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Monetary policy on launching new production facilities in Russia: Opportunities in the semiconductor market

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Abstract. The paper discusses the capabilities of the Russian monetary system for massive lending to new industries that are of strategic importance to the country and contribute to its technological sovereignty. The key provisions of monetary theory and the concept of multiplier constitute the theoretical basis of the study. Modelling transient processes was used as the main research method. Empirical evidence is official data from the Bank of Russia and the Federal State Statistics Service (Rosstat), as well as industry reports on the global semiconductor market. The authors propose their own model of the transition process, which allows assessing the possible inflation rate and economic growth generated by massive credit investments. Testing the model in the microelectronics industry showed that assumptions about the Bank of Russia possibly losing its control over inflation due to a large-scale lending are unfounded. Even during the first two years, when the construction of a new enterprise is underway and there is an obvious imbalance between the product and money supply, the additional inflation rate caused by this initiative does not exceed 0.5 % per year. We conclude that the regulator has enough reserves to open credit lines for establishing new high-tech enterprises simultaneously in several industries. The proposed model can be used to optimize the public administration system when designing the country's technological development strategy focused on domestic import substitution.

Keywords: state regulation; investment; lending policy; semiconductor market; microelectronics.

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Монетарное регулирование в России по запуску новых производств: оценка возможностей на примере рынка полупроводников

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Аннотация. Статья посвящена определению возможностей российской монетарной системы для массированного кредитования новых производств, имеющих стратегическое значение и способствующих обеспечению технологического суверенитета страны. Методологической базой исследования послужили ключевые положения теории денег и концепции мультипликатора, а в качестве инструментальной основы использовалась практика моделирования переходных процессов. Информационную базу работы составили официальные данные Банка России и Росстата, а также отраслевые отчеты о мировом рынке полупроводников. Предложена авторская модель переходного процесса, позволяющая оценить возможный уровень инфляции и экономического роста в результате осуществления масштабных кредитных инвестиций. Расчеты модели для отрасли микроэлектроники показали, что опасения относительно возможного выхода инфляции из-под контроля Банка России из-за масштабной кредитной эмиссии являются безосновательными. Даже в течение первых двух лет, когда осуществляется строительство нового предприятия и наблюдается дисбаланс между товарной и денежной массой, дополнительные темпы инфляции от указанной инициативы не превышают 0,5 % в год. Обоснован вывод о наличии у регулятора резервов по открытию кредитных линий для создания новых высокотехнологичных предприятий в нескольких отраслях одновременно. Представленная авторская модель может использоваться для оптимизации системы государственного управления при проектировании технологического развития страны, ориентированного на внутреннее импортозамещение.

Ключевые слова: государственное регулирование; инвестиции; кредитная политика; рынок полупроводников; микроэлектроника.

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INTRODUCTION: INVESTMENTLESS TECHNOLOGIES

Following the special military operation in Ukraine launched in 2022, Russia has been almost completely cut off from foreign investment; domestic investment activity has also decreased sharply for obvious reasons. At the same time, the operation has exposed the problem that can no longer be postponed, namely restoring Russia's technological sovereignty. All this resulted in a glaring contradiction: on the one hand, there was an increase in the demand for manufacturing investments, on the other, their supply was shrinking. Moreover, in some cases, investments should be allocated not just to expand the existing production, but also create sub-sectors that are absolutely new to the national economy. In fact, strategically important productions need to be 'restarted' on a qualitatively different technological basis. As a result, some questions arise about what sources, and what amount, of investment should be used in the current circumstances in order to keep the financial situation in the country stable.

As shown in previous studies [Balatsky, Ekimova, 2021], the sums indicated in the federal programmes for industrial development of Russia are insufficient for launching new high-tech industries. In October 2022, the RF Government announced the allocation of 1 billion rubles to finance the creation of small and medium-sized electronics design centres[1]. However, experts are quite sceptical about the programme due to, among other things, the obvious discrepancy between the amount of funds specified and the goals stated[2]. In such a situation, it seems quite logical for the public administration system to shift the 'centre of gravity' from budgetary instruments to monetary ones.

In this case, however, there is a danger of triggering galloping inflation and undermining financial stability in the economy. The foregoing makes it increasingly relevant to study the problem of applied calculations that would at least partially demonstrate the reserves of the Russian monetary system in terms of launching new production and the restrictions arising.

The purpose of the study is to develop a simple model that allows one to test possible lending scenarios for a specific vital project, i.e., the construction of new semiconductor production facilities. When modelling, the emphasis is on clarifying the scale of production and inflation trends that emerge with the intensive use of credit resources. The modelling results should answer the question of how expedient it is for the regulator to implement targeted credit expansion in relation to priority industries.

MONETARY POLICY, INFLATION AND ECONOMIC GROWTH: A LITERATURE REVIEW

Studying issues of credit policy and inflation is steeped in history. In this context, there are two aspects that need to be elaborated, these are attributing loan issuance to inflationary processes and effects of inflation on economic growth. Without getting into too much detail about the indicated problem, look at its most relevant facets in retrospective.

