China's Economic Growth in 2010–2017: Analysis from the Perspective of the Input-Output Model and Modern Monetary Theory

A.A. Bykov[a], S.A. Tolkachev[b] ✉, U.A. Parkhimenka[c], T.V. Shablinskaya[d]
[a] Belarusian State Economic University, Minsk, Belarus;
[b] Financial University, Moscow, Russia;
[c] Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus;
[d] Ministry of Economy of the Republic of Belarus, Minsk, Belarus
[a] https://orcid.org/0000-0003-2005-9061; [b] https://orcid.org/0000-0003-3766-2246;
[c] https://orcid.org/0000-0001-7690-8873; [d] https://orcid.org/0000-0002-2880-4495
✉ Corresponding author

ABSTRACT

The article **aims** to analyze the external and internal growth factors of the People's Republic of China in 2010–2017. The authors use **methods** such as input-output modeling, statistical methods, content analysis of scientific publications. The study explores different perspectives on China's rapid economic growth in recent decades. In particular, the authors consider neoclassical models that investigate and explain the dynamics of the Chinese economy due to the accumulation and development of factors of domestic production. Some studies are analyzed, which consider economic growth as a result of the final demand, both internal and external, on the basis of the input-output approach. The article examines the views that interpret the monetary policy as one of the most important factors in stimulating economic growth. The authors, based on the economic growth decomposition method, determine the components due to domestic demand and the components due to exports, both for the entire Chinese economy and for particular industries. Calculations based on the data of input-output balances for 2010–2017 allowed the authors to draw a **conclusion** about the significant contribution of domestic demand to the economic growth of China in the context of active monetary stimulus. Thus, the novelty of the study is ensured by the fact that Thirlwall's law does not apply to modern China –– stimulating the economy in China does not lead to a decrease in the trade surplus due to the monetary and financial sovereignty, industrial competitiveness, and the innovative economic development. The search for tools for adapting China's monetary policy to the realities of Russia and the Republic of Belarus opens up opportunities for future research on the topic.
Keywords: input-output analysis; global value chains; China; factors of economic growth; monetary policy; modern monetary theory

INTRODUCTION

In scientific studies of the factors of economic development, several groups of theories and approaches can be distinguished that explain and quantitatively describe the factors of economic growth in economies, including the Chinese economy. The neoclassical growth theory is dominant. It explains the GDP growth by an increase in the volume of production factors, as well as an increase in their productivity, which is identified with the total productivity of production factors.

Post-Keynesian approaches have become widespread, explaining economic growth not by the presence of factors, but by the demand for goods and services. In particular, we considered the possibilities of applying the input-output methodology in analyzing the growth of the Chinese economy, as well as theoretical approaches to monetary stimulation of economic growth.

Previously, the authors used this research methodology to analyze and forecast economic growth on the example of the economies of Belarus and Russia [1, 2]. In particular, it was possible to establish that the positive results of stimulation are temporary and may be accompanied by crises: in Belarus, the growth of domestic demand due to the increase in the money supply with the ruble exchange rate restrained was observed in 2010 and in 2013–2014. The negative consequences of the stimulus were not long in coming: in 2011 there was a sharp collapse of the ruble exchange rate, and in 2015 a two-year recession began. These circumstances do not allow us to call the attempts of monetary stimulation of the economy of Belarus successful.

After a decline in export earnings in 2014, the Central Bank of Russia pursued a rather tight monetary policy, but in 2020 there were some signs of softening in the form of maintaining the ruble exchange rate, which is explained by the counteraction to the economic downturn caused by the pandemic crisis.

Currently, the official website of the Asian Development Bank (ADB) has publicly available input-output tables for the period from 2010 to 2017 of some economies of Asia and the Far East, including the economy of China.[1] It also published an analytical report on their application to analyze economic growth and global value chains in key economies of the region.[2]

Our interest in analyzing the Chinese economy using the methodology previously developed and applied for Belarus and Russia is due to the following reasons. We aimed to test and verify the calculations by comparing their results with those of the ADB report; to calculate previously used indicators for the

Chinese economy, which are not taken into account in the ADB methodology, in particular, the contribution of the added value of the main manufactured products to the trade balance; to test the hypothesis: monetary policy stimulates China's economic growth, or China's economic growth is "natural" and is mainly driven by factors such as exports, foreign direct investment (FDI), research and innovation activities.

Before using the methodology, we have developed, we consider the results of research on the development of the Chinese economy known from scientific publications, dividing them into three groups:

a) application of neoclassical growth theory to the Chinese economy;

b) the application of the "input-output" methodology for the analysis of the Chinese economy;

c) an overview of scientific and practical approaches to monetary stimulation of economic growth.

NEOCLASSIC MODELS OF ECONOMIC GROWTH AND THEIR APPLICATION FOR THE ECONOMY OF CHINA

The most widespread in scientific publications is the neoclassical theory of growth, or growth through the use of internal factors of production — labor, capital, entrepreneurship, science and innovation [3, 4]. Various modifications of this theory have made it possible to prove that in high-income countries over the past 50 years, human capital, knowledge, development and technology transfer have contributed more to economic growth than other "material" factors of production [5].

Studies of the factors of economic growth in China from the point of view of neoclassical growth theory are also based on the assessment of the contribution of labor, capital and total factor productivity (TFP).

Thus, E. Hong and L. Sun [6] argue that China's rapid economic growth is mainly due

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[1] URL: https://data.adb.org/dataset/peoples-republic-china-input-output-economic-indicators (accessed on 23.03.2021).
[2] Economic Indicators for Eastern Asia. Input-Output Tables. December 2018. Metro Manila, Asian Development Bank, 2018. 310 p. DOI: http://dx.doi.org/10.22617/TCS 189778–2

to the accumulation of factors of production, while technological progress does not play a significant role.

Since 1978, China has received over US$ 1 trillion in foreign direct investment. The rapid growth of China's role as a new pole of global economic growth since the early 1990s was closely linked to FDI inflows on such a large scale.

The export share of Chinese subsidiaries of multinational corporations (TNCs) in total Chinese exports increased from 26% in 1992 to 50% in 2000 and reached 60% in 2006. Using a spatial dynamical model and raw data from 1980 to 2005, E. Hong and L. Sun [6] demonstrated that foreign direct investment inflows have a significant positive impact on overall factor productivity both within and between provinces in China. An increase in the ratio of foreign direct investment to total investment in fixed assets by 10% will lead to an increase in TFP and per capita income by more than 1%.

This finding is supported by other studies that similarly identify foreign direct investment as a source of TFP growth [7, 8].

The article by J. Han, Y. Shen [9] assesses the impact of China's regional financial development on the growth of total factor productivity; provincial panel data from 1990 to 2009 were used in the calculations. The study shows that high rates of development of the financial sector lead to an overall increase in factor productivity by reducing inequality between provinces in the distribution of resources. According to the analysis, the contribution of technological progress to the growth of the Chinese economy is more than 90%; it is the main channel through which the financial sector drives TFP growth. In addition, the development of the financial sector leads to poverty reduction.

