Банк России

Центральный банк Российской Федерации

Estimating the exchange rate pass-through effect on prices at the micro level

This analytical note investigates the exchange rate pass-through mechanism[1] at the micro level, i.e. at the level of individual enterprises[2].

Theoretical models of the optimal behaviour of companies and analysis of their actual activities demonstrate[3] that when the national currency weakens (or strengthens), large companies with a relatively low proportion of import costs can raise (cut) prices more intensively than that proportion dictates[4]. This variation is achieved through active margin management, i.e. increasing or decreasing of the margin in response to anticipated pricing activity of competitors.

The pass-through effect, therefore, is not determined solely by the amount companies spend on imported materials and components or by the market share of importers. In order to estimate the intensity of the effect it is also important to know the number of companies in the market, as well as its structure, and, accordingly, the extent to which companies take into account their competitors' actions.

Using Russian data we have compared the estimates of the pass-through effect calculated on the basis of expenses with the estimates that take into account the ability of a company to manage their margin and the extent to which they consider competitors' actions[5].

The study shows that, first, the estimated pass-through effect calculated on the basis of expenses at the micro level was 0.18, which lies within the range of published macroeconomic estimates[6]. Surveys indicate that the pass-through effect is asymmetrical: when the ruble weakens, the effect is twice as strong as when the ruble strengthens.

Secondly, the pass-through effect estimates change only slightly when companies' motivation to manage their margin actively is taken into account. In part, this reflects the insignificant intra-industry variation of the proportion of imports in costs, which reduces a company's motivation to correct the pass-through effect; moreover, to a certain degree, it reflects the different directions of pass-through effects at the industry level, which offset each other in the total price index.

Our estimates show that in agriculture and food production the pass-through effect is strongly affected by companies' behaviour: they closely track the pricing policy of their competitors. These industries are generally represented by several very large enterprises, which have a relatively high proportion of imports in costs, and a large number of small companies with smaller import ratios (regional producers). When the exchange rate is weakening, major market players have to decrease their margin in order to maintain their market share[7], whereas small companies can aggressively raise prices

---

[1] The Exchange Rate Pass-Through (ERPT) reflects the elasticity of commodity prices with respect to movement in the exchange rate, i.e. it answers the question: 'To what extent will prices change, in terms of percentage points, if there is a 1% change in the exchange rate'.

[2] ERTP estimates are usually calculated on the basis of macroeconomic data. As a result, the decisions and stimuli of individual companies are left out, and the estimates themselves do not provide any information as to what drives the pass-through effect. Even when ERTP estimates are made with due regard to the market share of importers, the impact of exchange rate shifts on inflation when there is a change in market participants' motivations may be incorrectly evaluated. For example, the increased market share of domestic companies, which, in comparison with importers, have low import costs, does not necessarily lead to lower ERTP effect as predicted by macroeconomic assessments.

[3] See [1].

[4] These price-setting strategies have been well described in the literature and are referred to as 'pricing-to-market'. However, this term is usually only applied to the behaviour of importers in the domestic market (see [3]).

[5] In order to carry out our assessment we have used a theoretical model of imperfect competition calibrated on the basis of the results of the company survey conducted by the Bank of Russia in December 2016 – January 2017.

[6] The results obtained somewhat exceed estimates made by the Bank of Russia (see Monetary Policy Report, 2017, No. 1, p. 21; Research and Forecasting Department Bulletin 'Talking Trends', 2017, October). This can be explained by both the specifics of the data used (microdata) and the fact that our estimations are related to the manufacturing of consumer basket goods, instead of retail trade, and the composition of goods does not fully reflect that of the CPI. However, the results are close to the estimates obtained by the IMF (2015) of 0.22.

[7] As their profit maximisation strategy requires.

to improve their financial standing (at the cost of their larger competitors). Our estimates demonstrate that, as far as food production is concerned, the total market influence of small producers is prominent enough for the pass-through effect to be greater than the effect of transfer based on costs. As a result, prices turn out to be more volatile within a given ruble exchange rate range (growing more intensively when the ruble weakens and falling when it strengthens) than they would be in a more homogeneous industry.

Therefore, the strengthening of the ruble in 2016–2017 had an additional minor disinflationary effect in agriculture and food production due to the competition structure in these industries. This can help explain variation in the dynamics of food and core inflation in 2017 as well as the contribution of the pass-through effect to the food and core inflation in September, estimated at the macro level[8].

Exchange rate shifts not only create price effects in the above industries, but also lead to the redistribution of profits between producers. When the ruble is falling (such as in 2014–2015), this redistribution negatively impacts the financial standing of larger borrowers (who usually have a large proportion of imports in costs) in the short term. This can lead to increased risks for financial stability. At the same time, small companies obtain additional resources for development and investments. As a result, in the midterm, the financial stability of these industries improves.

---

[8] See Research and Forecasting Department Bulletin 'Talking Trends', 2017, October.

Introduction

What factors determine the amount by which a company changes product prices in the case of exchange rate fluctuations? First, it depends on the extent to which the given company *has* to adjust its prices. This is determined by the proportion of imports in its costs (imported raw materials, supplies, and investments), as well as whether the company exports its products or sells them in the domestic market only, i.e. in which currency it receives earnings . The second factor is the extent to which the company *wants* to adjust its prices. For example, if the exchange rate fluctuations do not affect the company's costs but its competitors have to adjust their prices, will it be willing to follow their lead? Thirdly, it depends on the company's *ability* to adjust its prices. Even if the first two conditions have been fulfilled, the company may be unable to implement such changes if prices are fixed by long-term agreements or if the market is highly competitive and any deviation from the market price can mean losing a large market share.