According to recent studies, the Taylor targeting rule, which has long been the theoretical and methodological guideline of monetary policy in different countries, is not followed so strictly now due to the specificities of the modern monetary system. Central banks are increasingly moving away from using this rule as a priority one and tend to account for additional factors and key indicators, including those of other countries, when setting interest rates [Burlachkov, 2016; Drobyshevsky, Trunin, Kiyutsevskaya, 2018; Feldkircher, Tondl, 2020].

At the same time, it is noted that there is a correlation between a country's development level and the increase in the interest rate, as well as the period for which it was set. In developing economies, this increase is accompanied by a fall in production and rising inflation, while in industrial countries it boosts foreign currency earnings and the national currency exchange rate, as well as leads to a decrease in inflation [Hnatkovskay, Lahiriy, Veghz, 2011]. Moreover, the relationship between interest rates and inflation is inverse (negative) in the short run, while in the long run it is direct (positive)[3].

The money supply is another factor affecting inflationary processes. It is commonly accepted that excessive money growth without a corresponding increase in the product supply contributes to inflation an surge [Evans, 1984; Payne, 1993; Oluwaseyi, 2023]. However, recent studies have refuted this generally accepted statement by

[1] The RF Government will subsidize the creation of small and medium-sized centers for the development of domestic electronics. http://government.ru/news/46872/. (in Russ.)

[2] Kirillov K. 7 years to transform Russia into a second Taiwan and 7 reasons why this is almost impossible. https://rb.ru/opinion/russia-to-taiwan/. (in Russ.)

[3] Cochrane J. (2016). Do Higher Interest Rates Raise or Lower Inflation? https://johnhcochrane.blogspot.com/2015/10/do-higher-interest-rates-raise-or-lower.html; Cochrane J. (2015). Early Fisherism. https://johnhcochrane.blogspot.com/2015/11/early-fisherism.html.

establishing an inverse relationship between the monetization coefficient and inflation [Yakunin et al., 2012; Glazyev, 2015; Glazyev, Arkhipova, 2018; Cukierman, 2017]. The correlation between inflation rates and money supply is significant when analysing a period of more than one year, whereas for shorter periods it is insignificant [Afanasyeva, 2022; Muzafar, Chee-Kok, Baharom, 2011].

In addition, the non-linear nature of the relationship between the money supply and inflation was established indicating that inflationary processes can be triggered by both the excessive money supply and its shortage [De Graude, Polan, 2005; Glazyev, Goridko, Nizhegorodtsev, 2016; Ilyin, Morev, 2018]. For instance, in countries with low money stock, money issuance will not have an impact on inflation as strong as in countries with high money supply, since additional issuance in these countries 'helps' the economy reach a natural level of monetization, and does not contribute to inflation [Ershov, 2014; Balikoev, 2017].

In the report to the RF President Vladimir Putin, Alexander Galushka, the Deputy Secretary of the Civic Chamber of the Russian Federation, formulated a number of proposals for a balanced use of monetary reserves. One of these proposals concerned "the introduction of a double-circuit monetary and financial system providing long-term and cheap financing of economic growth on the required scale"[1]. Solving this problem involved a non-inflationary mechanism for financing investment projects, i.e., targeted project-specific issuance using escrow accounts. However, the document did not enlarge on the problem of the 'flow' of money issued by the Bank of Russia for project financing of investments into the escrow account. Loans as investments attracted to set up a new enterprise still flow into the consumer market, thereby stimulating inflation. The time lag between making investment and starting the sales of products manufactured will be of a pronounced inflationary nature. In theory, this issue is organically connected with the so-called "Adam Smith's Dogma" that the price of every product resolves itself into three parts: labour (wage), capital (profit), and land (rent). Issued loans, which at the initial stage are not involved in the production process, nevertheless enter the consumer market at least as wages, thus contributing to the emergence of inflationary processes.

As for the impact inflation has on economic growth, it is worth paying attention to the work by Balatskii [1997] who examines how inflation, in the form of inflation taxes, causes the erosion of enterprises' working capital and thereby sets up barriers to the expansion of their production. Later, in [Balatskii, Kolesnichenko, 2001], inflation vulnerability factors in Russia's industries were calculated taking into account their production specificity. These studies proved the fact that high inflation rates pose an impenetrable barrier to economic growth, and the magnitude of this barrier is highly differentiated by industries and enterprises. More recent empirical studies have confirmed that the effect of inflation on economic growth is quantitatively significant only after a certain inflation threshold is reached. While inflation is below this level, there can be even observed reverse processes linked with increased economic growth in developed countries [Brick, 2010; Lopez-Villavicencio, Mignon, 2011; Kremer, Bick, Nautz, 2013; Arawatari, Hori, Mino, 2018; Sequeira, 2021].

The foregoing demonstrates the unconventional nature of analytical calculations for assessing the potential for inflation and economic growth in the course of lending to new industries. To solve this problem, we propose our own model of the transition process for a production facility under construction starting from opening a credit line to launching the projected amount of its products into the market.

STRUCTURAL CHANGES AND THE BANKING SECTOR: A STALEMATE

The current study concentrates on one priority industry, namely electronics (according to the OKVED classification[2] – Production of computers, electronic and optical products). Other industries can be analysed by analogy with this basic scheme.