A study by H. Liao, X. Liu, C. Wang [10] examines the dissemination and assimilation of knowledge and technologies by industrial enterprises in China on the basis of a sample of more than 10 thousand firms with local

and foreign investments for the period 1998–2001 The results show that there is positive cross-industry productivity gains from R&D and foreign presence, while data on intra-industry productivity gains from foreign direct investment in Chinese firms are less reliable.

Zh. Yao [11] calculates the total factor productivity for the industrial sector of the Chinese economy using production functions. The results confirm that reform policies and the opening up of the Chinese economy contributed to higher productivity growth, but conclude that TFP began to decline after the 2008 financial crisis.

Despite the widespread use of neoclassical growth models in the study of the factors of economic development, they have a significant problem, since, they poorly consider the influence of internal and external demand on economic dynamics. The demand factor is key in post-Keynesian economic growth models, which are grouped together with demand-driven growth models. The input-output analysis is used as a general methodology for constructing this class of models.

APPLICATION OF THE INPUT-OUTPUT METHODOLOGY FOR ANALYSIS OF CHINA'S ECONOMY GROWTH

A study of the Chinese economy at the level of aggregated indicators such as GDP growth, inflation, interest rates, exchange rates, foreign exchange reserves may be superficial. These indicators do not reflect the specifics of the work carried out in the Chinese economy, do not reveal bottlenecks that can change the direction of its evolution. The use of input-output tables provides a comprehensive understanding of the "inner workings" of the Chinese economy, its bottlenecks, and evolutionary characteristics, as stated by Canadian professor C. Debressona, a specialist in inter-firm collaboration [12].

Most of the Chinese provinces surpass many countries in the world in terms of population and GRP, therefore China pays great attention to interregional cooperation.

To analyze the economic interaction of the provinces of China, an interregional input-output table is used, the procedure for compiling which is described in detail by Zh. Zhang, M. Shi, Zh. Zhao [13].

The interregional input-output model is used as an analytical tool to track the movement of profits between provinces in China in order to identify signs of tax evasion by firms, including VAT and income tax [14]. The intraregional structure of the tables follows the input-output table in China's national statistics and includes more detailed information on the domestic value chain.

Labor force employment in China has become another important issue that has been addressed using the input-output methodology. H. Doan and L. Trinh [15] analyze the sources of employment growth and assess the contribution of exports, labor productivity, technological innovation, and domestic final demand to the creation of new jobs in China. As a source of information, they used the annual data of the input-output tables for 1981–2010. The study found that an increase in final demand, including domestic demand and exports, is the main driver of employment growth in China. The rapid growth in final demand compensates for the decline in employment caused by the growth of labor productivity, especially in the 2000s. Since China's accession to the World Trade Organization, the contribution of exports to job creation has increased significantly, especially in manufacturing and agriculture. Labor productivity has grown in all sectors, primarily in the manufacturing industry. Technological innovation has become the main source of productivity growth in manufacturing and agriculture [15].

X. Jiang [16] analyzes the state of employment in China under the influence of changes in the structure of the trade balance at the sectoral level using input-output tables. Jiang estimates the potential additional output that would be required if China used its trade surplus as the primary vehicle to absorb its surplus labor. It was found that the ability of sectors of the Chinese economy to create new jobs is inversely proportional to the contribution of these sectors to the trade balance.

A modification of the input-output model focused on the analysis of the energy sector has become widespread in China. Z. Tan, L. Li, J. Wang, Y. Chen [17] investigated the potential impact of the system of differentiated electricity prices on macroeconomic indicators. And S. Lindner et al. [18] present a methodology for disaggregating the electricity sector in China's national input-output table using regional information and data on the operating and maintenance costs of power plants. The electricity sector is subdivided into the transmission and distribution sector, as well as eight subsectors representing different types of technologies in power plants. The structure of electricity consumption in each industry is determined considering the regional presence of the industry and the regional balance of electricity. The disaggregated input-output table contains refined indicators suitable for calculating CO_2 emissions from international exports from China.

Input-output tables by country (e.g., WIOD, Eora, TiVA) are becoming more common in research and are used in the analysis of global value chains (GVC). The criteria for the participation of the economy in the GVC (GVC Participation), the calculation of which is carried out according to the data of multi-regional tables, will be discussed below. However, the level of vertical specialization can also be measured on the basis of traditional (national) input-output tables using an indicator of import intensity.

According to the generally accepted methodology, when calculating the import intensity of a certain product, no distinction is made between its sales markets. When delivered for export or for the domestic market, it is assumed that the import intensity is the same. The use of adapted tripartite

input-output tables (for 2002 and 2007) made it possible to separately calculate the import intensity of export products of the manufacturing industry, regardless of the products remaining in the domestic market, and thereby more accurately assess the vertical specialization of China [19].

The analytical report of the Asian Development Bank (2018)[3] considers the methodology for using input-output tables to calculate the most important macroeconomic indicators and shows the results of their calculation for the period from 2010 to 2017, including for the PRC economy. The article presents the calculations of important macroeconomic indicators that would be impossible to calculate without using the methodology and the availability of detailed data from the input-output tables. Among them is the part of GDP created through the export of goods and services (GVA attributed to exports), as well as the part of GDP created from final demand in the national economy (GVA attributed to final demand).

The results of the calculation based on the data of the Chinese economy showed, for example that the contribution of exports to GDP for the period from 2010 to 2017 decreased from 22.7% to 16.4% — the growth of the Chinese economy is becoming focused mainly on domestic demand. Against the background of a general decline in the contribution of exports to GDP, indicators of China's GVC participation make it possible to detail these changes by country and industry. Among the most important importers of value added produced in China (included in exported goods and services), the USA, Japan and India dominate, while Japan's share decreased over the time period under consideration. High-tech goods prevail among China's export goods. Over 8 years, the volume of their gross exports increased by 40%, and the added value in exports — by 50%, which

indicates a decrease in the import intensity of exported products due to an increase in the localization of production.

Summarizing the results of the above studies, we can conclude that the classical input-output methodology allows a sufficiently deep and detailed analysis of various aspects of economic growth, however without additional information and additional analytical procedures, it does not fully disclose all sources of growth in the Chinese economy.

THEORY AND PRACTICE OF MONETARY STIMULUS FOR ECONOMIC GROWTH

The COVID-19 pandemic and lockdown sparked a "monetary response" from the world's leading central banks to the 2020 economic crisis. Assets of the world's seven leading central banks (excluding the People's Bank of China and central banks of other emerging economies) reached US$ 25 trillion in October 2020, an increase of US$ 8 trillion in 9 months of this year, nearly 10% of global GDP. For 9 months of 2020, in dollar terms, the Fed's assets grew by US$ 3.1 trillion (which is about 15% of the annual US GDP), the assets of the ECB grew by US$ 2.9 trillion, the Bank of Japan — by US$ 1.3 trillion, the central banks of England, Switzerland, Canada, and Australia — in aggregate by more than US$ 1 trillion.[4] The growth of the balance sheets of central banks indicates the injection of liquidity (money supply) into the economy, this process is also accompanied by an increase in the debt of sectors of the economy.

