynamics in real prices (mln USD) taking into account proportions of the physical and human capitals and also correspondences of the national economy to the technological progress of Ukraine as a country-victim and Russia as a country-aggressor under conditions of the «hybrid» conflict. As a result of modeling there were obtained 5 equations of Tinbergen-Solow production function as a result of realized iterations as follows:

– the first iteration in modeling is realized according to official statistic data of the World bank [27] for1995–2013, obtained values of the technological progress parameter are taken as base ones, because 2013 is the last one before «hybrid» aggression;

– the second iteration is realized by adding the previous volume (for 1995–2013) to the data for 2014 (first year of «hybrid» aggression – occupation of the Autonomous Crimean Republic and separate territories of the Donetsk and Lugansk regions). As a result of modeling, there are obtained new values of the technological progress parameter;

– the third, fourth and fifth iterations are realized analogously with the first-turn addition of official statistic data to the existent volume for the next year and modeling of the indicated production function for obtaining the numerical technological progress parameter.

The obtained results of modeling Tinbergen-Solow production function for each of 2013–2017 years for Ukraine and Russia, given in Table 3, allow to make a series of important conclusions. All obtained equations are statistically important, because values of correspondent coefficient of plural determination are $R^2 > 0.9$. The structure of the influence of production factors on GDP formed in the national economy of Ukraine:

– for the end of 2013 the physical capital influence was 68 %, human one – 32 %. That is human capital losses for compensating the decrease for 1 unit of the physical capital are 2.2 times more;

– for the end of 2017 the physical capital influence was 70 %, human one – 30 %. That is human capital losses for compensating the decrease for 1 unit of the physical capital are already 2.4 times more.

In the Russian national economy:

– for the end of 2013 the physical capital influence was 80 %, human one – 20 %. That is human capital losses for compensating the decrease for 1 unit of the physical capital are 4 times more;

– for the end of 2013 the physical capital influence increased to 84 %, human one correspondingly decreased to 16 %. That is human capital losses for compensating the decrease for 1 unit of the physical capital are already 5.2 times more.

Another typical result of the study is the observed reduction dynamics of the technological progress parameter of the studied countries (–0.003 for Ukraine and –0.008 for Russia), that is a direct result of «hybrid» aggression. Thus, the process of the «hybrid» conflict causes innovative potential losses of the national economy of both country-victim and country-aggressor, so domination of the physical capital in the national economy grows. So, there appears a necessity of the complex estimation of volumes of losses (increment) of the innovative potential of the states-parties of «hybrid» aggression. For that it is necessary to make calculations of the multiplier of Tinbergen-Solow production function that includes the technological progress parameter (Table 4).

Table 4

Calculations of losses (increment) of the innovative potential of the national economies of the states-antagonists of «hybrid» aggression in 2013–2017

Calculating parameter *	Values of parameter by years :					Totally
	2013	2014	2015	2016	2017	
Ukraine						
$e^{\gamma_i t_i}$ **	2.064	2.307	2.336	2.272	2.256	x
$e^{\gamma_{2013} t_i}$	2.064	2.144	2.228	2.314	2.404	x
$e^{\gamma_i t_i} - e^{\gamma_{2013} t_i}$	0	+0.163	+0.108	–0.042	–0.148	+0.081
Increment (+) Losses (–) of the innovative potential of the national economy, mln USD	0	+7858.9	+5207.1	–2025.0	–7135.7	+3905.3
Russia						
$e^{\gamma_i t_i}$	1.305	1.316	1.253	1.188	1.156	x
$e^{\gamma_{2013} t_i}$	1.305	1.323	1.342	1.360	1.380	x
$e^{\gamma_i t_i} - e^{\gamma_{2013} t_i}$	0	–0.007	–0.089	–0.172	–0.224	–0.492
Increment (+) Losses (–) of the innovative potential of the national economy, mln USD	0	–2768.7	–35202.3	–68031.3	–88599.0	–194601.3

Note: * – symbols of parameters are taken from formula (1); ** – where $i \in [2013; 2017]$

In Table 4 annual losses (increments) of the innovative potential of the national economy of Ukraine (ΔIPU_i) were calculated by formula:

$$\Delta IPU_i = 48213.9(e^{\gamma_i t_i} - e^{\gamma_{2013} t_i}), \quad (4)$$

where 48213.9 – volume of base GDP of Ukraine in real prices of 1995, mln USD; γ_i – technological progress parameter of *i*-year, $i \in [2013; 2017]$; t_i – successive number of *i*-year, $i \in [2013; 2017]$.

Annual losses (increments) of the innovative potential of the national economy of Russia (ΔIPR_i) were calculated by formula:

$$\Delta IPR_i = 395531.1(e^{\gamma_i t_i} - e^{\gamma_{2013} t_i}), \quad (5)$$

where 395531.1 – volume of base GDP of Russia in real prices of 1995, mln USD.