The production volume of electronic micro-components in Russia is currently insufficient to meet its demands. At the same time, it is the microelectronics industry that acts as a fulcrum of the country's technological sovereignty, and its healthy development predetermines the well-being of the entire Russian economy. It is quite logical, therefore, to undertake structural reforms of the country's economy with a special focus on accelerated growth in semiconductor production.

According to the Bank of Russia data, over the past 5 years the banking sector in the country has witnessed no fundamental structural changes. In fact, all industry-specific shares of issued loans experienced fluctuations showing no clear general trend. The data on the credit activity of the Russian banking sector in terms of three priority sectors (Table 1) help us arrive at the following unambiguous conclusions.

Firstly, loans from the banking sector were greatly 'scattered' across the economic industries indicating no noticeable concentration in the priority areas. Despite the fact that the monthly share of loans to the machine tool industry could differ 3.2 times, and in electronics and pharmaceuticals – 4.3 and 6.9 times, respectively, none of these industries went beyond the 1 % barrier of issued loans.

Considerable fluctuations in the industry shares are largely due to the small loan volumes, which could vary noticeably because of situational political decisions. In

[1] Galushka A. Proposals to ensure economic growth. https://files.oprf.ru/storage/image_store/docs2022/doklad_galushka.pdf. (in Russ.)

[2] OKVED refers to the Russian National Classifier of Economic Activities.

Table 1 – Lending dynamics to the priority sectors of the Russian economy, 2018–2023
Таблица 1 – Данные о динамике кредитования приоритетных отраслей российской экономики, 2018–2023

Industries	Range of industry share in monthly loans, %	Range of loan volumes, billion rubles	
		monthly	yearly
Production of computers, electronic and optical products	0.23–0.99	11–48	132–576
Production of medicines and materials used for medical purposes	0.08–0.55	3–27	36–324
Production of machinery and equipment not included in other categories	0.29–0.92	15–45	180–540

Source: complied using the Bank of Russia data. https://www.cbr.ru/.

any case, however, the credit pressure emerging in relation to certain industries were quickly eliminated, and the original industry status quo was restored. For example, the share of pharmaceuticals in the total volume of loans issued was 0.13 % as of January 2018, and 0.21 % as of January 2023; for electronics these figures were 0.43 % and 0.46 %, and for mechanical engineering – 0.63 % and 0.47 %, respectively. Hence, credit resources did not result in intense concentration on the priority areas and did not generate substantial structural changes in the economy.

Secondly, loans themselves performed a purely supporting function, while the mission to develop the economy by creating new industries required way more credit resources. For example, in one of our previous studies [Balatsky, Ekimova, 2021][1], we showed that it takes approximately 5–15 billion US dollars to construct and launch one modern enterprise to manufacture microelectronic components, which is equivalent to 820–1,230 billion rubles. This is 10 times the minimum annual loan for the entire electronics industry and 2.5 times the maximum tranches issued to it. Thus, in all previous years, the Russian banking sector was able to maintain the operating activities of the existing factories and companies, but was fundamentally unable to invest in new high-tech production.

The above indicates that the banking sector in Russia did not act as a driver of progressive structural changes in the national economy, but limited itself to maintaining the status quo. Consequently, other orders of magnitude and projects are needed to restore the country's technological sovereignty. For the sake of clarity, we will hereinafter assume that massive targeted lending of new production by the Bank of Russia takes place when the annual issue of these annual loans reaches 1 trillion rubles or more.

The Industrial Development Fund (IDF) created within the framework of the implementation of the Federal Law No. 488-FZ "On Industrial Policy in the Russian Federation" (2014) was supposed to be one of these instruments. The main goal of the IDF is to stimulate direct investment in the processing industry by providing loans to industrial companies for deep modernization of the existing production facilities and creation of new ones at interest rates of 1 % to 3 % per annum for a period of up to 7 years in the amount between 5 million and 2 billion rubles [Tkachenko, Starikov, Evseeva, 2022]. However, as seen from the figures above, the size of project loans does not comply the formidable task of radically updating the technological park of the Russian economy, which is confirmed by recent studies.

For example, Tkachenko, Starikov, and Evseeva [2022] note that the IDF does not yet act as a system integrator of industrial development in the country. The IDF projects have a positive effect on economic growth of Russian regions with medium and low levels of industrial development, whereas in industrialized regions the stimulating effect is not so obvious. Yakovlev et al. [2023] support these conclusions: the IDF activities produce no cumulative (macroeconomic) financial and production effect; however, one is obtained for medium-sized enterprises. In fact, the benefits of the IDF activities are reaped by a relatively small number of the most successful firms, and, interestingly, the positive effect is much more noticeable for small and micro enterprises [Ibid.].

Without going into details, we should note that the IDF's actions contributed to strong fluctuations in the volume of industry loans (see Table 1). Nevertheless, as indicated above, the IDF's programmes cannot reverse the negative dynamics associated with the lack of investment in new high-tech production, as cannot the lending activities of the Russian banking sector.

