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BASIC INCOME AS A TOOL TO SUPPORT AGGREGATE DEMAND

Askar Akaev[1], Alexander Petryakov[2] ✉, Nauryz Baizakov[3], Zoltan Zeman[4]

[1] Lomonosov Moscow State University, Moscow, Russia;
[2] Saint Petersburg State University of Economics, Saint Petersburg, Russia;
[3] JSC «Economic Research Institute», Nur-Sultan, Kazakhstan;
[4] St. Stephen's University, Godollo, Hungary

✉ apetryakov1991@gmail.com

Abstract. The developed economies of the world are now facing new challenges, the main of which are: the degree of human participation in the production process, in which it will not be an "appendage" of new intelligent systems; prevention of further social and economic polarization of society; development of new economic tools to mitigate the negative effects of extensive digitalization of production and services. This paper shows that conditional basic income as a macroeconomic policy tool can be a response to these challenges, especially given its role as the instrument of maintaining aggregate solvent demand.

Keywords: technological change, universal basic income, aggregate demand, economic policy

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БАЗОВЫЙ ДОХОД КАК ИНСТРУМЕНТ ПОДДЕРЖКИ СОВОКУПНОГО СПРОСА

Аскар Акаев[1], Александр Петряков[2] ✉, Наурыз Байзаков[3], Золтан Земан[4]

[1] Московский государственный университет им. М.В. Ломоносова, Москва, Россия;
[2] Санкт-Петербургский государственный экономический университет, Санкт-Петербург, Россия;
[3] АО «Институт экономических исследований», г. Нур-Султан, Казахстан;
[4] Университет Святого Стефана, Годолло, Венгрия

✉ apetryakov1991@gmail.com

Аннотация. Развитые экономики мира стоят сегодня перед новыми вызовами, основными из которых являются: степень участия человека в производственном процессе, при котором он не будет "придатком" новых интеллектуальных систем; предотвращение дальнейшей социальной и экономической поляризации общества; разработка новых экономических инструментов, смягчающих негативные последствия широкой цифровизации сферы производства и услуг. В работе показано, что обусловленный базовый доход как инструмент макроэкономической политики, может быть ответом на эти вызовы, особенно учитывая его роль как средства поддержания совокупного платежеспособного спроса.

Ключевые слова: технологические изменения, безусловный базовый доход, совокупный спрос, экономическая политика

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Introduction

Industrial growth over the past 100 years has had a tremendous impact on the development of technological infrastructure and changing lifestyles. Three major components of this development are related to personalization: automobile as a personal means of transport and greater personal freedom; personal computer as a means of intellectual autonomy; and personal telephone as a means of freedom of communication and access to information. These three development factors have significantly changed the psychology of the employee and created the conditions for the diffusion of qualitatively new, synthesized (cyber – physical) technologies, which became the basis of Industry 4.0 and the Internet of Things – the two main working concepts of industrial and infrastructure development for the next 20 years. The personalization of consumption and individualization of social demands can be seen as a transition point to a new machine age, which includes: a) Industry 4.0; b) the Internet of Things; c) systems based on elements of artificial intelligence.

These qualitative changes have matured over the past 25–30 years. A key feature of world development during this period was a decline in the rate of economic growth in industrialized countries with simultaneous socio-economic polarization. Another important feature was the qualitatively new role of information and communication technology, which became the basis of the new digital infrastructure of society. As for changes in the nature of labor, they are characterized by three main trends: a) direct replacement of human functions through robotization and computerization; b) rapid washout of certain types of professions due to global information and social networks; c) growth of a parallel labor market (non-standard forms of employment). In essence, the society is facing new challenges, the main ones being: the degree of human participation in the production process, in which it will not be an "appendage" of new intelligent systems; prevention of further social and economic polarization of society; development of new economic tools to mitigate the negative effects of extensive digitalization of production and services. It seems to us that conditional basic income, as a macroeconomic policy instrument, can be an answer to these challenges, especially given its role as an instrument of maintaining aggregate effective demand.

Materials and Methods

Technological factors of the labor changing nature and market

The twentieth century saw a number of empirical patterns accompanying the process of long-term economic growth, when the effects of various economic and financial shocks and crises are smoothed out. A number of them were first formulated by N. Kaldor (Kaldor, 1961). A number of papers published in recent years on the central question of economics – the distribution of income among factors of production and distribution of income and wealth among people – show that not all patterns are observed given the dynamic and widespread use of artificial intelligence (AI) (Korinek and Stiglitz, 2018, 2017; Stiglitz, 2015).