When assessing the exchange rate pass-through effect with respect to (producers' or retail) prices, it is common practice either to use aggregated price data or to calculate the inflation consequences of a weakening exchange rate on the basis of certain views as to the proportion of imports in costs (pass-through effect calculated on the basis of expenses). In the first case, it is not possible to explain the pass-through effect other than by "a correlation between product prices and the exchange rate over the given period in the past". In the second case (pass-through effect calculated based on costs), the above explanation is oversimplified[9] and, as demonstrated in [1], may not correspond to the behaviour of real companies. This means that use of such estimates in determining and forecasting price growth resulting from a weakening exchange rate is unreliable.

In order to study the pass-through effect in more detail, to determine the impact of market structure (differences in the behaviour of large and small companies) on the consequences for inflation of exchange rate fluctuations, thus providing alternative estimates of the pass-through effect, we used information contained in the company review conducted by the Bank of Russia in December 2016 – January 2017.

The further structure of this analytical note is as follows. First of all, we describe the latest developments in economic theory with regard to the influence of market structure and the behaviour of companies with high market power (monopolies) on the pass-through effect. The apparent paradox is that large companies with a large market share can theoretically make the pass-through effect weaker than under conditions of perfect competition where all companies are equal. We then apply these results to model estimates of the exchange rate pass-through effect on the product prices of various types of domestic producers, with due regard to the industry structure. (See Appendices 1 and 2 for the technical details).

---

[9] It is assumed that companies transfer changes in costs to changes in prices, i.e. the pass-through effect is equal to 1.

1. Theory: the impact of monopoly power of companies on price growth after exchange rate shocks

Every company dreams to become and forever to remain a monopoly in its own market. According to the classical definition, a company is considered as monopoly if it sets its prices higher than its costs[10]. We will stick to this definition. Companies become monopolies as a result of the following factors:

– Technological or productivity advantages in comparison to competitors;

– Barriers to market entry.. If the barriers are natural, the company is a natural monopoly[11];

– Advantages of the company's goods as perceived by buyers. Many companies maintain high advertising budgets in an attempt to stand out in the eyes of consumers and find the market in which they can set their prices above their marginal costs.

The above-mentioned monopoly advantages lead directly to a company having a high market share. It is easier for monopolies to grow because they can temporarily sacrifice their profitability rate (margin or mark-up) to boost their market share by lowering prices and pushing out competitors. Lowering absolute amount of profits in this case is compensated by a higher volume of sales.

The higher a company's market share (its monopoly power), the easier it is considered to be for that company to raise prices after growth in costs due to, for example, weakening in the national currency. This means that it is easier for the companies with high market power (a high market share) to transfer growing costs of imported raw materials, supplies or intermediate products to final prices, and the reaction of prices to the weakening foreign exchange rate is found to be more pronounced than in more competitive markets. However, a few specifics of real markets are often overlooked.

First, no matter how large a company is, its market share is rarely higher than 30%, unless it is a natural monopoly[12]. In microeconomics, the existence of competitors (no matter how small) significantly affects the behaviour of large companies. Companies care about their market share, and take other market participants into account in their operations; large companies are no exception. Even large enterprises consider the potential or actual actions of their competitors when making pricing decisions.

Secondly, companies with high monopoly power have a bigger margin, which serves as a buffer in case of adverse shocks and allows the company to protect its

---

[10] We are referring not only to average unit costs but to marginal costs, i.e. how much it will cost a company to produce one more unit of a given product. In general, a price comprises two constituents: *price = marginal costs + margin.* Marginal costs are considered as the economic, rather than accounting, sense, meaning that they include alternative ways of utilising a company's resources: the company may place its capital into a bank deposit instead of investing in manufacturing. Thus economic costs already include a certain profitability rate (e.g. deposit interest rate). Under conditions of strong (perfect) competition, a company can have only a standard profitability rate (as deposit interest income). In other words, for such a company the price of one unit of a given product is equal to its marginal costs. Margin should not be confused with the amount of profit. The margin represents the marginal amount of profit, i.e. increases in profit received from selling one more unit of a given product. A monopoly does not set the price at a randomly high level; it sets the price at the level that will maximise its profits over a certain horizon. The inverse dependence of the demand for a monopoly's goods on the price of those goods acts as a natural limitation which prevents the company from setting a price too high.

[11] We are leaving the price-setting issues of natural monopolies out of the scope of this note, due to the fact that these types of companies are generally state-regulated and therefore their price-setting behaviour is not driven by purely economic factors. A zero margin of natural monopolies is socially desirable.

[12] This is confirmed by indirect assessments of companies' market shares based on our survey data.

market share without raising prices. According to theoretical calculations and behavioural studies of a large number of real companies, enterprises with high market power and significant influence over market prices can in fact avoid raising prices despite higher import expenses in their production cost structure as a result of the weakening national currency[13].

We present certain examples of these ideas in Appendix 1. In particular, we provide calculations based on a model formulation of a hypothetical market structure involving a company with significant market power. These calculations demonstrate that one year after a drop of 45% in the foreign exchange rate, price growth can be both higher and lower (by 4 p.p. in both cases) than in a market where all companies are equal and therefore fully transfer their cost growth to prices (in that case, prices would grow by 18% a year after the shock).

Below, we provide estimates of the exchange rate pass-through effect with respect to product prices of Russian companies involved in particular types of economic activity based on various assumptions regarding the structure of industry markets.