The aforementioned raises the question of how lending activities need to be transformed to accelerate the technological renewal of the Russian economy and break the stalemate. In our view, the solution is to switch to targeted macroeconomic lending of large-scale projects aimed at establishing new production facilities in the priority sectors. It is large industrial complexes with the state-of-the-art technological equipment that can reverse the negative dynamics in production. However, such high-tech megaprojects can provoke inflationary trends and worsen the macroeconomic situation as a whole. This is the issue that is discussed and evaluated below.

Here, it is worth clarifying that credit policy aimed at achieving the technological sovereignty of the country is seen as priority lending to those industries that are

[1] As of April 4, 2023, the official US dollar/ruble exchange rate set by the Bank of Russia was 81.74 rubles per 1 US dollar.

frankly underdeveloped in Russia, but play a central part in ensuring the independence of the national economy from cross-border supplies. This is primarily microelectronics, pharmaceuticals, and machine tool industry. Other aspects of this problem are not touched upon in the article.

LENDING TO NEW INDUSTRIES: A GENERAL MODELLING LOGIC

In applied calculations, we will build on the fact that lending to a new production is fraught with inflation surges, which can be of such a magnitude that will make systemic economic growth impossible. The logic of the study, therefore, consists in modelling the following simple process.

The launch of a new production requires a certain amount of investment, which in our scheme is provided by the banking system through priority projects with low interest rates. The costs incurred in the construction of a new factory are commensurate with a sum of money injected into the national economy without an equivalent product backing; this amount is issued by the Bank of Russia specifically for a particular project and delivered to the intermediary bank, which is selected as the operator of the opened credit line. As the production process evolves, credit inflation is 'replaced' by the product mass. Once the construction is completed and the enterprise is in full swing, part of its revenue is returned to the banking sector in the form of loan payments, which, in the absence of refinancing, is equivalent to the withdrawal of money from circulation and the emergence of deflationary pressure. As a result, every year two key indicators are recorded, these are the rate of economic growth due to the products of the new enterprise and the rate of inflation due to credit manipulations for its construction and launch. Comparison and analysis of the indicators obtained underlie the decision on starting the loan project itself. The overall monetary environment with corresponding structural parameters is assumed to depend on the country's banking sector. The diagram of the described process's logic is presented in Fig. 1.

In the scheme considered, the main 'intrigue' of all applied calculations lies in the ratio of the cost of new production and the scale of the national economy, including its monetary component. If a new project (object) turns out to be too large-scale, then its financing should be more complex; it is not unlikely that the strategy for ensuring technological sovereignty should be adjusted taking into account this circumstance. Otherwise, the project is launched according to those reasonable risks that accompany the proposed credit injections.

To perform applied calculations, sufficiently reliable data about the enterprise under design are needed: the more accurate the information about the production process and the industry-specific product market, the more correct the results of the modelling. At the same time, we can talk about an indicative enterprise referring to either a company having several factories or a set of legally separate enterprises – it makes little difference for the model.

There are two principles that make the modelled process specific.

The first one can be called the *principle of markets clearance,* which implies 'clearing' the product and money markets from other events to deal with only one project. In other words, it is assumed that production and lending in the economy remain at the level attained initially, and lending to, and constructing of, a new enterprise take place against their background. Thus, we disregard other macroeconomic increases in the product and money supply, while focusing on one object only. This principle does not distort the real course of events, since subsequently the expected (projected) macroeconomic indicators of production and money emission can be superimposed on the product and money supply determined by the new production facility. By adding up the growth rates of the product and money supply brought about by the local process (new enterprise) and the rest of the economy, we get an overall picture of possible macrodynamics.

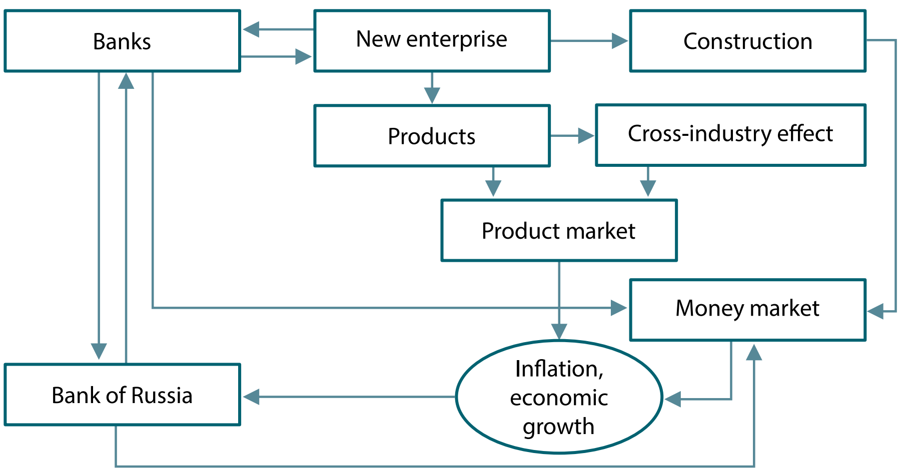

Fig. 1. Logical scheme of lending to new production facilities

Рис. 1. Логическая схема кредитования новых производств

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The second principle is the *principle of the transition process,* which involves modelling a relatively short transition process of lending, construction and production and is implemented within the first 3 years after the project is launched. During this period, there is a consistent decrease in the initially created surplus of money against the background of an increase in the new enterprise's production. Upon completion of this process, the dynamics of the product and money supply 'straightens out' and a stationary trajectory of economic growth is then formed. The main 'intrigue' of the study is to understand the disruptions and macroeconomic differentials that arise in the first 3 years after the start of lending to a new enterprise. Once the transition period is over, the macrodynamics of the national economy restores its relative smoothness.