One reason for such rethinking was the rapid growth of the NBIC-technology sector (Bainbridge et al., 2006; Roco, 2011). The technologies of the 4th Industrial Revolution (Schwab, 2016; Schwab and Davis, 2018) and Industry 4.0 itself (Kagermann et al., 2013) have become a practical reality. At the same time, the Industrial Internet is becoming the underlying infrastructure of Industry 4.0 (Greengard, 2021), a digital platform that ensures the efficient interaction of all industrial production facilities based on the Internet. With the emergence of intelligent robots capable of interacting with humans and learning through practical operation, a critical stage in the development of robotics begins, when its mass application in most areas of public life and the economy will take place (Ford, 2015). At the same time, a Blockchain multifunctional digital information technology emerged for the reliable accounting of assets and transactions with them (Swan, 2015).

Applied to present day, much of the negative expectations for the labor market are attributed to the development of digital technology, with estimates from the effects of widespread automation estimated at a reduction of between 9% of the workforce in the European economy (Arntz et al., 2016) and 47% in the US economy (Frey and Osborne, 2017). Much of the urgency of the debate also stems from growing income inequality in advanced economies over the past 30 years (Piketty, 2014; Stiglitz, 2012) and the long-term trend of falling shares of employment in manufacturing in advanced economies (Keese et al., 2017).

McKinsey Global Institute experts' forecast shows that by 2055 half of the existing jobs in all countries of the world could be eliminated due to complete automation of production. Robots could put 1.1 billion workers worldwide out of work and deprive them of $15.8 trillion in wages. As a result of such job cuts, global labor productivity will rise steadily, increasing by 0.8 to 1.4 percent per year.

One of the consequences of the widespread use of digital technology is the decline in average wages, which is due to the widespread use of information and communication technologies, and as a result, their gradual cheapening. Acemoglu and Resrepo (Acemoglu and Restrepo, 2020) note that the use of industrial robots between 1990 and 2007 in local U.S. labor markets has shown that robots can reduce employment and wages: one robot per thousand workers reduces the employment-to-population ratio by about 0.18–0.34 percentage points and wages by 0.25–0.5 percent. According to other estimates of robot use in EU countries, one robot per thousand employees reduces employment by 0.16–0.20 percentage points, i.e., the crowding out effect dominates (Chiacchio et al., 2018). The use of industrial robots across the global economy (Carbonero et al., 2020), also poses significant threats: estimates indicate a long-term employment decline of about 1.3% due to a 24% increase in the number of robots between 2005 and 2014. In developed countries, this reduction in employment is just over 0.5%, while in emerging economies it reaches nearly 14%. The impact of automation on labor market transformation, according to some experts, is long-term and will lead to a significant decrease in labor force participation and an increase in inequality in the long run: automation is very good for economic growth and very bad for equality (Zanna et al., n.d.). There are already attempts to assess the global effects of the widespread use of computers and digital technology on employment. According to a survey by the World Economic Forum (*The Future of Jobs*, 2016), there will be net job losses of 5.1 million jobs between 2015 and 2020 (total job losses will be 7.1 million and new jobs will not exceed 2 million).

In contrast to the views outlined above, there is another point of view which is based on the fact that new technologies in real economic systems do not threaten the employment system, because by displacing some activities, they simultaneously promote the emergence of others. For example, analyzing the U.S. labor market from 1850 to 2015, the authors of the study argue that levels of professional outflow in the U.S. are now at historic lows, and that no more than 10 percent of jobs in the U.S. economy are truly threatened by automation (Atkinson and Wu, 2017). In many cases, machines replace and complement human labor; they add value to those tasks that are accomplished through the unique qualities of workers (Autor, 2015). Another study notes that because of the imbalance in technological progress, where there is an inability to replace routine tasks with information technology, there is an increase in wages and employment in low-skilled services (Autor and Dorn, 2013). Individual researchers in Europe also tend not to dramatize the effects of extensive workplace automation (Arntz et al., 2016; Pouliakas, 2018). In Germany, research suggests that no more than 13 to 15 percent of the workforce is at risk of automation (Arnold et al., 2016; Dengler and Matthes, 2018) OECD researchers also tend to believe that no more than 10% of those employed in the U.S. economy are exposed to automation (Nedelkoska and Quintini, 2018). Exploring the practical application of robots and artificial intelligence (Vermeulen et al., 2018), a group of authors notes that this is a "common structural change" because the occupations affected by the effects of new technologies account for no more than 20% of jobs. In analyzing German industrial practices regarding the use of robots between 1994 and 2014 (Dauth et al., 2018), the authors note that the use of robots led to a loss of manufacturing jobs, but this was offset by gains in the business services sector.