Thus, the summary increment of the innovative potential of Ukraine (country-victim of «hybrid» aggression) in 2014–2017 was +3.9 bil USD or 2.1 % of GDP volume in real prices of 2013. In general, it indicates the presence of widened recreation of the Ukrainian national economy by increasing production volumes in the military-industrial complex and other adjacent economic spheres, effectiveness of the macroeconomic help, increase of volumes of capi-

tal investments in material production and so on. These positive arrangements were realized under conditions of the «hybrid» conflict, temporal occupation of the Crimean Autonomous Republic and parts of the Donetsk and Lugansk regions, real economic decline, inflation in whole and growth of prices for energy sources in particular; devaluation of the national monetary unit and so on. But in 2017 Ukrainian GDP in real prices (mln USD was only 61.2 % of the pre-conflict level of 2013.

According to the data of Table 4, summary losses of the Russian innovative potential in the period of 2014–2017 were 194.6 bil USD or 8.5 % of GDP volume in real prices of 2013. The country-aggressor in the «hybrid» conflict suffers from essential losses, mainly because of international economic sanctions, external economic isolation of key economic spheres and negative price dynamics of oil as a main GDP-creating resource. In 2017 Russian GDP in real prices (mln USD) was only 68.7 % of the pre-conflict level of 2013. It means that renovation of the national economy of the country-aggressor is faster (by 7.5 %), comparing with the country-victim, but with essential innovative potential losses.

7. SWOT analysis of research results

Strengths. Strengths of the research as to using the model of Tinbergen-Solow production function are in fact that the dynamics of the technological process parameter allows to estimate volumes of innovative potential losses of the parties of «hybrid» aggression – both country-victim and country-aggressor.

Weaknesses. Weaknesses of the conducted research may be considered as the fact that the estimation results, obtained using the offered methodological approach are not complete, although they are based only on modeling the base GDP dynamics taking into account three factors – base growth rates of the physical and human capital and technological progress. At that any other factors are neglected.

Opportunities. It must be noted that in further the process of estimation of innovative potential losses of the conflict parties may be considered as a base of setting and solving the wide spectrum of optimization problems, connected with Ukrainian GDP maximization under conditions of «hybrid» aggression. It will be the base for further studies.

Threats. Threats of estimation of innovative potential losses of the parties as a result of «hybrid» aggression of Russia against Ukraine include the fact that the offered methodical approach cannot be considered as a means that allows to provide a base for making managerial decisions at the international level The estimation process is complicated by the objective impossibility to classify and detail existent losses concretely by types.

8. Conclusions

1. The work realizes an attempt to estimate losses (increment) of the innovative potential of Ukraine as a state-victim and Russia as a state-aggressor in the «hybrid» war, started from 20 of February of 2014 from the temporary occupation of the Crimean Autonomous Republic and continuing till today. It was grounded, that the estimation reliability is provided at the expanse of using real (official) statistic data for the period of more than 10 years and an estimation object must be at the same time a subject of the innovative process.

2. There was improved the methodical support of estimating innovative potential losses at the macrolevel by probating Tinbergen-Solow production function and studying the dynamics of the technological progress parameter for the states-antagonists in the «hybrid» conflict for 2013–2017. There were conducted 5 iterations of the model for the studied countries and calculated the differences of multipliers of Tinbergen-Solow production function, including the values of the technological progress parameter – fixed for 2013 and current for 2014–2017.

3. There was studied the dynamics of the technological progress parameter for the states-antagonists in the «hybrid» conflict for 2013–2017. The technological progress parameter, obtained for the national economy of Ukraine in 2013 before the aggression was 0.038. At the expanse of the existent innovative potential it increased in 2014 by +0.004. For the end of 2017 its value for the country-victim decreased by–0.007, comparing with 2014. The numerical value of the technological progress parameter, obtained for the national economy of Russia at the end of 2013 was 0.014. It remained at the same level in 2014 at the expanse of the existent innovative potential. The general decline of the technological progress parameter for Russia for the period of «hybrid» confrontation was – 0.008.

4. It was proved that during 4 years of «hybrid» aggression the renovation of the national economy of Ukraine is slower than in Russia by 7.5 %. But the summary increment of the Ukrainian innovative potential in 2014–2017 was +3.9 bil USD or 2.1 % of the GDP volume in real prices for the end of 2013. Russian innovative potential losses for the same period were –194.6 bil USD or 8.5 % of the GDP volume of 2013. The offered methodical approach to estimating innovative potential losses of thee parties of «hybrid» aggression will be further probated for the dynamics of real GDP and its physical volume, and will be further investigations of the authors in this direction.

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