2. The estimated pass-through effect with respect to product prices in particular industries, with regard to market structure (Russian company survey data)

In order to estimate the exchange rate pass-through effect with respect to product prices in particular industries, we examined data on Russian companies obtained through the sample survey of a variety of enterprises conducted by the Bank of Russia in December 2016 – January 2017[14]. The survey covered almost 500 companies involved in a range of different types of economic activity. Appendix 2 contains a short description of the data and procedures used to calculate the pass-through effect on the basis of the model. We reviewed a single-layer competition structure at the production stage (allowing for potential import of finished products) and left out competition at the stage of selling finished products (in the retail market).

The following three market characteristics are the most important for our calculation: the level of homogeneity among Russian companies in terms of the proportion of imports in their costs; the level of competition between producers and importers of similar

---

[13] See [1].

[14] We have also conducted calculations based on the model suggested by Amiti, Itskhoki and Konings [1] on the basis of information about the business activity of a large number of Russian companies and their financial statements. Although this information has a number of advantages over the sample survey data, it also has significant limitations in relation to the calculation of the pass-through effect. In the end, these limitations outweigh the advantages and greatly diminish the value of estimates. One of the advantages is the *a priori* complete nature of such information: according to the statistic accounting law, all legal entities must submit statistical reporting. Another advantage is the availability of information regarding the volume of production of different kinds of products by individual companies. This data is required to calculate marginal costs and to find out exactly where market boundaries lie (in terms of markets for individual goods, rather than for the products of individual kinds of economic activity). In reality, however, the database did not contain data on important representatives of certain industries, which made it impossible to assess the structure of the industry and its level of competition. The second and most important drawback was that the estimated share of imports in the (marginal) costs could only be obtained through an indirect and a very unreliable procedure (analysis of the reaction of production unit costs in response to the ruble weakening in 2008–2009). In the end, we decided not to include the calculations based on such data in this note.

products (the market share of importers[15]); and the size (market share) of companies in the market represented by domestic producers as well as importers.

With regard to the first characteristic (the proportion of imports in costs), we not only discover the absence of homogeneity between industries but also find that the proportion of imports in costs varies heavily between individual companies within the same industry.

Thus, the highest levels of imports have been identified in textiles and clothing manufacturing, wholesale trade, chemical production and furniture manufacturing industries (see Appendix 2, Table 2.1). In the production of machinery and equipment, electrical equipment, vehicles, and pulp and paper products this proportion is significantly lower. The highest intra-industry variation (variation coefficient) of the proportion of imports in production costs is observed in the production of foodstuffs, vehicles, and machinery and equipment. The lowest variation is observed in textiles and clothing and furniture manufacturing. This means that the textiles and clothing industry is represented by companies that are heavily dependent on imported raw materials, supplies, and capital, whereas the machinery and equipment and vehicles production sectors are characterised by very high variation in the proportion of imports in costs despite the fact that on average this figure is low. This heterogeneity creates favourable conditions for the cost-based pass-through effect to differ from the indicator based on companies' pricing decisions, which have factored in competitors' actions.

With regard to the second characteristic (the strength of competition with importers), the surveys show that competition with importers is stronger than competition with domestic producers in the industries accounting for one third of the GDP (out of 40%) produced by the types of economic activity included in the calculation,. Importers, who compete heavily with domestic producers, dominate in less than half of the industries reviewed (by their share in the GDP). In three sectors, the wholesale trade, textiles and clothing, and leather production, competition with importers is exceptionally strong. Those same industries demonstrate a high proportion of imports in their costs. This means that when the exchange rate is falling, it is more difficult for the companies in these industries to convert the growth of importers' costs to their advantage, as their own costs also increase. At the same time, low relative competition with importers (and therefore, their low market share) is noted in the food production industry. This can be explained by the fact that, with the exception of one large domestic producer, the sample contains local (regional) companies, for whom competition with other domestic producers in the local market is more important[16]. The low share of importers in the industry must decrease companies' incentives to deviate from the pass-through effect determined by costs. However, the proportion of imports in costs varies heavily between companies. Therefore, the total effect on prices in these industries from the exchange rate weakening cannot be predicted.

The third characteristic (company size) is also present in the survey. According to a broader array of data on the largest Russian companies (e.g. the Expert-400 rating), the Russian economy is very concentrated, and every industry has its evident leaders. At the

---

[15] We assume that importers operating in the Russian market also use the pricing-to-market strategy.
[16] We were not able to determine whether this was due to a bias in the sample or the specifics of the industry in the general population (i.e. heavy fragmentation of the industry).

same time, the companies which theoretically could have had a high proportion of imports in costs (such as Coca-Cola or PepsiCo), actually demonstrate high levels of production localisation. Table 2.1 of Appendix 2 shows indirect estimates of the market share of the largest domestic company, adjusted for the estimated share of importers based on the sample. They demonstrate that agriculture and electrical equipment manufacturing are represented by a large number of quite similar producers while in the food, furniture and vehicles production sectors a high concentration of production is observed.

We have calculated the pass-through effect based on the responses of enterprises regarding the proportion of imports in their production costs. The pass-through effect with respect to the prices of industries representing 40% of the GDP was estimated at 35% (in response to doubling of dollar vs. ruble), which is reflected in Table 2.3, Appendix 2. Model [17] calculations produced similar results (32%), however individual industries demonstrate quite prominent heteroogeneity (Table 2.3, Appendix 2).