An important feature of the digital economy is the increased demand for more skilled labor. Therefore, we should expect a new stage of labor market evolution caused by the transition to a high-tech and knowledge-intensive digital economy, in which the main labor force will be concentrated in STEM (Science, Technologies, Engineering and Mathematics) industries. Thus, McKinsey Global Institute experts predict that by 2020, companies in STEM industries around the world will need about 40 million highly skilled professionals, but 100 million middle-skilled people will be out of work.

Another feature will be the qualitatively new role of technological progress generated by the 4th industrial revolution – the uneven increase in the productivity of the main factors (capital and labor) of economic growth. Empirical evidence over the past 40 years shows that median income in a number of developed countries stopped growing in the 1980s, although for decades before it had been growing in proportion to productivity, following the growth of the latter. This process accelerated after the 2000s. While the median wage stagnated before 2000, it has now begun to decline, although the aggreagate factor productivity in developed economies has been rising steadily all along (Brynjolfsson and McAfee, 2014). Such inequality increases as a result of two forces: a) growing gap between labor income and capital income, and b) growing gap between high-income and low-income families (Leipziger and Dodev, n.d.). Appealing to data on the U.S. economy, they emphasize that the share of domestic income that goes to labor remunerarion has been declining since the early 1970s, as the share that goes to capital (interest, dividends, realized investment income, capital gains) has increased. This trend in the ever-decreasing share of gross domestic income devoted to the labor force (wages and salaries) since its peak in 1970 explains the expansion of inequality in the United States in recent decades. We should expect this process to worsen in the 2020s as digital technology destroys jobs faster than it creates them, thereby increasing unemployment and causing the median income to fall further.

Universal basic income as a symptom of social discomfort

The idea of basic income, of course, is not new. A recent work by the World Bank (Gentilini et al., 2019) provides a brief historical sketch of the evolution of social protection systems, from poverty alleviation in the 16th century to the explosive growth of social assistance programs in the 21st century. The authors of the study rightly note that social protection systems, due to the inertia of institutions and political structures, require time to adapt to rapidly changing structural changes brought about by demographic and technological factors. It is the need to rethink the role of the social protection system, according to the authors, that is one of the key reasons for the growing discussion of the concept of universal basic income (UBI) as a possible platform for a new system of social protection. It must also be recognized that interest in UBI is a symptom of serious social discomfort, as even in developed countries there is unequal access to education and health systems, widespread low-wage and low-productivity work, poorly functioning markets, corruption, regressive tax laws, unequal pay, and social discrimination (Piketty, 2016).

It must be admitted that even during the period of rapid economic growth after the war, when many Western European countries were practically implementing the idea of building a welfare state, their social protection systems were the object of constant criticism. It is therefore no coincidence that the introduction of a universal basic income for all adult citizens was seen by F. Hayek as an “economic security cushion” (Hayek, 2021). M. Friedman proposed supplementing the income of the poor segment of population with their unused income tax benefits and deductions, which he called a negative income tax (Friedman, 1966). E. Atkinson viewed basic income as a realization of the principle of social protection and provision of a decent minimum income (Atkinson, 2011). However, such estimates of basic income, while widely used, are not dominant. A number of researchers consider basic income an "immoral idea" and, appealing to the successful experience of economic reform in India, observe that without work people will engage in undesirable activities, from petty crime and gambling to terrorism (Aiyar, 2017). Other arguments of UBI opponents include its high cost to the economy, need for substantial tax increases and cuts in other social programs, and the very reduction in the workforce, which would negatively impact economic growth (Minogu, 2018). Another strong argument by opponents of UBI is the lack of nationwide projects to test basic income, although there are a significant number of countries where such experiments have been conducted within individual administrative units or have been the subject of national referendums.