LENDING TO NEW PRODUCTION FACILITIES: A SIMPLE MODEL

Detail the diagram in Fig. 1 by breaking it down into step-by-step elements.

1. *Establishing the annual demand for credit resources (K)*. Based on data on the cost of the project/object (I), the time period of its construction (T), the volume of standard annual revenue (X^*) of the new enterprise, and its activity after the first year of construction (bX^*, where b is the share of standard output), it is possible to calculate the annual loan amount needed:

$$K = \frac{I}{T}. \quad (1)$$

Formula (1) assumes uniform lending to a new production facility over the years. In the first year, products are not produced ($b = 0$), in the second year – half of the design capacity is provided ($b = 0.5$), and in the third year – the full capacity is reached ($b = 1$).

2. *Calculating the output multiplier (k) and the final output increase (ΔX)*. It is taken into account here that the output of the enterprise in question can be used by other companies as intermediate goods in their production process. For example, microchips can be used in the automotive and other industries. Consequently, the output bX^* will generate an extra volume of products from related industries, and the product market will be replenished to a greater extent than it is assumed by the design capacity of the credited enterprise. Then, the final output increase (ΔX) is calculated by formula:

$$\Delta X = (1 + k)\, bX^*, \quad (2)$$

where k is cross-industry multiplier of a new enterprise's output.

We assume that in the first year of the project implementation no products are manufactured, and $b = 0$.

3. Drawing up the dynamic Fisher equation and determining the inflation rate. To measure the rate of inflation caused by issuing a loan to new production, it is enough to use Fisher's equation in the following form:

$$PX = VM, \quad (3)$$

where X and M are the product and money supply in the economy, respectively; P is the price level of the product; and V is the velocity of money. In some cases, the GDP monetization coefficient (Marshall coefficient) is used, which equals $1/V$.

Fisher's equation in static form (1) can be easily translated into its dynamic equivalent:

$$(1 + p)(1 + \lambda) = (1 + m)(1 + v), \quad (4)$$

where p is inflation rate; m is money supply growth rate; v is money velocity growth rate; λ is economic growth rate.

Based on previous calculations, one can determine the money supply growth rate ($\Delta M = K$)[1]:

$$m = \frac{I}{TM}. \quad (5)$$

Formula (5) is based on the mentioned Smith's Dogma that states that all income is distributed to cover macro-factors and forms money supply. In this case, we are talking about the fact that the loan is used to pay for the construction services and salaries to the project participants. All these payments ultimately enter the product market and form the effective demand, which must be covered with the corresponding products. Even the project participants' income taxes still return to the market after a several months lag during which budget revenues are transformed into budget expenses. Similarly, money converted into foreign currency and spent on purchase of equipment from abroad still replenishes the country's money market and forms the goods-money balance.

It is worth mentioning that in a simplified form we here consider the functioning of the so-called *monetary policy transmission mechanism*. Initially, the transmission mechanism was interpreted as a model (system of variables) describing the influence of the money supply on the economy; the very system of links was perceived as a 'black box', in which the corresponding variables are transformed [Moiseev, 2002]. Today, this mechanism is understood as a complex of economic relationships, through which the central bank's decisions influence the national economy [Mogilat, 2017]. The Bank of Russia defines the monetary policy transmission mechanism (or monetary policy transmission) as a sequence of links in the economy through which monetary policy influences demand and, accordingly, inflation[2].

However, there is no unified theory of the transmission mechanism, and therefore calculation of the monetary policy's impact on inflation and production growth

[1] Since in our model the loan is fully secured by funds from the Bank of Russia, there is no point in the monetary base, as well as the money multiplier. In this regard, the value of the money supply M2 appears in the calculations.

[2] Monetary conditions and monetary policy transmission mechanism. Information and analytical commentary. (2022). No. 1 (July). Moscow: The Bank of Russia. https://www.cbr.ru/Collection/Collection/File/42253/DKU_2206-01_e.pdf.

is more of an art of assessing the current situation. That is why we will further rely on a simplified scheme for transforming money creation into the rates of inflation and economic growth; the principle of markets clearance makes this approach not only legitimate, but absolutely relevant.

The money velocity growth rate can be calculated by formula:

$$\nu = \frac{V_N - V_0}{\theta_V}. \qquad (6)$$

where V_N is the normative value of the velocity of money, which corresponds to a reasonable international standard; V_0 is the initial value of the velocity of money at the start of the loan project; θ is a period, of reconstruction of the country's monetary system to its normal state, determined by the standard V_N. In our case, we can assume that $\theta = T + \delta$, that is, the reconstruction period consists of the period of construction of the object T and the period after construction δ. 'Stretching' the adaptation of the monetary system seems quite reasonable and natural.