Scientific interest in the monetary stimulus of economic growth increased after the financial crisis of 2008, to neutralize the effects of which quantitative easing (QE) was applied, which means the purchase by central banks of illiquid financial assets, instead of which liquid money was supplied to the markets. At the same time, interest rates were reduced to their minimum values.

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[3] Economic Indicators for Eastern Asia. Input-Output Tables. December 2018. Metro Manila, Asian Development Bank, 2018. 310 p. DOI: http://dx.doi.org/10.22617/TCS 189778–2

[4] Ryabov P. Faith in immortality. IA Aurora. URL: https://aurora.network/articles/1-mirovoy-krizis/86158-vera-v-bessmertie (accessed on 23.03.2021).

By 2015, the US Federal Reserve began a slow reduction in the balance sheet, gradually raising rates, and QE came to be seen as a temporary measure that should have been completed after the economy returned to solid "natural growth", which did not require regulatory support. However, shortly after the start of the pandemic crisis, QE did not stop and became the main and almost the only measure of anti-crisis regulation.

In the scientific literature, controversy has been emerging for years, with proponents and opponents clashing over monetary stimulus for economic growth. The former call QE an innovation that is available for practical implementation only in countries with a developed financial sector; the latter refer to the incompatibility of incentives with the main postulates of economic theory and predicts the collapse of the financial system if QE continues.

According to experts from the Research Department of the National Bank of the Republic of Belarus [20], the US Federal Reserve System was able to release US$ 6 trillion to support the economy without inflationary consequences only due to the fact that there is US$ 13 trillion deficit in the global financial market. China made a significant contribution to the formation of demand for dollars, which financed its own investment projects in dollars since investors did not accept country risk in yuan.

The "principle of the long-run money neutrality" is widely known, according to which the growth of money supply over a sufficiently long period does not affect real economic activity (economic growth and employment), but only leads to an increase in the general level of prices and wages. Based on this principle, well-known economists Sergei Guriev and Aleh Tsyvinski argue that in the real economy, central banks are not able to accelerate economic growth by changing monetary policy.[5]

According to M. Demidenko et al. [20], most of the proposals of numerous experts about new, "non-inflationary" methods of monetary stimulation of the economy are myths. Such myths include, for example, the statement about the possibility of increasing the monetization of the economy (the ratio of the money supply to GDP) due to emission; the possibility of targeted emission that does not lead to inflation, or investment emission; the possibility of writing off overdue loans in commercial banks. The authors also call modern monetary theory (MMT) a myth that is now widely discussed in financial and scientific circles. MMT simply postulates the possibility of economic growth through monetary stimulus.

A detailed theoretical presentation of the main postulates of MMT is given, for example, in the work of E. Tymoigne, L. R. Wray [21]. MMT is essentially post-Keynesian monetary theory; experts associate its increased popularity with the 2008 global financial crisis. It turned out that standard working models of monetary policy, based on the principle of monetary neutrality, are also not suitable for explaining the causes of the financial crisis, nor for developing measures to counter it [22]. Rather than targeting inflation as the primary goal of the central bank, the post-Keynesian school proposes additional goals for monetary policy, including measures of the exchange rate, balance of trade, unemployment rate, and income distribution [23].

The practical application of MMT is considered[6] the introduction of quantitative easing by the leading central banks of the world for more than 10 years since 2008, which has never led to inflation.

Despite the popularity of the new theory, the central banks of most emerging economies are influenced by

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[5] Sergei Guriev, Aleh Tsyvinski: The Central Bank is not able to accelerate growth. Vedomosti, 21.05.2013. URL: https://www.vedomosti.ru/opinion/articles/2013/05/21/chto_mozhet_i_chego_ne_mozhet_cb (accessed on 23.03.2021).

[6] Tunev V. MMT: what is the modern money theory why everyone is talking about it. Yango.Pro. 24.12.2019. URL: https://yango.pro/blog/mmt-chto-takoe-sovremennaya-teoriya-deneg-i-pochemu-o-ney-vse-govoryat/ (accessed on 23.03.2021).

the mainstream economics and its models, which is also explained in the MMT. In particular, proponents of MMT distinguish between sovereign and non-sovereign monetary systems. Full fiscal monetary sovereignty exists in countries where the consolidated public sector (treasury and central bank) issues fiat currencies with flexible exchange rates, such as Australia, the United States, the United Kingdom, and Japan [24].

Assuming that only economies with sovereign monetary systems are able to fully realize the benefits of MMT, i.e. to stimulate the growth of the money supply in the long term, then the introduction of MMT principles into the practice of regulating the economy with non-sovereign currency systems is threatened with failure. This logic explains the fears of the central banks of emerging economies, including Belarus and Russia, to use elements of emission stimulus of economic growth.

Taking the above countries as economies with sovereign monetary systems, as well as the economies of the eurozone, we pose the question: does the Chinese economy have financial (monetary) sovereignty? On the one hand, there are many examples of government control over the Chinese foreign exchange market, which makes it impossible to fully call the yuan exchange rate regime flexible — for example, restrictions on transactions with cryptocurrencies, which are much stricter than in the United States and Europe. On the other hand, in 2016, the International Monetary Fund added the yuan to the basket of reserve currencies used to calculate Special Drawing Rights (SDRs). The share of the yuan in the currency basket is about 11%, which theoretically increases China's chances of becoming a country with a sovereign monetary system.

With the onset of the global financial and economic crisis, China felt a decrease in external demand for its products and began to reorient its economy from exports to domestic consumption. In 2009–2010, the PRC authorities took a number of measures to stimulate domestic demand. The equivalent of US$ 500 billion was earmarked for the plan to stimulate the growth of the Chinese economy, which accounted for 20% of China's GDP and 80% of government spending. Almost half of these funds went to finance infrastructure projects, the rest went to support agriculture, the development of environmentally friendly technologies, support for low-income segments of the population, the development of science and innovation [25].

Chinese experts argue [26] that China began to apply elements of monetary stimulus to the economy much earlier than the onset of the global financial crisis, in 1993. The annual growth of the M2 money supply in peak periods exceeded 30%, but already by 2019, it fell to 10%. Over the past several decades, China's Ministry of Finance, in cooperation with the PBoC, has repeatedly injected capital into financial institutions, characterizing China's monetary stimulus situation as similar to quantitative easing in the United States. The result was an increase in the debt of economic sectors, primarily the commercial non-financial (up to 160% to GDP) and financial (up to 130% to GDP) sectors. Credit expansion, according to the authors, inevitably led to an increase in debt and the accumulation of financial risks.