In June 2016, 76.9 percent of Swiss voters rejected a proposal for a guaranteed basic income for all after a difficult debate about the future of work in a time of increasing automation. In Finland, the experiment was slightly different: 2,000 unemployed people selected at random for 24 months (from January 2017 to December 2018) received monthly payments of 560 euros to encourage them to find permanent employment. Thus, this project was aimed at combating unemployment. The Finnish government declared the experiment unsuccessful and closed the issue of UBI. As we can see, even in such social states as Switzerland and Finland, the idea of UBI did not find broad support (Gotev, 2016; Valero, 2019). In the Netherlands, opinion polls show an increasing number of supporters of basic income (De Roo, 2021). Similar projects are under development in Denmark, France, Catalonia and Scotland, Corsica and Portugal (Wispelaere and Haagh, 2019). In Italy, the Association for introduction of a subsistence income (AIRE) proposes to set the level of such income in the range of 400 to 800 euros per month, depending on different scenarios for their implementation (De Basquiat, 2016). In February 2017, the European Parliament voted 328 times against a universal basic income to compensate for the losses from the use of robots in the labor market. However, the idea of a basic income itself is gaining significant traction among the general public, with support for a basic income averaging just over 50 percent in the European Social Survey (ESS) wave (Lee, 2018). Negative attitudes in the very idea of UBI are expressed by researchers from the United States (Kearney and Mogstad, n.d.). They rightly point out that trends such as growing inequality, elimination of high-paying jobs due to the use of robots, and complex systems of social benefits have objectively contributed to the question of UBI. However, the idea of UBI is sub-optimal in their view, and perhaps a harmful political answer to all three of these problems because of its extremely high cost and inability to address inequality. This position of the authors, however, did not prevent them from calculating the approximate cost of the UBI program on a national scale. Their calculations show that, depending on the UBI scenario chosen, federal spending would range from $1.2 tln. to $2.49 tln. This significantly exceeds the volume of current payments under various social programs of the federal government (about USD 1 tln.). In another paper (Hoynes and Rothstein, 2019), the authors specifically note that the motivation for using UBI is a labor market situation where there has not been adequate wage and income growth for those workers at the bottom of the income distribution curve for a long time. The authors believe that it is the long, decades-long stagnation of wages and fears about widespread automation and the use of robots, as well as dissatisfaction with the current social safety net, that are causing increased interest in the UBI in the United States and other countries.

International Labor Organization (ILO) regards the UBI as a radical proposal for social assistance, where an unconditional cash transfer is guaranteed to all residents. In this regard, they highlight key ILO principles and standards to which UBI itself should approach: (i) the adequacy and predictability of UBI benefits to ensure a guaranteed income, set at least at the national poverty level; (ii) social inclusion, including those in the informal economy; (iii) social dialogue and consultation with stakeholders; (iv) adoption of national laws regulating UBI rights, including indexation of benefits; (v) consistency with other social, economic, and employment policies, and (vi) sustainable and equitable funding [50]. At that, ILO experts emphasize that UBI could replace general social security and unemployment benefits, but should not replace basic public social insurance, health care, education, other important social services, and programs for people with special needs (e.g., additional support for disability-related expenses) (Ortiz et al., 2018).

The Russian segment of research recognizes the process of labor market polarization, but all papers devoted to quantitative estimates of automation and labor substitution are characterized as controversial, and therefore most alarmist forecasts seem unfounded, and the risks of automation and significant changes in the labor market in Russia are estimated as lower than in developed countries (Lyashok et al., 2020). Such estimates are given against the background of Russia's significant lagging behind many countries in Europe and North America in terms of economically active life expectancy and short life expectancy (Denisenko and Varshavskaya, 2017). We must also take into account the fact that Russia, like all other countries in the world, is subject to the natural process of population aging, which will inevitably lead to the need to develop a new mechanism of interaction between demographic and macroeconomic variables (Kapeliushnikov, 2019). Given this broad palette of opinions, it is suggested that basic income be seen not so much as an economic, social, and even political phenomenon, but as something new that could actually change the whole social policy in the broad sense (Gontmakher, 2019). The introduction of basic income is also associated with certain additional costs related to their administration, but these costs are justified because they reduce the information asymmetry arising in the relationship between the state and recipients of social assistance (Kuznetsov, 2019). The implementation of the concept of basic income in Russia is also dictated by the need to reform the extremely complicated system of social support, when a significant part of the poor (according to Rosstat estimates – 15%, according to the World Bank estimates – much more) is excluded from the social support system (Gontmakher, 2019).

Results and Discussion

Conditional basic income as an economic policy instrument

Current trends in technology (development of the internet, data processing systems, NBIC technologies, robots, artificial intelligence, electronic platforms, digital technologies) have a direct impact on the economic environment and the development of the social landscape: increasing economic inequality; changes in the structure of the labor market and employment system; a growing wage gap between highly skilled and unskilled labor; and the elimination of many types of occupations. The considerable empirical material accumulated so far on the processes of digital transformation in the context of different economies, together with new stylized facts, may serve as a basis for developing a system of mathematical models describing key economic trends in the era of digital transformation.

We use the modified Mankiw-Romer-Weil neoclassical model with human capital as our baseline model to describe long-term economic growth (Mankiw et al., 1992). We introduced a special parameter to account for the increasing contribution of knowledge and information to the production of innovative goods and services, to account for the increasing returns generated in high-tech knowledge-intensive industries (Arthur, 1996). We also obtained a formula for calculating the joint share of physical and human capital in national income, which, based on the equality of the net marginal product of physical capital to the net marginal product of human capital (Barro and Sala-I-Martin, 2003), more accurately estimates the share of physical capital in national income. All of this made it possible to generate:

– a basic model of economic growth, taking into account physical capital and the exogenous mechanisms of capital's share of national income and technological progress;

– a model of economic growth that takes into account both physical and human capital, and the endogenous mechanisms of formation of the shares of physical and human capital in national income as well as technological progress, from which estimates of potential GDP and jobs may be obtained under given scenarios of wage rates and basic income levels required for a sustainable economy.