We have obtained the following results from the pass-through effect estimation[18]:

1. In nearly a third of sectors, the pass-through effect is close to that calculated on the basis of costs, as if companies make decisions without considering their competitors' behaviour. For example, the largest electrical equipment and pulp and paper manufacturing enterprises are almost identical to other companies of those industries in terms of the proportion of imports in costs (all competitors together approximate the single large competitor). Therefore, market leaders are not motivated to supress their margin to keep their market share, and the changes in costs of small companies are similar to those of their larger competitors. This is also characteristic of transport equipment manufacturing, however the variation of share of imports in costs is higher within this industry.

2. The pass-through effect in other sectors is weaker than that calculated based on costs, except for food production, where it is a little stronger. The weaker model-based pass-through effect in certain sectors (agriculture, wholesale trade, textiles and clothing, chemical and machinery and equipment manufacturing) can be explained by the fact that these industries are dominated by large enterprises with a higher proportion of imports in their costs (domestic producers or importers) than their competitors. Despite their dominating position, such companies reduce their profitability rate (margin) in response to exchange rate shocks in order to maintain their market share. At the same time, smaller companies with a lower proportion of imports in their costs raise prices more aggressively than the growth in their costs requires because they expect importers to raise prices as well. However, small companies are unable to outweigh the low pass-through effect of large enterprises, and the overall effect turns out to be lower than the cost-based pass-through.

3. The food production sector experiences a stronger pass-through effect because here multiple small companies with a low proportion of imports in their costs aggressively raise prices, whereas large enterprises tend to restrain their price growth cutting their profitability rate. In contrast to the above, the combined power of small companies turns

---

[17] See [1].

[18] It is worth noting that all our assessments are imprecise, which is characteristic of all assessments based on sample data.

out to be higher and the pass-through effect stronger than would be the case if companies acted without taking account of their competitors.

The estimated influence of strategic cooperation on the pass-through effect, albeit low, distinguishes the food production sector (which is the largest in terms of its contribution to the added gross value) from other industries. Multiple small companies in the sector have a low proportion of imports in their costs but, according to model estimate, aggressively raise prices in response to the ruble weakening. At the same time, large enterprises, whose proportion of imports in costs is higher than that of all their competitors combined, restrain their price growth at the expense of a profitability rate. The combined power of small companies turns out to be slightly higher and the pass-through effect slightly stronger than would be the case if companies acted without factoring in their competitors' actions.

According to the surveys, transport equipment manufacturers (another important industry) do not experience strong competition from importers, however, competition from domestic producers is noted. The average proportion of imports in costs is just 14%, yet it varies a lot (from 0% to 85%). The proportion of imports in costs of the largest companies is almost identical to their competitors' average. As a result, this sector is characterised by perfect competition where the cost-based pass-through is optimal.

In contrast, economic activities such as wholesale trade, agriculture and fishing, chemical production, and textile production experience a lower pass-through effect than that calculated on the basis of costs. We can conclude that large industry importers reduce their mark-up in response to growth in costs after weakening in the exchange rate, whereas small domestic companies raise their prices more aggressively. Due to the specifics of market share distribution, the overall effect is determined by companies with a higher proportion of imports that have to absorb a part of their cost growth. In the end, the calculated pass-through effect is lower than the pass-through effect calculated on the basis of costs: in agriculture by 4 p.p. out of 28%; in wholesale trade by 2 p.p. out of 58%; in textiles manufacturing by 5 p.p. out of 56%.

Regarding the applicability of the above results to the analysis of consumer price index dynamics, it is important to take the following three circumstances into account:

1. The output of certain industries is not included in the calculation of the consumer price index (CPI) but in the calculation of the producer price index. If we consider only the industries whose output is mainly represented by final products and is therefore included in the CPI calculation (according to our estimates, the sectors under review produce nearly 60% of the CPI basket nomenclature), the GDP weighted pass-through effect will be significantly lower (down from 35% to 19%) for all the reviewed sectors. The calculated estimate of the pass-through effect in final product industries, with due regard to the structure of industry markets, was 18%, or only 1 percentage point lower. The estimates obtained by the Research and Forecasting Department are higher than those published by the Bank of Russia in its Monetary Policy Report, including those for individual CPI components. This can be explained by both different sources of data (macroeconomic statistics and company surveys) and different market competition stages

(between producers, which includes importers, and the retail trade)[19]. Our estimates are close to those of other developing countries (see [4]).

2. Even for goods that are included in the consumer price index our assessments only take into account the first level of competition – competition at the level of production. Besides this, it is necessary to consider competition in wholesale and retail trade, where large rivals (e.g. retail chains) can also manage the margin to mitigate the effects of adverse shocks. This can weaken or strengthen the pass-through effect in comparison with the estimate obtained for the first level of competition.

3. The assessments are based on the unchanged proportion of imports in producers' costs and unchanged demand (consumers' incomes) in view of a strong exchange rate shift. In reality, companies will try to switch to alternative options that do not involve importing raw materials, supplies, or equipment. Cutting the proportion of imports in costs is a relatively long-term strategy, implemented over a period out of the scope of our research. Similarly, changes in consumers' incomes at the given relative prices level can trigger the mechanism substitution of certain goods in their basket with others. We do not analyse that effect specifically. In our model, the decrease in consumers' incomes affects all goods symmetrically at the given relative prices level, and prices themselves are flexible.

---

[19] Monetary Policy Report No. 1, 2017, p. 21.

Appendix 1.

Article [1] describes a theoretical model for the optimal behaviour of a company, showing that, if the market leader has a higher proportion of imports in costs (or high elasticity in costs with respect to exchange rate changes, which is the same thing) than its competitors, in response to an exchange rate shock it will raise prices more slowly, at the expense of its mark-up, in an attempt to maintain its market share.