Without claiming to put an end to scientific discussions about the factors of economic growth in China, we carried out a number of independent calculations that allowed us to draw some conclusions regarding the specifics of this growth and its determining factors.

METHOD OF DECOMPOSITION OF ECONOMIC GROWTH BASED ON INPUT-OUTPUT BALANCE

According to the classical formula, GDP, calculated as the sum of expenditures on the

purchase of domestically produced final goods and services, is equal to:

$$GDP = C + I + G + EX - IM, \qquad (1)$$

where C — consumer spending of households and non-profit organizations; I — gross fixed capital formation (investments in current and non-current assets); G — government procurement of goods and services; EX — export; IM — import.

Let us denote by D the expenses for the purchase of final goods and services (i.e. $C + I + G$), carried out within the country. Then formula (1) can be rewritten as:

$$GDP = D + EX - IM. \qquad (2)$$

Therefore, in this case, it is about domestic demand (D) and external demand (EX) as two fundamental factors in the formation of GDP in the Keynesian paradigm. However, for a complete assessment of their real contribution to GDP, one should "get rid" of the third term in formula (2) — imports.

By definition, imports consist of imports of intermediate goods and services used in domestic production and imports of final goods and services consumed domestically or exported to a third country (we omit this case for the purposes of this article):

$$IM = IM_{intermediate} + IM_{final}, \qquad (3)$$

where $IM_{intermediate}$, IM_{final} — import of intermediate and final goods and services, respectively.

On the other hand, domestic demand in formula (2) in general includes both expenditures on domestic final goods and services, and on imported ones, i.e.:

$$D = D_{domestic} + D_{imp} = D_{domestic} + IM_{final}. \qquad (4)$$

Thus, based on formulas (3) and (4), we can rewrite formula (2) as follows:

$$GDP = D_{domestic} + EX_{domestic} - IM_{intermediate}. \qquad (5)$$

As mentioned above, imports of intermediate goods and services used in domestic production are contained in a certain proportion (shares) in domestic final goods and services for domestic and foreign consumption.

To formalize this fact, we present the imports of goods and services for intermediate consumption in terms of the coefficients of the intensity of imports of domestic final goods and services consumed domestically (im_D), and the intensity of imports of domestic final goods and services provided for export (im_{ex}):

$$IM_{intermediate} = im_D \cdot D_{domestic} + im_{ex} \cdot EX_{domestic}. \qquad (6)$$

Import intensity here is understood as the total import intensity, i.e., the share of both direct and indirect costs of imported goods and services that were used for the production of domestic final goods and services, considering all existing technological chains in the national economy.

Now formula (5) can be rewritten using (6) in the form of two required terms:

$$GDP = D_{domestic} \cdot (1 - im_D) + $$
$$+ EX_{domestic} \cdot (1 - im_{ex}) = VAD + VAX, \qquad (7)$$

where VAD, VAX are parts of GDP (gross value added of national origin) formed by domestic and foreign demand, respectively.

To assess the coefficients of import intensity introduced into formula (6) both at the level of the economy as a whole and (which is especially interesting) at the level of its individual industries, we will use the input-output methodology.

In this case, we use the results obtained by the authors earlier [1, 2], briefly describing their main provisions. Note that some of them are reflected in the publications of other Belarusian researchers [27–29, 31].

The starting point will be the balance equation of Leontief, rewritten taking into account the division of flows of goods and services into domestic and imported ones:

$$\left(A_{domestic} + A_{imp}\right) \cdot X + \left(Y_{domestic} + Y_{imp}\right) = X + IM , \quad (8)$$

where $A_{domestic}, A_{imp}$ are the matrices of direct costs, built according to the data of intermediate consumption of domestic and imported goods and services, respectively (dimension $n \times nn$); $Y_{domestic}, Y_{imp}$ — column vectors containing data on the end-use (including export) of domestic and imported goods and services, respectively (dimension $n \times 1$); X is a column vector describing the total volume of output of goods and services produced within the country at basic prices (dimension $n \times 1$); IM is a column vector describing the total volume of imported goods and services (dimension $n \times 1$).

If we solve formula (8) for X, taking into account that imported goods and services are consumed within the framework of intermediate consumption (increases linearly with an increase in the volume of production within the country) and within the framework of final use (does not depend on the volume of output, but only on exogenous factors — for example, from the preferences of households), we obtain the following expression:

$$X = \left(E - A_{domestic}\right)^{-1} \cdot Y_{domestic}, \quad (9)$$

where E is the identity matrix of the corresponding dimension.

The matrix $\left(E - A_{domestic}\right)^{-1}$ in formula (9) is the matrix of the total costs of domestic goods and services per unit (1 ruble) of the final demand for domestic goods.

The aggregate of the total costs of imported goods and services required for the production of domestic products with a change in the final use of domestic goods and services per unit (1 ruble) can be found using the matrix of the total import intensity:

$$C = A_{imp} \cdot \left(E - A_{domestic}\right)^{-1}. \quad (10)$$

In particular, a specific element of the matrix c_{ij} shows how much the demand for imports in the i-th industry will increase with an increase by unit of the final use of domestic goods and services in the j-industry.[7]

Thus, the import component (direct and indirect) in the output of j-th industry will be equal to:

$$c_j = \sum_{i=1}^{n} c_{ij}. \quad (11)$$

And the added value of national origin for the j-th industry (product) per unit of the final product, respectively, can be found by the formula:

$$va_j = 1 - c_j. \quad (12)$$

We note that from the point of view of the basic logic of the Leontiev model, the total import intensity and the added value of national origin per unit (ruble) of the final product are unchanged values (constants) and are set by the production "recipe" in the j-th industry.

At the same time, the amount of gross exports of goods and services for all sectors, weighted by the share of the national value added in the value of final products, gives us the total value of national value added in exports (VAX). And the amount of the final use of domestic goods and services for all industries, weighted by the coefficients of the added value of the final product, shows the added value of national origin created through sales in the domestic market (VAD):

$$VAX = \sum_{j=1}^{n} ex_{domestic j} \cdot \left(1 - c_j\right), \quad (13)$$

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[7] The import intensity is indicated differently than in formulas (6) and (7), deliberately in order to distinguish between two approaches: aggregated at the level of the economy as a whole and on the basis of the balance of inputs and outputs.

$$VAD = \sum_{j=1}^{n} d_{domesticj} \cdot \left(1 - c_j\right). \qquad (14)$$

By analogy with formula (7), we write down the decomposition of GDP into two parts, however, unlike the general approach, in this case, we have the opportunity to unambiguously determine the total import intensity of each of the industries using the input-output table and obtain estimates of the contribution of domestic and external demand in the formation of GDP:

$$GDP = VAD + VAX = \sum_{j=1}^{n} d_{domesticj} \cdot \left(1 - c_j\right) +$$

$$+ \sum_{j=1}^{n} ex_{domesticj} \cdot \left(1 - c_j\right). \qquad (15)$$

Of particular interest is the assessment of the trade balance in the context of each of the industries reflected in the input-output tables. This estimate can be obtained by the formula:

$$tb_i = ex_{domesticj} \cdot \left(1 - c_j\right) - d_{domesticj} \cdot c_j - IM_{final, j}. \qquad (16)$$

Thus, the balance of trade for each "product" depends on the added value of national origin embodied in exports; intermediate imports contained in domestic goods and services consumed in the domestic market; import of finished products.