Based on World Bank statistics for physical capital and GDP of the US economy for 1982–2018, coefficient estimates for models of physical capital accumulation in the 21st century were derived using c.a.m.

Thus, we have calculated a forecast of the potential number of jobs in the US economy – $L_p(t)$. Its chart is shown in Fig. 1. This figure also shows the projected employment curve with technological replacement $L_{CK}(t)$ and robotization of production $L_{CKR}(t)$ under the capital share scenario.

As Fig. 1 shows, if the current economic model remains unchanged, about 100 million additional jobs could potentially be created by 2050, while the new development model, based on the widespread digitalization of all areas of life, will see a modest increase in jobs until 2025, and then a gradual decline to a minimum level comparable to the crisis year of 2009 – around 140 million jobs. As Fig. 1 shows, digital technology is cutting four times as many jobs as robots.

Fig. 2 shows the projected growth trajectories of potential US GDP up to 2050, calculated under different scenarios of declining employment Y_{CK}, Y_{CKR}, Y_{rd} (see Fig. 2) and accelerated K-capital accumulation. As can be seen from examining the charts in Fig. 2, the technological replacement of labor for capital slightly reduces the potential level of GDP, but not by much. We calculate a curve Y_{rd} showing the real aggregate demand for goods and services. As Fig. 2 shows, GDP rises slightly until 2025, athen starts to fall. As a result, the gap between potential output and aggregate real demand will widen gradually to around \$20 tln or 54% of GDP by 2050. In the digital economy, then, it is demand that will begin to play a key role and will be the main constraint on GDP growth.

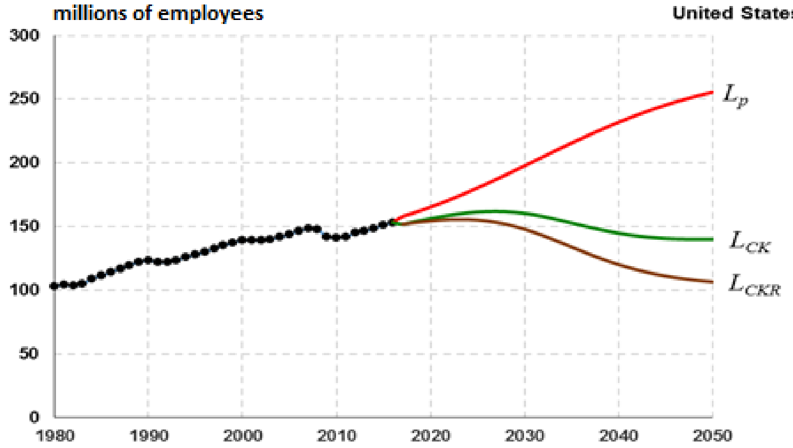

Fig. 1. Projections of the number of the employed in the US economy,
allowing for the technological replacement of jobs (L_{CK}) and production robotization (L_{CKR})

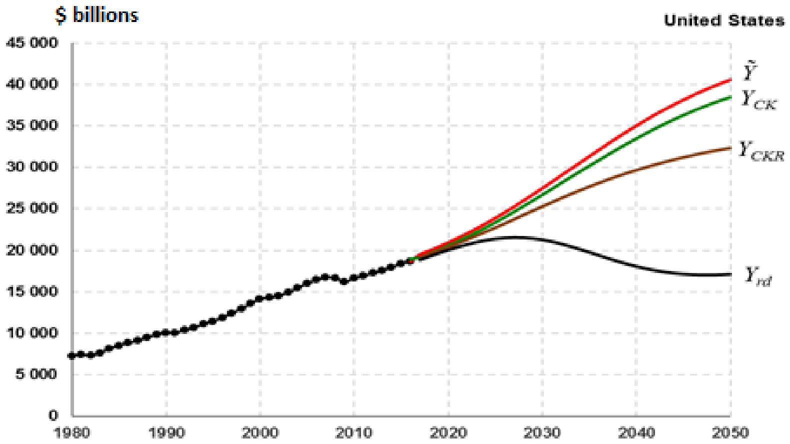

Fig. 2. Forecast of GDP dynamics allowing for technological replacement of jobs (Y_{CK}, Y_{CKR})
and falling demand from the households (Y_{rd})