Rule (6) is based on the fact that for many decades Russia has functioned in a mode of monetary starvation, where the monetary coverage of the product supply by all international standards is considered insufficient: $V_0 > V_N$. Consequently, restoring normal monetization of the mass of goods can become a temporary substitute for inflation and ease inflationary pressure for several years through the policy of *quantitative easing* [Balikoev, 2017].

As follows from formula (2), the economic growth rate due to the launch of a new facility is calculated as follows:

$$\lambda = \frac{(1+k)bX^*}{X}. \qquad (7)$$

Formula (7) accounts for the *effect of the cross-industry multiplier*, which makes it possible to more fully assess the growth in the product market. Then, the inflation rate is obtained as a residual effect of formula (4):

$$p = \frac{(1+m)(1+\nu)}{1+\lambda} - 1. \qquad (8)$$

4. *Assessing economic parameters upon completion of the project.* Once the construction of the enterprise is over, it reaches its design (standard) capacity and starts repaying the loan. However, at this point many different scenarios of completing the investment project are possible. Look at them in more detail.

The *first scenario* involves a non-repayable loan. Since the loan is generated by the Bank of Russia, and a certain authorized commercial bank acts as the loan operator, the latter should earn from servicing the transaction in the amount of γ (no more than 3 % per annum). For simplicity, we assume that this amount is repaid in a single instalment, at the end of the third year after the loan is issued and the loan principal is subject to write-off. Then the enterprise pays interest on the loan in an amount not exceeding a certain proportion (α) of its gross profit. This condition takes the following form:

$$[(1+\gamma)^{T+1} - 1]\,K \le \alpha\zeta X^*, \qquad (9)$$

where ζ is the rate of return of new production (the share of profit in the company's revenue); α is permissible share of profit taken away for covering debts. Constraint (9) is completely natural, since the company must constantly make additional investments in production.

According to the *second scenario,* the received loan is fully repaid to the Bank of Russia on an interest-free basis. In this case, the condition for the normal functioning of the enterprise (formula (9)), which is one-off in nature, is transformed into an annual restriction:

$$\frac{\rho K}{\tau} \le \alpha\zeta X^*, \qquad (10)$$

where ρ is the loan interest rate; τ is loan repayment period after completion of construction of the enterprise. Then the total loan term (τ*) is $\tau^* = \tau + T$.

This option implies violating inequality (10) at a certain reasonable loan period due to the excessive size of the loan principal. In this regard, this circumstance may result in searching for a different debt repayment strategy. If such a situation arises, condition (10) can be considered as a strict equality for determining the project's payback period:

$$\tau^* = T + \frac{\rho K}{\alpha\zeta X^*}. \qquad (11)$$

Estimate (11) in itself is quite informative and allows one to understand the scale of the project being launched and the credit problems arising.

The *third scenario* provides for a one-time repayment of the loan to the Bank of Russia through the corporatization of the constructed state-owned enterprise and the sale of shares issued to private owners. If it was the state that initially acted as investor and founder of the enterprise and the enterprise itself was originally state-owned, then the founder has the right to change its status to a joint-stock form; a private investor (founder) can also be initially involved on the conditions specified above. Then, keeping control over the enterprise is ensured by a controlling stake with a share of β (usually 51 %), and the remaining shares can be sold in the market. The par value (N) and number of shares sold (A) can be determined from the loan repayment condition:

$$\rho K = (1-\beta)NA. \qquad (12)$$

In this case, the need to repay a giant term loan at a fixed rate is replaced by an annual and perpetual payment of dividends with yield i:

$$i = \frac{\alpha\zeta X^*}{NA}. \qquad (13)$$

The final choice of capitalization option for a new enterprise depends on numerous circumstances and is decided through discussion and agreement between representatives of various government agencies. Below, we will consider exclusively the quantitative side of the modelled process.

RESULTS OF MODEL CALCULATIONS

Consider the microelectronics industry and the parameters of a new enterprise that require issuing a loan. This question is by no means trivial, since there are many subtleties and nuances that are of great importance in practice, but can be ignored for model calculations. Using a case study of a microchips manufacturer, we will address the very source data identification scheme.

As noted earlier, modern microchip production equipment requires 5–15 billion US dollars; in our case, we will proceed from 10 billion US dollars. According to expert estimates, the new factory's annual output makes it possible to return the investment in literally 1 year[1]. To link investments with product output, it is enough to compare these indicators considering a 2-year lag, which is equal to the average construction period of a new factory for the production of semiconductors. According to the global semiconductors market statistics, investments of 2019 and 2020 resulted in the annual outputs of 2021 and 2022, respectively, with a coefficient (X^*/I) of 5.3–5.8[2].

In the light of the foregoing, we will assume a more modest output coefficient of 4.5 for the Russian enterprise. We estimate that the net profitability (ζ) of the top-10 semiconductor companies ranges between 11.0 % and 38.7 % of revenue[3]; in our calculations, we will utilize their average value, i.e., 19.4 %. The profit share withdrawn from investment turnover is estimated at 50 %; the controlling stake is 51 %.