INTERPRETING THE MAIN RESULTS

For the calculations, the authors used data of the input-output tables for 2010–2017, presented on the ADB website,[8] in US dollars at the nominal exchange rate. During the analyzed period, the average rate of the yuan against the dollar fell from 6.77 yuan to the dollar to 6.13, and then rose again to 6.73.[9] Such insignificant and multidirectional fluctuations of the exchange rate suggest that

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[8] URL: https://data.adb.org/dataset/peoples-republic-china-input-output-economic-indicators (accessed on 23.03.2021).
[9] URL: https://ru.investing.com/currencies/usd-cny-historical-data (accessed on 23.03.2021).

the influence of the yuan exchange rate on the indicators of economic growth and the balance of payments of China in the analyzed period was insignificant.

For the sake of fairness, it should be noted that when assessing economic growth, indicators in constant prices are used, but they are too difficult to calculate in input-output tables, where it is necessary to maintain balance equalities between indicators. Indicators in "current" US dollars, of course, will include an inflationary component. Meanwhile, GDP, measured in dollars at the nominal exchange rate, is one of the most important development goals of China, which claims to be the first economy in the world. In terms of GDP, taking into account PPP, China has already overtaken the United States, but not all experts consider this estimate to be correct in the context of comparing the sizes of economies.

Based on formula (16), we estimated the contribution of the most important products or sectors of the Chinese economy that produce final products to the country's trade balance. This estimate differs from the data summarized in the balance of payments, as it takes into account the added value of the final products of national origin, rather than their price. The indicators of the contribution of each product to the trade balance characterize the international specialization of the economy: the products that form the trade deficit are intended mainly for the domestic market, the net profit from their exports is lower than the import of final products in this industry and intermediate imports in the composition of domestic goods and services.

This group of economic activities includes the construction industry; production of transport equipment; as well as non-tradable services — public administration, education, health care (*Fig. 1*). For the products of these industries, domestic demand exceeds export earnings; these industries are developed by export earnings from other industries, which create a positive trade balance. Such products
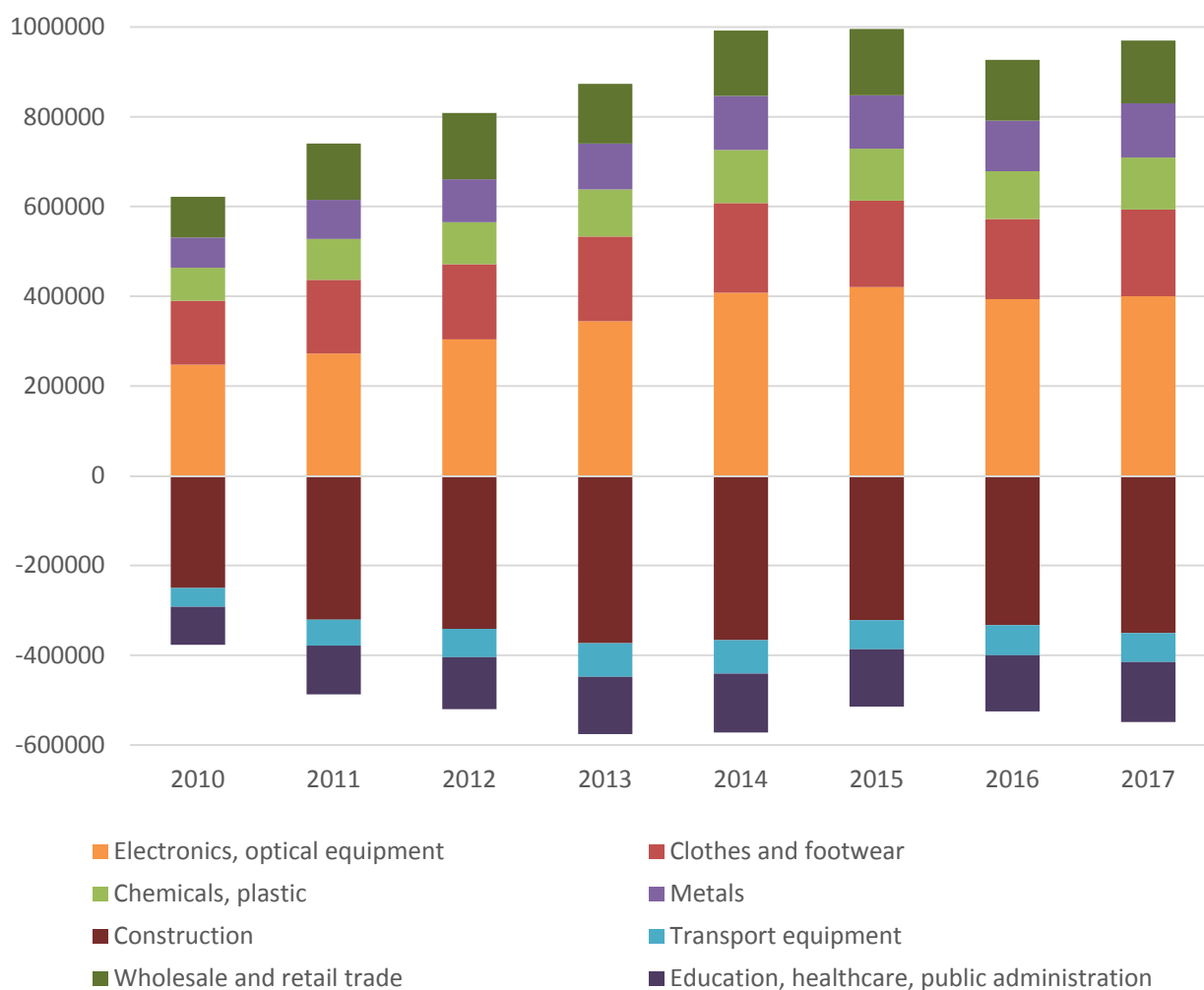
Fig. 1. **Dynamics of the contribution of particular industries to the trade balance (added value of national origin, USD million)**

Source: calculated by the authors based on ADB data.

are characterized by an excess of net export proceeds over imports. They define the international specialization of a country.

The bulk of China's net export revenue comes from electronics and optical equipment. This industry generates about US$ 400 billion in net export revenue per year. Another US$ 600 billion in net export earnings are generated by such goods as clothing and footwear; chemical products, rubber, and plastic; metals; as well as wholesale and retail trade services. More than half of China's net export revenues are generated by high-tech sectors of the economy.