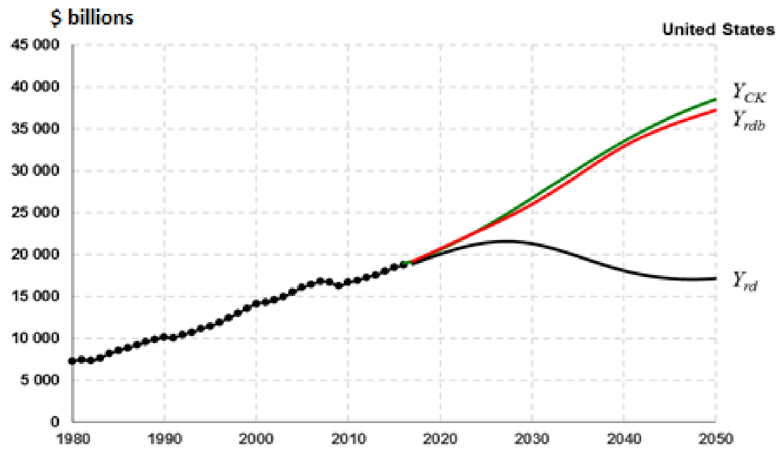

Fig. 3a. Restoring the potential amount of aggregate demand of households (Y_{rdb}) by introducing a basic income (Y_{Nb})

The growth trajectory of aggregate household demand including UBI and the growth curve of UBI itself are shown in Fig. 3.

As Fig. 3b shows, to compensate for the decline in aggregate demand, a universal basic income of \$50 per person per month is required and then ramped up logistically: in 2025 – \$500/person/month; in 2030 – \$1000/person/month; in 2035 – over \$2000/person/month; in 2040 – over \$3000/person/month; and in 2050 – already over \$4000/person/month.

The projected growth trajectories of potential US GDP to 2030 under different accelerated capital accumulation scenarios K are shown in Fig. 4a and 4b.

Estimates for 2030 show a potential GDP value Y_p of \$23.7 trillion with 164.1 million jobs. L_p Table 1 shows projections for the US economy in 2030 under the scenarios considered.

The growth trajectory of aggregate household demand including UBI and the growth curve of UBI itself are shown in Fig. 5a and 5b.

The difference in approaches to determining the nominal wage between the 2 scenarios is also evident at the level of the calculation of the required UBI. The calculations confirm the conclusion that there is a smaller gap between real demand and supply under the hypothetical scenario – the amount of funds

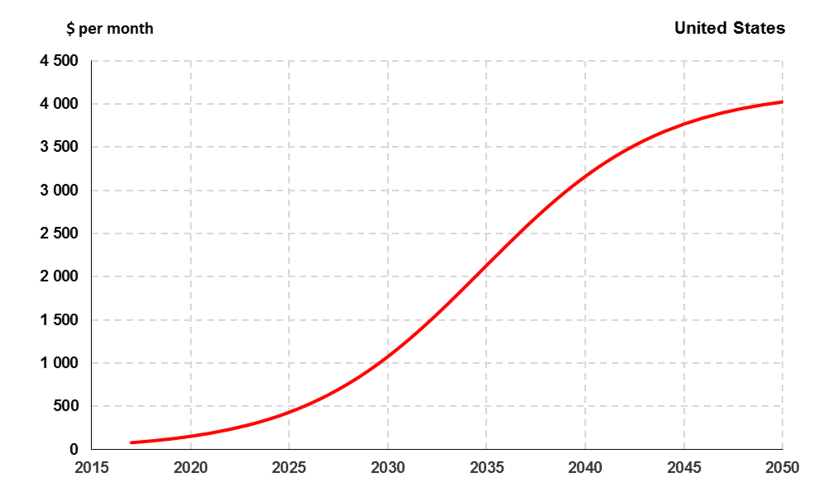

Fig. 3b. Dynamics of annual basic income r_b

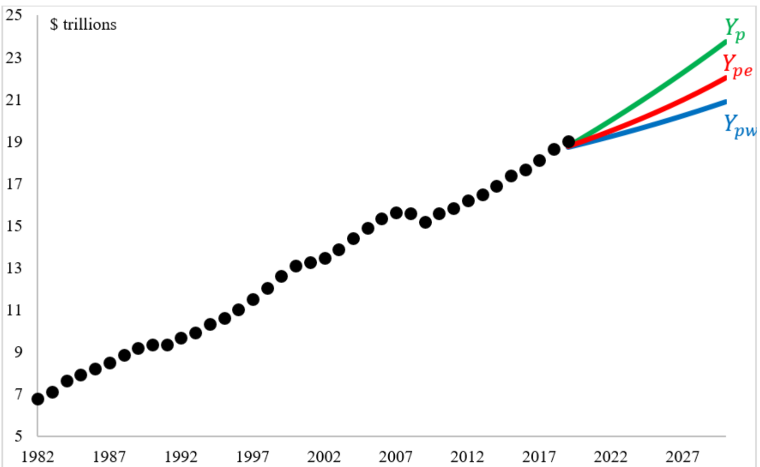

Fig. 4a. Forecasts of GDP dynamics taking into account technological replacement of jobs (Y_{pe}, Y_{pw})