The 2020 semiconductor shortage demonstrated that a single missing critical chip worth a few dollars can halt the sale of a device costing tens of thousands of dollars. Moreover, the average number of chips, for example, in a modern vehicle has grown 5 times compared to partially automated cars. According to Deloitte, the chip shortage in 2019 and 2020, which we estimated at 81.1 billion US dollars, resulted in a global revenue shortfall of more than 500 billion US dollars[4]. This means that the value of the cross-industry multiplier is 6.2 (500/81 = 6.2).

In our study, the reconstruction period of the country's monetary system is 3 years, and the loan repayment period after completion of the construction of the enterprise is 5 years. The target value for the velocity of money is at China's level, which can serve as a model for Russia in supporting domestic producers[5]; the initial values of GDP (X_0), money supply (M2 money supply is represented by the variable M_0) and velocity of money (V_0) for the Russian Federation are taken as of the end of 2022[6]. The initial model variables and parameters are presented in Table 2.

[1] Infineon will build a semiconductor plant in Germany for 5 billion euros – investments are planned to be recouped in a year. https://3dnews.ru/1082072/infineon-postroit-v-germanii-zavod-stoimostyu-v-5-mlrd-dlya-vipuska-poluprovodnikov. (in Russ.)

[2] Semiconductors: The global market. https://www.tadviser.ru. (in Russ.)

[3] Top 20 semiconductor companies by revenue recorded healthy growth, says GlobalData. https://www.globaldata.com/media/business-fundamentals/top-20-semiconductor-companies-revenue-recorded-healthy-growth-says-globaldata/.

[4] Review of the semiconductor market and manufacturers of related equipment. https://gazprombank.investments/blog/market/semiconductor/. (in Russ.)

[5] Trading Economics. https://ru.tradingeconomics.com/country-list/money-supply-m2. (in Russ.)

[6] The Bank of Russia. Statistics. https://cbr.ru/statistics/. (in Russ.)

Table 2 – Model parameters and variables in the baseline scenario
Таблица 2 – Параметры и переменные модели в базовом сценарии

Parameters	Symbol	Measure units	Value
Model parameters			
Investments in construction	I	billion rubles	810.0
Construction period	T	years	2.0
Standard annual output	X^*	trillion rubles	3.6
Rate of return	ζ	%	19.4
Permissible share of profit for covering debts	α	%	50.0
Cross-industry multiplier	k	times	6.2
Controlling stake	β	%	51.0
Loan interest rate	γ	%	3
Adaptation period of the monetary system	θ	years	3
Loan repayment period	τ	years	5
Initial and target values of variables			
GDP initial value	$Y_0 = P_0X_0$	trillion rubles	153.4
Value of M2 money supply aggregate	M_0	trillion rubles	82.4
Initial value of the velocity of money	V_0	times	1.86
Target value of the velocity of money	V_N	times	0.44

As mentioned earlier, the model period in our case is relatively short and is limited to three years from the date of opening the credit line.

Calculations for the baseline scenario (Table 2) are aggregated in Table 3 and provide an array of data that need to be comprehended.

Table 3 – Results of model calculations
Таблица 3 – Результаты модели расчетов

Variables, %	Year		
	1st	2nd	3rd
Scenario 1 (k = 0)			
λ	0.0	8.4	16.9
p	–24.0	–37.2	–53.1
Scenario 2 (k = 0)			
λ	0.0	1.2	2.4
p	–24.0	–32.7	–48.8
Scenario 2 (k = 0; V = const)			
λ	0.0	1.2	2.4
p	0.5	–0.7	–2.3

Firstly, a new microelectronics enterprise generates tremendous economic growth throughout the country as early as the second year of its launch; in the third year this figure is even more fantastic (scenario 1, Table 3). This only means that truly large-scale and modern semiconductor production can help Russia leapfrog to a completely new level of economic development.

Secondly, the fears of rising inflation under the quantitative easing policy are not only exaggerated, but also unfounded. Gradually increasing monetization of GDP to a reasonable level will not only suppress inflation, but also, apparently, will lead to powerful deflationary pressure on the economy. For instance, at the end of the third year, one can expect a two-fold drop in prices due to the products of the new enterprise entering the product market. This circumstance once again indicates that without the policy of quantitative easing, the country will face outright monetary starvation in the future.

Thirdly, concerns about loan non-repayment and the low financial attractiveness of the new enterprise are also baseless. Our calculations show that conditions (9) and (10) are met with a large margin, which indicates the record-high solvency of the new production. Moreover, according to our calculations, the amount of equity capital that needs to be collected to fully cover the loan is NA = 1.98 trillion rubles. Moreover, even under the strictest credit conditions (ρ = 1.2), the debt repayment period is no longer than 5 years (τ^* = 4.78 years), and the projected production capacity allows for dividend payments to shareholders at the level of i = 17.6 %. This is the level of payments that may be of interest to any investor and may well be used to launch a *model of people's capitalism* according to which residents of the region where the new production is located will be the enterprise's shareholders.