For model calculations, we used a partial equilibrium model in a market of N companies suggested in [1]. The model is static (companies adjust to shocks immediately). It does not cover the general equilibrium (that of other markets, e.g. labour or money market equilibrium). Prices are flexible (the equilibrium is achieved after shocks due to very fast price adjustment). These simplifications aim to focus attention on understanding the role of competition between companies *per se*, without going into details, which are not important in this particular case. However, as we see in [2], the market structure affects not only the pass-through effect but also price rigidity: larger companies tend to review their prices less often, so their adjustment to shocks takes more time.

Our model consists of the following equations, which come down to the 3N + 1 equation:

$$Q_{it} = \xi_{it} D_{st} P_{st}^{\rho-\eta} P_{it}^{-\rho}$$

$$M_{it} = \frac{\sigma_{it}}{\sigma_{it} - 1}$$

$$MC_{it} = \frac{W_t^{1-\varphi_i}(E_t)^{\varphi_i}}{A_{it}}$$

$$P_{it} = M_{it} MC_{it}$$

$$S_{it} = \frac{P_{it} Q_{it}}{\sum_{j=1}^{N} P_{jt} Q_{jt}} = \xi_{it}(\frac{P_{it}}{P_{st}})^{1-\rho}$$

$$P_{st} = [\sum_{i=1}^{N} \xi_{it} P_{it}^{1-\rho}]^{1/(1-\rho)}$$

$$\sigma_{it} = [\frac{1}{\eta} S_{it} + \frac{1}{\rho}(1 - S_{it})]^{-1},$$

where Q_{it} is the demand for i company product; ξ_{it} is consumer preference towards purchasing i company product (demand shifter); D_{st} is the relative demand for products of this industry; P_{it} is the price of I company product; P_{st} is the general or industry price level; M_{it} is the mark-up, which is positively dependent on the perceived elasticity of demand σ_{it}; MC_{it} is the company's marginal costs; S_{it} is company i's market share, which is positively dependent on its relative price; W_t is the company's employee salaries; E_t is the foreign exchange rate (rubles per dollar); φ_i is the elasticity of marginal costs with respect to the foreign exchange rate $\rho - \eta \gg 0$.

The obtained 3N + 1 equations were solved in Matlab for the given industry structure.

We assumed that each reviewed sector comprised 15 companies (for purposes of determination only; the results did not change materially if the number of companies was higher) varying in terms of both productivity and elasticity with respect to exchange rate changes (see Table 1.1). The industries differed only by the parameters of the last, 15th, company, which could either be very ineffective and small with a high/low proportion of imports in costs, or a market leader with a high/low proportion of imports in costs.

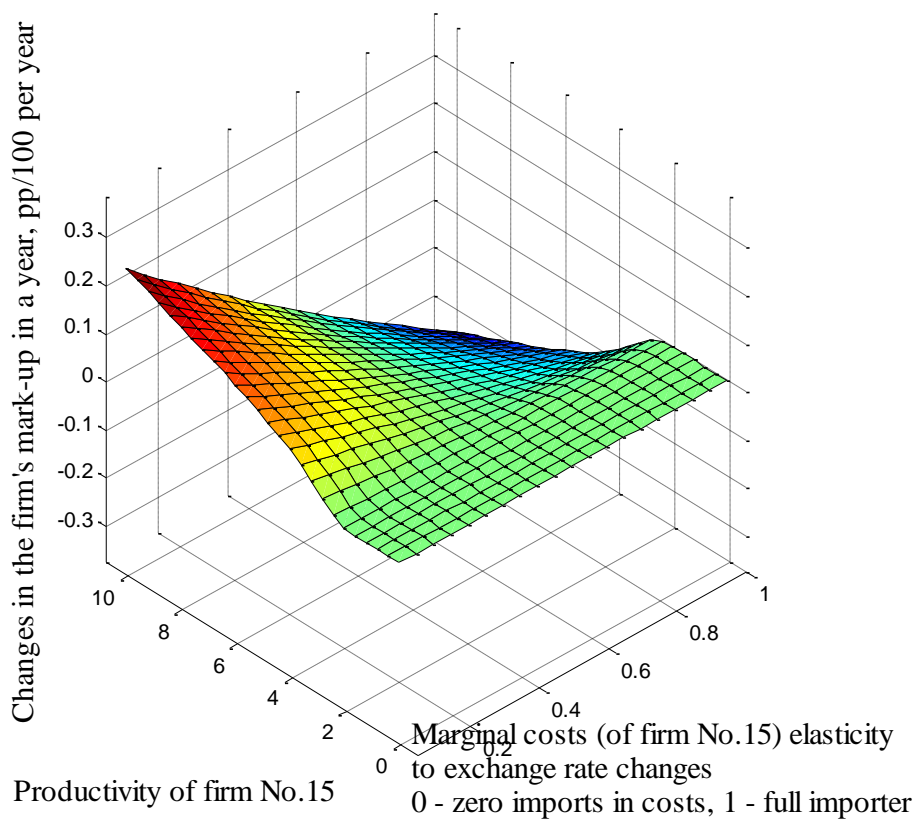**Table 1.1 Premises regarding sector structure in the model**

Parameter	Company No.			
	1–5	6–10	11–14	15
A_{it} – productivity	0.1	1	5	[0.1; 10]
φ_i – elasticity of marginal costs with respect to the exchange rate (related to the proportion of imports in costs)	0.1	0.3	0.5	[0.1; 1]

We also assumed that $W_t = V_t = 1$, $\xi_{it} = 1, \forall i = 1, N$.