needed to restore demand averages 18.19% of the projected GDP for the empirical scenario and 17.01% for the hypothetical scenario. This fact has an impact on the UBI value – according to our calculations, with the assumption of simplifications in the hypothetical scenario, the initial UBI of $860/month per person over 10 years would increase by about $160, whereas the empirical scenario calls for both a higher starting level of UBI ($880/month per person) and an annual increase to $1,200/month in 2030.

Overall, the resulting projections are consistent with the postulates about the impact of digital transformation on the economy and the new stylized facts. Accelerating technological progress, automation and robotics are having a negative impact on the labor factor. Under these conditions, the evolution of economic development indicators (GDP, real demand, number of jobs) is inversely proportional to changes in the real wage rate. On the other hand, an increase in pay has a positive effect on smoothing out inequalities and reduces the required UBI value.

When discussing the results of the modelling, it is necessary to compare them with existing estimates. According to projections of the U.S. Congressional Budget Office (*U.S. Congressional Budget Office*, 2020, potential real GDP of the US by the end of 2030 would be $23.3 trillion, a 1.7% difference from

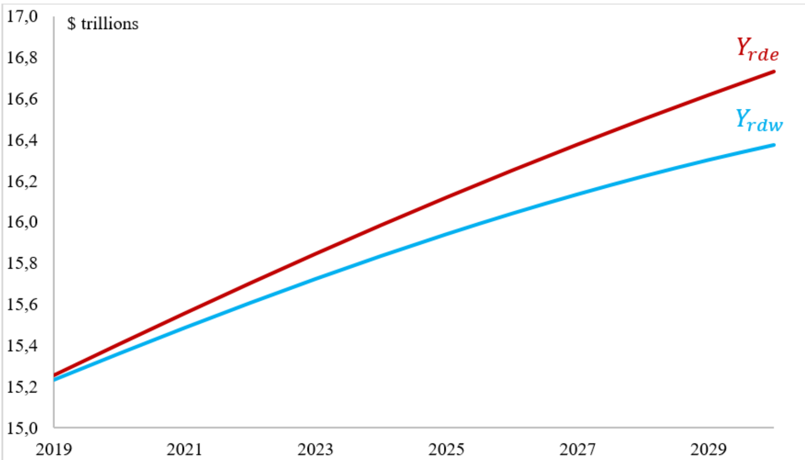

Fig. 4b. Projections of real household demand dynamics (Y_{rde} and Y_{rdw})

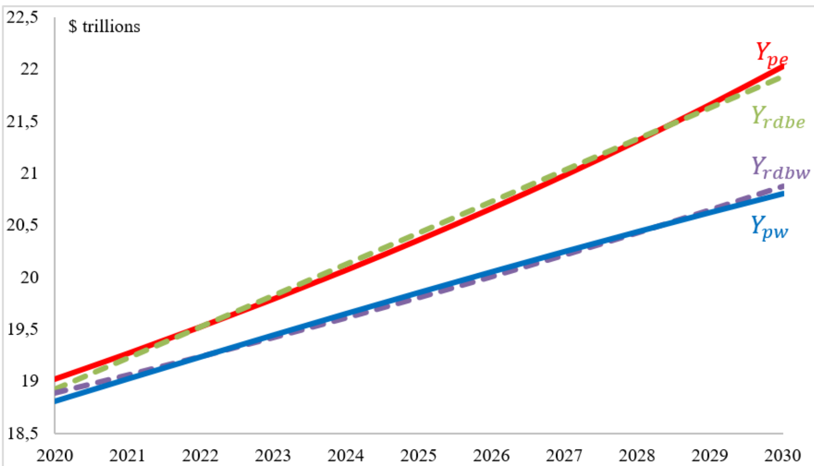

Fig. 5a. Restoring the potential amount of aggregate demand of households (Y_{rdb}) by introducing a basic income (Y_{Nb})