To gain a better understanding of China's international specialization, we will analyze

the dynamics of indicators of the integration of industries into global value chains (GVCs), which are calculated using data from multi-regional input-output tables. As known, the criterion for the participation of the national economy in the GVC is the indicator "Total GVC participation," which is calculated as the sum of two other indicators:

• Backward GVC Participation: the share of the value of imported components (foreign added value) used for the production of export products in the value of export products of a given country, otherwise — downward or backward linkages in the GVC;

• Forward GVC Participation: the share of the value of national components (national

Table 1

Backward linkages dynamics (BW) and RCA in China, 2005–2015

RCA dynamics, % / BW dynamics, %	Decrease	Increase
DECREASE	Production of commodities (–11; –42) Food industry (–19; –26) Light industry (–42; less than –17*) Mineral products (–32; –63)	Woodworking industry (–27; +12) Chemicals and pharmaceutical products (–35; +33) Plastic and rubber products (–39; +13) Metal products (–31; +22) Machinery and equipment (less than –33**; +14) Motor vehicles production (–31; +65)
INCREASE	Fuel industry (+4; –42)	

Notes: * – depending on the sub-industry, the dynamics of the RCA value ranges from –17% to –41%; ** – mechanical engineering: –36%; electrical, electronic and optical equipment: –33%.

Source: the table is compiled on the basis of the Revealed comparative advantage data. URL: https://wits.worldbank.org/CountryProfile/en/country/by-country/startyear/LTST/endyear/LTST/tradeFlow/Export/indicator/RCA/partner/WLD/product/Total; Trade in Value Added: 2018. OECD. WITS. World Bank. URL: https://stats.oecd.org/Index.aspx? DataSetCode=TIVA_2018_C 1 (accessed on 23.03.2021).

added value) used for the production of export products of other countries in the value of the export products of a given country, otherwise — ascending or forward linkages in the GVC.

To assess the impact of industry integration in GVCs, we use the Revealed Comparative Advantage (RCA) indicator. This indicator was proposed by B. Balassa [32] to identify the country's trade advantages in relation to industrial products. RCA is calculated as the ratio of the share of exports of a certain type of product in the total volume of a country's exports to the share of the same type of product in the world export volume. Index values of more than 1 indicate that the country has a competitive advantage in the production of this type of product.

The following tables show data on the growth of indicators of the backward (BW) and forward (FW) integration of the Chinese economy and the change in the RCA indicator for 2005–2015. *Tables 1, 2* are compiled according to the matrix principle in such a way as to compare the growth or decline in the competitiveness of industries with changes

in the indicators of forward and backward linkages in the GVC. The first number is the percentage change in the forward or backward GVC channel over the period 2005–2015, the second is the percentage change in RCA over the same period.

Analysis of the integration of sectors of the Chinese economy into the GVC allows us to draw the following conclusions:

1. All industries in which China has lost competitiveness in terms of RCA are low-tech. All industries in which China has increased its competitiveness are medium and high-tech (except for woodworking).

2. In all industries with increased competitiveness, we note a surprising combination: BW indicators are negative, FW indicators are positive. This means that China has successfully restructured its medium and high-tech industries. On the one hand, there were processes of import substitution, since negative BW values indicate the substitution of imported supplies of components for national exports by domestic production. On the other hand, the positive growth of FW indicates a successful foreign economic

Forward linkages dynamics (FW) and RCA in China, 2005–2015

RCA dynamics, % / FW dynamics, %	Decrease	Increase
DECREASE	Fuel industry (0; –42)	Woodworking industry (0; +12)
INCREASE	Production of commodities (+2; –42) Food industry (+44; –26) Light industry (+6; less than –17*) Mineral products (+44; –63)	Chemicals and pharmaceutical products (+24; +33) Plastic and rubber products (+47; +13) Metal products (+3; +22) Machinery and equipment (менее +14**; +14) Motor vehicles production (+38; +65)

Notes: * – depending on the sub-industry, the dynamics of the RCA value ranges from –17% to –41%; ** – mechanical engineering: +14%; electrical, electronic and optical equipment: –10%.

Source: the table is compiled on the basis of the Revealed comparative advantage data. URL: https://wits.worldbank.org/CountryProfile/en/country/by-country/startyear/LTST/endyear/LTST/tradeFlow/Export/indicator/RCA/partner/WLD/product/Total; Trade in Value Added: 2018. OECD. WITS. World Bank. URL: https://stats.oecd.org/Index.aspx? DataSetCode=TIVA_2018_C 1 (accessed on 23.03.2021).

expansion of semi-finished products manufactured in China. They replace similar production facilities of foreign competitors. Consequently, the national technological base has reached a high level of competitiveness, which makes it possible to combine the development of its own import-substituting industries with an increase in the export of intermediate products of high-tech industries.

3. Similar ratios of BW, FW, and RCA can be seen in low-tech industries where China has diminished its competitive advantages. Since it is almost impossible for an individual country to achieve RCA growth in all sectors, a deterioration in competitive positions in certain areas is inevitable and even natural. It is important that China, "losing its position" in the production of finished products of low-tech industries, is pursuing a successful policy of import substitution of components and foreign economic expansion of its own production of intermediate products.

Then we will consider the dynamics of the contribution of exports and domestic demand to China's GDP, which can be estimated using formula (15). *Fig. 2* shows the decomposition of GDP into two parts, formed at the expense of domestic and external final demand, respectively, in the dynamics for 2010–2017.

Fig. 2 illustrates that over the specified period, the contribution of exports in absolute terms did not change significantly (from 1.4 to 2.0 trillion US dollars), and in relative terms, it steadily decreased from 23 to 16%. On the contrary, the share of domestic demand in GDP grew by an average of 17% per year and more than doubled in absolute terms. The values of the relative indicator of the contribution of exports to GDP, calculated in accordance with the methodology developed by us, completely coincide with the results given in the analytical report of ADB,[10] which confirms the accuracy of our methodology.