For all such industries, we identified the initial equilibrium level and the equlibrium level a year after significant weakening of the ruble. According to our assumptions, the one-year exchange rate changes were 45%, i.e. $E_1 = 1$, $E_5 = 1,45$.

In practice, a company can have a high proportion of imports in costs if it is simply an importer and packer of semi-ready goods, or if, directly or indirectly (through production chains), it uses a lot of imported raw materials and supplies. For such a company, a weaker ruble will mean increased costs. If the given company is a market leader (and the average proportion of imports of its competitors is lower), competitors understand that the importer's position is less favourable. The importer has to raise prices more aggressively, or else lose profits or even leave the market with losses. A large importer, in turn, acts strategically, with the knowledge that competitors are expecting it to raise prices to a greater extent, thereby losing a significant market share. However, a big enterprise has a powerful countermeasure at its disposal: a large margin. To maintain its market share, a large importer either refrains from raising prices at all or raises them to a lesser extent than is required. As a result, its margin decreases, acting as a buffer in response to an adverse shock (the blue zone in Chart 1.1). In Chart 1.1 we see that higher homogeneity of companies in terms of productivity and, consequently, equal market shares lead to the fact that the mark-up does not change in response to shocks: companies fully transfer the changes in exchange rates onto prices.

Chart 1.1 Changes in a company's No.15 mark-up according to its productivity (monopoly power) and the share of imports in costs after 45% weakening of the national currency, one year after change in the rate, p.p./100
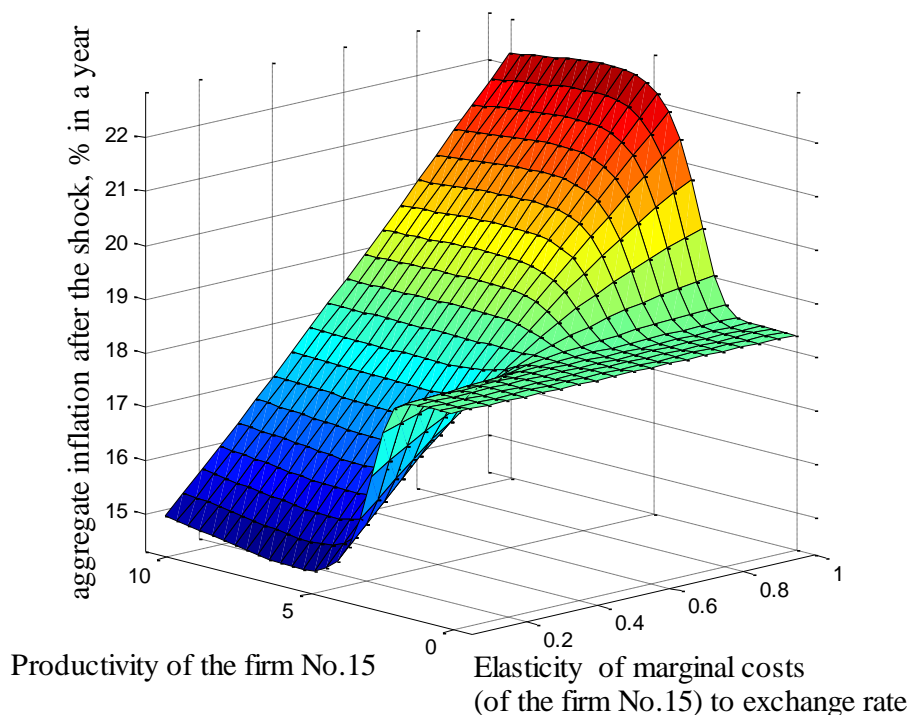

Note. Calculations using the model from [1] and the market example from Table 1.1.
Source: authors' own calculations.

When there is an importer that is an evident market leader, domestic companies tend to raise prices more than their cost growth requires: they make use of the importer's price increase, even if it is insignificant, because it is the relative price dynamics (relative to the market leader) that are important in maintaining market share. As a result, the market share of competitors can even grow. Overall price growth in the market turns out to be larger than growth in companies' import expenses dictates, i.e. despite the decreased mark-up and moderate price increase made by the market leader, all the smaller companies raise prices to a larger extent than their cost growth requires (the red zone in Chart 1.2). This occurs as a result of forced, albeit moderate, price increases made by the importer.

The pass-through effect may be stronger or weaker than in more competitive markets, where companies are all equally too small to be able to influence prices, as a result of which the pass-through effect is generally becomes complete. **Consequently, growth in prices after exchange rate shocks will be higher or lower than in a market of perfect competition** (Chart 1.2).