The above unambiguously indicates that all fears regarding possible threats from the development of new industries based on credit injections are unreasonable.

Such optimistic quantitative estimates and conclusions need to be commented and supplied with additional calculations. To that end, let us consider two more scenarios, in which we remove two very strong assumptions. In scenario 2, we will completely abandon the assumption that there is a cross-industry effect in related industries and thereby evaluate the 'net' impact exerted by the products of the solitary new enterprise on the product market. In scenario 3, we further remove the assumption about quantitative easing policy and a reduction in the velocity of money, and thus evaluate the 'direct' impact of credit on the money market in isolation from systemic shock absorbers.

Based on the calculations performed (Table 3), we can arrive at the following conclusions.

First, even if the new enterprise supplies final products that will not be used in the future to form new value chains, the expansion of the product market will be macro-economically significant – more than 2 % per year. Such a result can be viewed as a strategic achievement, and the construction of a new plant is completely justified.

Second, even without reforming the GDP monetization regime, a half percent inflation may take place only in the first year, and in the next 2 years, moderate deflation about 1–2 % will occur, which can only improve the overall macroeconomic climate in the country. Thus, no inflation shock would be expected from a sharp rise in prices even under the most unfavourable circumstances.

The last two theses entirely dispel doubts about the effectiveness of credit instruments for launching new production. The above calculations show that even the most conservative assumptions about future events are quite optimistic.

DISCUSSION

The applied calculations performed using the constructed model allow drawing strategically important conclusions. In particular, it is absolutely clear that the inflationary potential of non-amortizing and massive loans accompanied by money creation is significantly overestimated. Russia is in dire need of large-scale production in many product lines. Large and technically equipped modern production facilities are capable of producing an output of such a volume that it will have a significant impact on the Russian product market, which is currently deeply flawed. This is a kind of trump card for the Russian economy, which falls under the category of 'lag advantages'. Paradoxical as it may seem, the regime of monetary starvation lasting in Russia for over 30 years since the collapse of the USSR also acts as a reserve for the country's monetary system and prevents the development of uncontrollable inflationary trends.

Above we discussed the facts and figures for a semiconductor manufacturer, but the same situation is typical of almost all areas in which Russia needs to restore its technological sovereignty. The difference in calculations in this case is not so considerable: there is a difference in amounts of investment per enterprise and cross-industry multipliers, but in general the effects are quite similar everywhere. The calculations show that in the next 3–4 years the country can and *should* consistently launch megaprojects in different industries that find themselves in the most problematic situation. The Russian economy is capable of withstanding the credit pressure, but the implemented projects will create such a potential for economic growth that will 'eat up' the possible money excess.

The foregoing implies that the credit factor, which was not truly involved in launching new production in the real sector of the economy throughout almost the entire modern history of the country, should finally come to the fore. The country's monetary system can become a driver of economic growth in general and industrial production, in particular. All attempts to bring the monetary system to a halt in this sphere will mean missed opportunities that may not come again, and this is a rather important message to the national mega-regulator, i.e., the Bank of Russia.

It is worth noting that it was our deliberate intention not to touch upon the issues of import substitution in the paper. For example, we do not discuss the question of whether or not the Russian economy will be able to 'digest' and effectively absorb the huge amount of semiconductors supplied by the new enterprise; whether these products will subsequently be exported, and whether they will become competitive in the global market. Such topics are quite numerous, but we try to sidestep them since they are widely discussed in the existing literature, and it is impossible to address all these issues within a single article. In this regard, we limit ourselves to only indicating fairly informative and detailed works on import substitution, such as [Dolgopyatova et al., 2021; Simachev, Fedyunina, Gorodny, 2022; Drapkin, Fedyunina, Simachev, 2022; Kuzminov, 2023; Simachev et al., 2023]. All the problems of import substitution posed in the listed works will need to be solved as they mature during the launch and expansion of new production.

CONCLUSION: EXPLORING THE DEVELOPMENT PATH

The proposed simple model of the transition process for launching new production facilities is a completely universal computational tool for studying credit expansion scenarios in Russia. The presented calculation scheme can be easily adapted to many megaprojects in different industries. To do so, it is necessary to estimate the relevant economic parameters as accurately as possible. New production projects in the model are aggregated when assessing additional total injections into the product and money markets. Mathematically, an increase in the number of enterprises analysed implies an increase in the share of cash and product injections into the 'cleared' market. Subsequently, the projected values of growth and inflation of the rest of the economy can be added to similar values of launching new enterprises, which will give a general picture of the possible course of events.

The task of restoring technological sovereignty cannot be solved in a short time using traditional 'soft' means, such as budget policy in the form of federal and regional development programmes. An additional 'hard' instrument – credit – is needed. This will speed up the solution to this problem, and adequate modelling tools can give an idea of the reserves that the Russian monetary system has today.

The pilot calculations performed using the proposed model showed that today's reserves of the Russian economy are truly enormous. We can state that the country is ready for pumping massive amounts of liquidity with a subsequent explosive growth in production on a new technological basis. The model's tools are intended to help in the effective design of new production projects in time and space. ■

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