Thus, the data in *Fig. 2* confirm the conclusions drawn from the indicators of the vertical specialization of the Chinese

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[10] URL: https://data.adb.org/dataset/peoples-republic-china-input-output-economic-indicators (accessed on 23.03.2021).
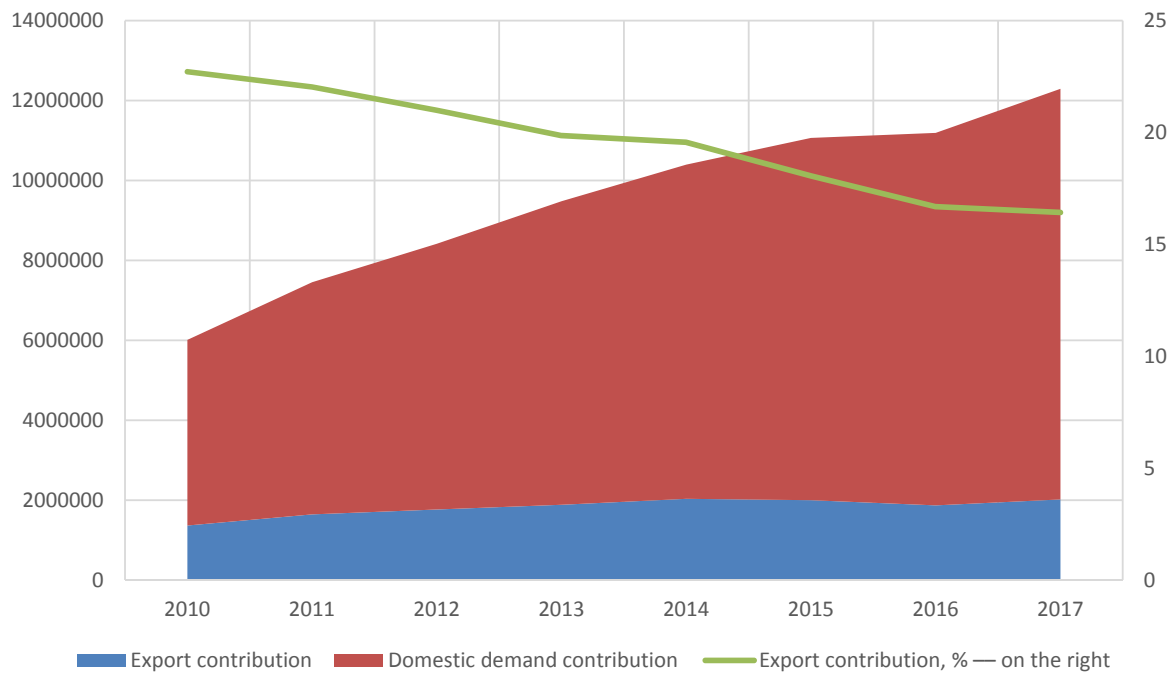
Fig. 2. **Contribution of exports and domestic demand to GDP (gross value added), USD million**
Source: calculated by the authors based on ADB data.

economy. The country is relatively reducing the export of finished products of low-tech industries, for example, light industry, which for many years was the locomotive of the "Chinese economic miracle", but at the same time, it is successfully implementing import substitution of components used in the production of finished products in all industries. The growth in the competitiveness of national technologies in the entire chain of manufacturers working on the production of finished products is reflected simultaneously in a decrease in BW and an increase in FW, which results in an increase in the added value created through sales in the domestic market (VAD).

Is the growth of domestic demand in China spontaneous, or are there signs of stimuli? *Fig. 3* shows the dynamics of GDP, the contribution of domestic demand to GDP (VAD), as well as the national money aggregate in the national definition of M2, converted into US dollars at the nominal exchange rate.

There is a fairly close correlation between the three indicators shown in the figure (above 0.99), which can be interpreted as follows: the growth of domestic demand is the main factor behind the increase in China's GDP in the selected time interval. At the same time, the increase in the M2 money supply became the main factor in the increase in domestic consumer and investment demand for goods and services. 1 dollar of growth in nominal GDP due to domestic demand (VAD) is approximately 2 dollars of growth in money supply M2 when converted at the exchange rate.

Is China's GDP growth in dollars real economic growth, or are prices rising? The exact answer to this question requires additional calculations, but as a first approximation, we can say that there is both an increase in prices in dollar terms and real economic growth. For example, the price index for rental housing in China from 2010 to 2017 increased by 49%.[11] Over the same period, the value added in the construction

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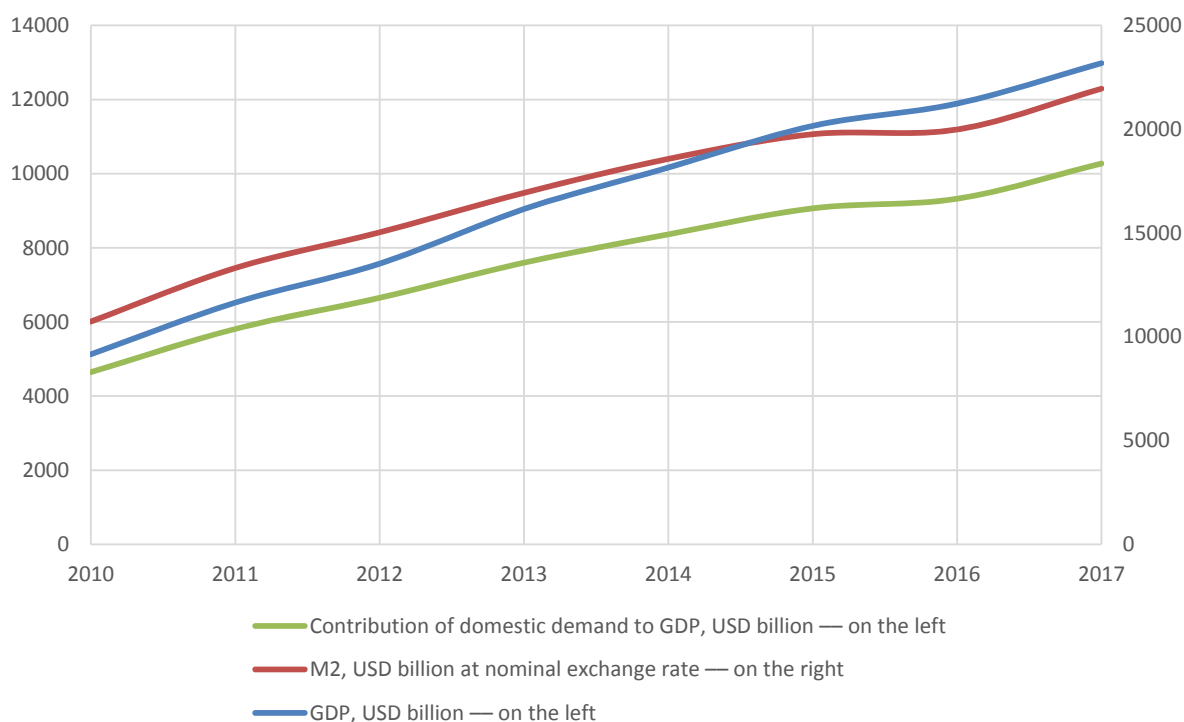[11] URL: https://data.oecd.org/price/housing-prices.htm (accessed on 23.03.2021).

Fig. 3. **Dynamics of M2 money supply, GDP and the contribution of domestic demand to GDP**

Source: calculated by the authors based on ADB and Bloomberg data. URL: https://tradingeconomics.com/china/money-supply-m2?user=reuters%7Cbloomberg (accessed on 23.03.2021).

sector increased by 103%. If we consider the economy of China as a whole, then the total accumulated economic growth for 2010–2017 at constant prices amounted to 167% [12] (growth over the period 67%); China's GDP growth in dollars was 104%, while growth in the domestic demand contribution (VAD) component of GDP calculated above was 121% over the period.