Chart 1.2 Dependency of industry price increase according to productivity (monopoly power) and the proportion of imports in costs after 45% weakening of the national currency, one year after the rate shock, % per year

Note. Calculations using the model from [1] and the market example from Table 1.1.
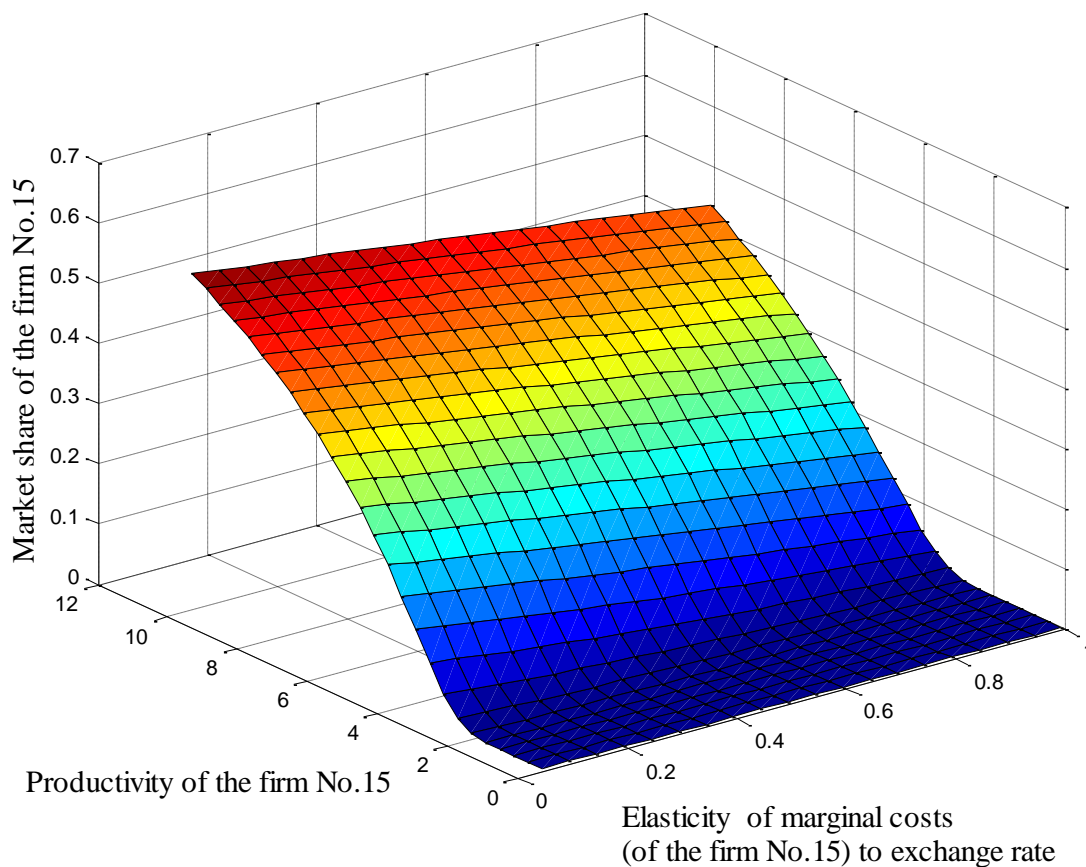*Source: authors' own calculations.*

When the market is dominated by a domestic company with a small proportion of imports in costs and its competitors (far smaller enterprises) on average have higher elasticity of costs with respect to the exchange rate, the level of inflation after weakening in the national currency (the pass-through effect) is found to be lower than in a market of perfect competition: many smaller companies actively reduce their margin trying to maintain their small share of the market[20].

Table 1.1 shows that all companies, except for the 15th, are divided into 3 groups. Due to differences in productivity, companies will take different market shares and, consequently, will have various levels of market power. According to the model, a company with high market power will have more ability to manage its mark-up in order to maintain its market share in case of cost shocks. The company will adjust its mark-up if this allows it to gain an advantage over its competitors.

---

[20] It is worth noting that this effect on the overall price level (higher inflation when the market is dominated by a single importer and lower inflation when it is dominated by a company with a low proportion of imports in costs) is caused by the market structure used in the example, which is merely illustrative and aimed to demonstrate that, despite a market leader's lower mark-up, the overall price level may increase due to aggressive price-raising activity by its smaller competitors.

Depending on the parameters, the 15th company's market share assumes the values shown in Chart 1.3.

Chart 1.3 Dependency of the 15th company's market share on productivity (market power) and proportion of imports in costs, %

Appendix 2.

For our calculations, we have used the data from the Bank of Russia's surveys of a variety of enterprises regarding their price-setting strategies. The key advantage of these data for our purposes is the ability to observe the proportion of imports in production costs of individual companies. Companies responded to the question: "What is the average proportion of imports in the total production costs (raw materials, supplies, equipment) of your goods?" by choosing one of the following ranges: 0–5, 5–30, 30–50, 50–75, and 75–100%.

However, in order to conduct the calculations, we had to assume the absence of a strong shift in industry structure (by company share in the industry market) in our sample and in the general population. We consider our sample at the industry level to be representative in terms of industry structure, which is the key company distribution necessary for us to conduct a model assessment of the pass-through effect. At the same time, the sample is biased in terms of the structure of the economy as a whole: for example, it contains only one small (in relation to the number of employees) extracting company, with the extraction of mineral resources being the key sector of the Russian economy. As we needed to get an idea of the structure of the industry, we considered only those sectors where the sample contained more than 10 companies.

Another source of bias is that the survey data did not contain any information on product types. Market boundaries are usually marked by a product type, and there can be many product types within a single type of activity. Therefore, in carrying out the calculations, taking one type of activity for an enterprise inevitably requires an assumption that the market structure is homogeneous for all product types in the sector. That is a strong assumption.

The third source of biast is related to the use of interval estimates of the proportion of import costs, instead of point estimate. In this case, the choice of the interval midpoint is a potential source of bias in the results.

However, the data on the proportion of imports in costs of individual companies is unique for Russia and allows us to calculate the pass-through effect with due regard to strategic cooperation, therefore the results should not be separated from the assumptions made for the purposes of calculation.

Table 2.1 contains a short description of sectors and their characteristics.