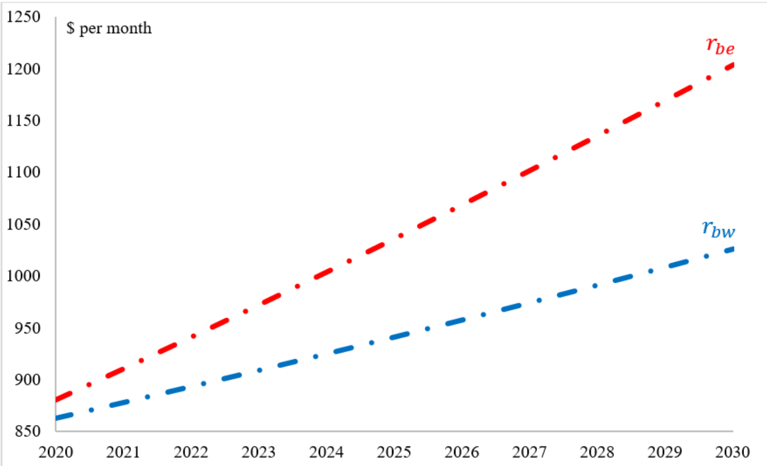

Fig. 5b. Dynamics of annua l basic income r_b

Table 1. Forecast for US economic indicators for 2030

Indicator	Scenario	
	Empirical	Hypothetical
Number of employees (million), including:		
– technological job replacements	152.2	144.3
– production and management robots	138.3	130.3
GDP, taking into account technological substitution of jobs ($ trillion)	22	20.9
Households real demand ($ trillion)	16.7	16.3

the value derived from our model. The alternative estimate proposed by the OECD (OECD, 2018) is $21.9 trillion, which is almost identical to our empirical scenario projection. Thus, accounting for different scenarios of wage rate dynamics in our model allows to generate an interval of reasonably adequate estimates of future GDP.

On the other hand, according to calculations made by the Bureau of Labor Statistics ("Bureau of Labor Statistics. Employment projections — 2018–2028," 2019), the number of jobs in the US economy by 2028 will be 169.4 million – 6% higher than our forecast for the same year. In our view, this divergence underscores the importance of the digital transformation of the economy and the search for tools to describe it.

Estimating the UBI level using the models we developed, we obtained an initial value of $860–880 per month per person in 2020 and projected values by 2030. Calculations under our proposed model showed that the annual cost per person should be around $10–12,000. This amount is close to what is currently being articulated in the research environment, for example in a study (Kearney and Mogstad, n.d.). These calculations show that, depending on the chosen UBI scenario, federal budget expenditures would range from $1.2 trillion to $2.49 trillion (5.85% to 12.15% of GDP) (5.85% to 12.15% of GDP).

Conclusion

The verification of the proposed models for the US economy shows that the model values are consistent with the real values. Our proposed modification of the simplest production function based on current views of economic development – taking into account human capital, according to Stiglitz, and the increasing returns generated by high-tech knowledge-intensive industries, according to Arthur – is adequate and can be used in practice. The introduction of UBI would certainly require redistribution of income from the rich to the poor, increased proportional income taxation, and possibly the introduction of a capital tax, as T. Piketty suggests (Piketty, 2016). However, we have to assume that the digital economy is the era of demand and with sufficient and varied supply from producers of goods and services, it is the satisfied and paid demand that will determine the sustainability of the growth of the economy as a whole.

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INFORMATION ABOUT AUTHORS / ИНФОРМАЦИЯ ОБ АВТОРАХ

AKAEV Askar A. – Doctor of Technical Sciences, Professor, Foreign member of the Russian Academy of Sciences.
E-mail: askarakaev@mail.ru
АКАЕВ Аскар Акаевич – д.т.н., профессор, иностранный член РАН.
E-mail: askarakaev@mail.ru
ORCID: https://orcid.org/0000-0001-8158-0171

PETRYAKOV Alexander A. – Ph.D Economics, Senior Fellow.
E-mail: apetryakov1991@gmail.com
ПЕТРЯКОВ Александр Александрович – к.э.н., старший научный сотрудник.
E-mail: apetryakov1991@gmail.com
ORCID: https://orcid.org/0000-0002-1471-2207

BAIZAKOV Nauryz – Ph.D student.
E-mail: nauryz.b@mail.ru
БАЙЗАКОВ Наурыз – аспирант.
E-mail: nauryz.b@mail.ru
ORCID: https://orcid.org/0000-0003-1346-400X

ZEMAN Zoltan – Professor, Head of the Department of Controlling.
E-mail: zeman.zoltan@gtk.szie.hu
ЗЕМАН Золтан – профессор, заведующий кафедрой контроллинга.
E-mail: zeman.zoltan@gtk.szie.hu
ORCID: https://orcid.org/0000-0003-2504-028X

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