In other words, the inflationary consequences of stimulating growth in China's domestic market are significant and account for about half of the GDP growth at current prices, but the real rates of economic growth were no less significant.

The ratio of the monetary aggregate M2 to GDP for the analyzed period increased from 1.52 to 1.89. For comparison, in Belarus, the same coefficient, which is called the level of

monetization of the economy,[13] is 0.15. That is, our indicator is an order of magnitude lower than in China.

Further evidence of the stimulus that is driving China's economic growth is the dynamics of the sector's debt indicators, which began to skyrocket since the 1990s. According to a study [18], from 2010 to 2015, the ratio of the debt of all sectors of the Chinese economy to GDP increased from about 310% to 410%. In absolute terms, corporate debt during this period increased from 75 to 170 trillion yuan, that is, more than doubled; financial sector debt — from 40 to 100 trillion yuan. In terms of dollars at the nominal exchange rate, the increase in domestic debt is 2010–2015 alone turned out to be at least US$ 25 trillion.

The share of corporate debt in the total structure of China's domestic debt in 2015 was 49%, while the share of debt in the financial

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[12] Calculated according to the World Bank, 2010 = 100%, then the indicator is multiplied by the growth index of each subsequent year until 2017. URL: https://databank.worldbank.org/ (accessed on 23.03.2021).

[13] When assessing the level of monetization, the aggregate M3 is used more often than M2.

sector was 34%. The share of domestic debt was 97%, respectively, only 3% of the total debt of sectors of the Chinese economy falls on external debt.

It is clear that by 2017, China's domestic debt increased even more, both in absolute terms and in relation to GDP. At the same time, the following proportion is characteristic of the macroeconomic indicators considered: the increase in domestic debt in absolute terms is 1.5–2 times higher than the growth in the money supply M2. M2 growth in absolute terms is almost 2 times higher than GDP growth generated by domestic demand and estimated in actual prices (VAD). About half of the increase in nominal VAD represents real growth, the other half is inflationary. Thus, under conditions typical for the selected period, including a relatively stable exchange rate of 6.5 yuan per dollar, 1 yuan of real economic growth accounts for at least 4 yuan in the form of an increase in the money supply M2 and 6–8 yuan from the increase in debt sectors of the economy.

If the growth was "natural", i.e. it was not caused by stimulus measures, the growth of the money supply should be considered as a consequence of the increase in GDP caused by other factors. But why is the amount of money growing faster than nominal GDP? Why are dollar prices rising in China? How to explain the rise in debt?

The considered example looks like evidence, if not confirming the accuracy of the provisions of the MMT, then at least prompting to pay attention to it.

CONCLUSIONS

According to most researchers, the key factors of China's economic growth in the period from the 1980s to the early 2000s were foreign direct investment and exports, which have shaped the modern model of an open economy and served as the basis for its technological modernization. The analysis carried out in the paper using input-output tables and the method of decomposition of GDP into "national" and "export" components, taking into account the full import intensity of goods and services, shows that in the period from 2010 to 2017, domestic demand in China grew much faster than export earnings and accounted for 83.6% of GDP in 2017. Thus, we conclude that among the sources of growth of the Chinese economy in recent years, not external, but domestic non-monetary and monetary factors predominated.

At the same time, a number of non-monetary factors can be attributed to industrial policy, the priorities of which were determined by analyzing the dynamics of the calculated indicators of the integration of industries into global value chains (BW, FW, RCA) and the indicators of the contribution of individual goods to the trade balance at the added value of national origin were calculated. Thus, on the one hand, the industrial sector is constantly being modernized, which allows it to reach the global level of competitiveness, which is reflected in the specialization of Chinese industries in the high-tech segment. On the other hand, the policy of import substitution is being implemented, as a result of which domestic demand is satisfied mainly by domestic goods and services.

Correlation analysis of the dynamics of the monetary aggregate M2, GDP, and the calculated contribution of domestic demand to GDP ($r > 0,99$ in all pairwise comparisons) shows that monetary factors are used to stimulate domestic demand, namely: an increase in the money supply, including by increasing domestic debt of the financial and non-financial sectors of the economy.

Such monetary policy seems justified from the point of view of heterodox modern monetary theory (MMT), but in many ways contradicts the traditional point of view. It is believed that attempts to stimulate domestic demand in developing countries, according to the Thirlwall's Law, are limited to the balance of payments. If against the backdrop of falling exports, governments and central banks of emerging economies stimulate domestic

demand by increasing money supply, after a short time imports begin to grow, the state of the balance of payments deteriorates, the national currency depreciates, real incomes of sectors of the economy fall, and economic growth stops. But this does not happen in China, stimulating the economy does not lead to a decrease in the trade surplus due to the combination of many conditions — the presence of monetary and financial sovereignty, the competitiveness of industry, the innovative nature of economic development.

At the same time, it is hardly worth expecting and hoping that the same sources and factors of economic growth can be fully used in Russia and Belarus. And the problem here is not even that the domestic financial system, from the point of view of modern monetary theory, does not fully possess monetary sovereignty, but, first of all, that the country's specialization is reduced to raw materials, not high-tech products, and this does not always allow the use of innovations for the production of goods and services competitive on the world market and, as a consequence, for the driver of economic growth.

To expand the possibilities of using the Chinese experience to stimulate economic growth in Russia and Belarus, it is necessary to simultaneously modernize both the financial system and industry. When analyzing the goals and directions of such modernization, among other things, the analytical tools proposed in the article can be used.

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ABOUT THE AUTHORS

Aleksei A. Bykov — Dr. Sci. (Econ.), Prof., Pro-rector for Research, Belarusian State Economic University, Minsk, Belarus
aliaksei.bykau@yandex.ru

Sergei A. Tolkachev — Dr. Sci. (Econ.), Prof., First Deputy Head of the Department of Macroeconomic Forecasting and Planning, Financial University, Moscow, Russia
tsa2000@mail.ru

Uladzimir A. Parkhimenka — Cand. Sci. (Econ.), Assoc. Prof., Head of the Department of Economics, Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus
parkhimenko@bsuir.by

Tat'yana V. Shablinskaya — Deputy Head of the Department of Economics of Innovation Activity, Ministry of Economy of the Republic of Belarus, Minsk, Belarus
viexost@mail.ru

Authors' contributions:
Bykov A. A. — literature review, theoretical part.
Tolkachev S. A. — development and application of criteria for the country's participation in GVCs (backward and forward participation; RCA) to the Chinese economy; generalization of research results and conclusions.
Parkhimenka U. A. — revision of the methodology for the decomposition of economic growth factors for the possibility of its use with the international standard of input-output tables; development and description of a mathematical model; statistical calculations using the model.
Shablinskaya T. V. — development of the initial version of the methodology for the decomposition of economic growth factors (as applied to the economy of Belarus).

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