Table 2.1 Key characteristics of reviewed sectors

Type of activity	Average share of type of activity in GDP in 2011–2013, %	Number of companies surveyed	Average proportion of imports in costs*, %	Coefficient of variation of proportion of imports in costs**, %	Relative strength of competition from import***	Maximum share of a domestic company, including importers, %
Agriculture, fishing	3,8	57	22	91	High	4
Foodstuffs, including drinks, and tobacco	20.7	46	21	133	Weak	24
Textiles and clothing	0.2	29	51	52	Very high	10
Pulp and paper manufacturing and printing	0.2	22	13	105	Weak	10
Electrical equipment	0.8	82	12	86	Weak	5
Transport means and equipment	1.4	57	14	112	Weak	13
Leather and footwear	0.0	16	28	63	Very high	9
Chemicals manufacturing	1.1	38	25	101	High	6
Machinery and equipment	0.8	79	13	121	High	5
Furniture and other goods	0.2	20	24	77	Weak	16
Wholesale trade	9.8	20	50	79	Very high	12
Total:	39.1	466	–	–	–	–

Sources: Bank of Russia survey, authors' own calculations.

* The sector average company estimate of the proportion of imports in its costs as a reply to the question: "What is the average proportion of imports in the total production costs (raw materials, supplies, equipment) of your goods?"

** The ratio of the standard deviation of the proportion of imports to the average proportion of imports, in %.

*** The estimation methodology is described below.

Table 2.2 contains a description of data sources for the variables required for the model calculation of the pass-through effect.

Table 2.2 Data sources for the model calculations

Parameter	Description	Analogous survey data
φ_i	Elasticity of marginal costs with respect to exchange rate changes	Interval midpoint of the responses to the question: "Average proportion of imports in the total production costs (raw materials, supplies, equipment)". We assume that average and marginal costs are equal and that the marginal costs function is homogeneous
S_{it}	Company's market share $$S_{it} = \frac{P_{it}Q_{it}}{\sum_{j=1}^{N} P_{jt}Q_{jt}}$$	The only indication of a company's market share in the survey is the information on number of employees. Therefore, assuming equal prices and an exponential production function, we get $$S_{it} = \frac{L^{\alpha}{}_{it}}{\sum_{j=1}^{N} L^{\alpha}{}_{jt}}$$

We review the market of companies of one type of activity comprising both domestic companies (represented in the review) and importers (not represented in the review, as they take into account direct shipments of that sector's products to consumers from abroad). Authors of [1] faced the same issue. It is difficult to determine to what extent a domestic company is a real producer (generator of value added) and not merely a packer of imported goods.

We estimate the share of importers in the market of each type of activity using the estimated relative import competition strength. Thus, if more than 75% of respondents in the sector, having provided their estimation of import competition, indicated that competition from imported goods was 'strong' or 'moderate', and competition from other domestic producers was 'weak' or 'none', we assumed that the market share of importers was 20 p.p. higher than the share of the largest Russian company in the sample. If 50% to 75% of respondents noted relatively strong import competition, we assumed that the share of importers was 10 p.p. higher than the maximum share among domestic companies. Otherwise, we assumed that the share of importers was 5% or 10% lower than the share of the largest company. After that, in order to account for the share of importers in the market structure, we normalised the weights of all companies so that the total came to 100%.

Table 2.3 shows the model calculations (equation 32 from [1]) to estimate the pass-through effect calculated on the basis of costs, i.e. on the average proportion of imports in costs weighted according to companies' market share.

Table 2.3 Model calculations of the pass-through effect for selected products

Type of activity	Average share of type of activity in GDP in 2011–2013, %	Pass-through effect in response to 1% ruble weakening, calculated on the basis of a strategic cooperation model	Pass-through effect in response to 1% ruble weakening, calculated on the basis of the proportion of imports in costs	Product included in CPI, yes/no
Agriculture, fishing	3.8	0.25	0.28	Yes
Foodstuffs, including drinks, and tobacco	20.7	0.26	0.25	Yes
Textiles and clothing	0.2	0.51	0.56	Yes
Pulp and paper manufacturing and printing	0.2	0.17	0.17	Yes
Electrical equipment	0.8	0.16	0.17	No
Transport means and equipment	1.4	0.17	0.17	Yes
Leather and footwear	0.04	0.35	0.43	Yes
Chemicals manufacturing	1.1	0.20	0.24	Yes
Machinery and equipment	0.8	0.18	0.23	No
Furniture and other goods	0.2	0.28	0.29	Yes
Wholesale trade	9.8	0.57	0.59	No
Total pass-through effect in response to a 1% change in exchange rates	–	0.32	0.35	0.18*

* Pass-through effect calculated according to the GDP structure of sectors involved in the manufacturing of final products, i.e. those included in the CPI.

References

1. *Amiti M., Itskhoki O., Konings J.* International Shocks and Domestic Prices: How Large Are Strategic Complementareties? // NBER Working Papers 22119. National Bureau of Economic Research, Inc. 2016.

2. *Gopinath G., Itskhoki O.* Frequency of Price Adjustment and Pass-Through // The Quarterly Journal of Economics. 2010. Vol. 125 (2). P. 675–727.

3. *Krugman P.* Pricing-to-market when exchange rate changes, published in Arndt // Real-financial linkages among open economies. Cambridge, MA and London: MIT Press, 1987.

4. Exchange Rate Pass-Through to Inflation. Is Russia different? // IMF Country Report, Russia. 2015. August. No. 15/212.

Research and Forecasting Department

Andrey Sinyakov
Dmitry Chernyadyev
Arina Sapova