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Intersectoral Shadow Economic Linkages and their Impact on Tax Evasion

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ABSTRACT
The article discusses shadow economic linkages between companies from different sectors. The research hypothesis is that the multiplier effect can cause a spillover of the shadow economy from one sector to another through business connections between companies. The research methodology comprises, first, a correlation analysis of the indicators reflecting the level of informal activities in the key industries of Russia in 2011–2017; second, analysis of input-output tables to reveal the patterns inherent to intersectoral financial flows that involve sectors with a large share of shadow activities; and, third, analysis of the tax ratio in the key sectors in the given period. The correlation analysis of Rosstat's adjustment of gross value added for informal economic activities and the share of undocumented workers employed in the total number of workers in the sector has revealed a strong correlation between these indicators. It was found that such sectors as real estate, agriculture and forestry, construction, trade and hotel industry have shadow economies exceeding the average level in the country. We used the input-output balance data to reveal the close connections between the sectors with a large share of shadow activities and other sectors. Our calculations have brought to light an increase in the share of illicit transactions in some industries due to interactions with shadow sectors. This trend was particularly characteristic of such industries as transport and communications, education, health care and social services. It was also found that the tax ratio for transactions involving companies from sectors with a large share of shadow activities tended to decline due to tax evasion. These research results can be used by tax authorities to detect and monitor economic operations associated with high tax evasion risks.

KEYWORDS
shadow economy, sectors of economy, tax evasion, informal employment, tax ratio, statistics, input-output balance

JEL H26, K42

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Межотраслевые теневые экономические связи и их влияние на уклонение от уплаты налогов

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АННОТАЦИЯ
В статье исследуются теневые экономические связи между отраслями экономики. Была выдвинута гипотеза о том, что высокий уровень теневых операций, сложившийся в одной отрасли, благодаря мультипликативному эффекту вызывает рост теневых операций в других отраслях, с которыми у отрасли сформиро-

ваны устойчивые деловые связи. Методика исследования включает, во-первых, корреляционный анализ показателей уровня теневой экономики в основных отраслях экономики России за 2011–2017 гг., во-вторых, анализ таблиц «затраты-выпуск» для выявления закономерностей межотраслевых финансовых потоков с участием отраслей с высокой долей теневых операций. В-третьих, анализ налоговой отдачи основных отраслей экономики России за 2011–2017 гг. Корреляционный анализ величины корректировки Росстатом валовой добавленной стоимости на экономические операции, ненаблюдаемые прямыми статистическими методами и доли занятых в неформальном секторе в общей численности занятых по видам экономической деятельности показал высокую взаимосвязь между данными показателями. Уровень теневой экономики, превышающий средний, был выявлен в следующих отраслях: операции с недвижимостью; сельское и лесное хозяйство; строительство; торговля; деятельность гостиниц. Использование данных межотраслевого баланса позволило выявить наиболее тесные деловые связи отраслей с повышенным уровнем теневых операций с другими отраслями экономики России и доказать выдвинутую гипотезу. Проведенные расчеты выявили рост доли теневых операций за счет взаимодействия с «теневыми» отраслями у таких отраслей, как транспорт и связь; образование; здравоохранение и предоставление социальных услуг. Выявлено снижение налоговой отдачи в сделках, в которых принимают участие отрасли с повышенным уровнем тенезации, вследствие уклонения от уплаты налогов участниками таких сделок. Полученные результаты могут быть использованы налоговыми органами для отслеживания экономических операций, отличающихся повышенным риском уклонения от уплаты налогов.

КЛЮЧЕВЫЕ СЛОВА
теневая экономика, отрасли экономики, уклонение от уплаты налогов, неформальная занятость, налоговый коэффициент, статистика, межотраслевой баланс

1. Introduction

The underground economy is a pervasive feature of countries across the world. In their transactions, companies seek to escape state control, resorting to semi- or altogether illegal forms of commerce. Nevertheless, the size of the shadow economy varies significantly across different groups of countries. In developed countries such as Switzerland, the USA and Japan, the size of the shadow economy is comparatively small – it accounts for 7–8% of GDP (see Fig. 1). In developing countries, including post-Soviet states such as Russia, Ukraine, Belarus, Kazakhstan, the shadow economy is much larger – 30–40% of GDP. In low-income countries such as Zimbabwe and Haiti, the shadow sector is flourishing and makes up over a half of these countries' GDP.

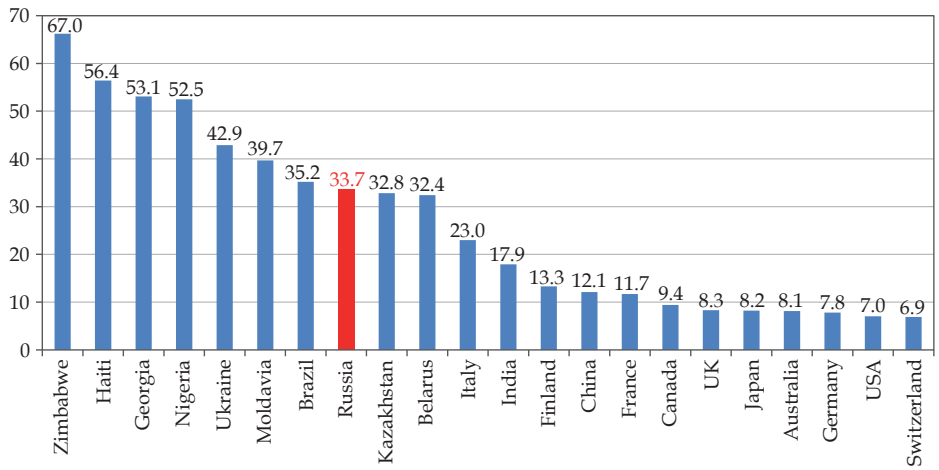

Fig. 1. **Size of the shadow economy in different countries in 2015, % of GDP [1, p. 69–76]**

Apart from the differences in the size of the shadow economy in developed and developing countries, there are also different reasons why companies move into the shadow sector. In developing countries, the main reasons are the lack of stable institutions regulating market relations; bureaucracy and corruption; and the high tax burden. In such conditions, businesses gain a substantial cost advantage by avoiding taxes and regulations despite the constraints associated with undocumented activities such as the lack of access to credit markets, state and municipal orders, and so on.

In developed countries, the situation is different – they generally have a good institutional environment for doing business while developed market relations make legal activities more beneficial than 'hiding in the shadows', outweighing the advantages of tax evasion. Some activities, however, cannot be formalized, especially in developed countries. These include organized crime – there are well-known examples of mafia groups operating in the USA, Italy and Japan, whose income largely remains unreported. Moreover, developed countries attract a lot of illegal migrants, who are employed under the table and whose activity also goes unreported. Shadow activities, however, are reflected in the macro-economic data included in national accounting and thus detected by national accounts statisticians.

No national economy is heterogeneous as far as the shadow economy is concerned and the size of the shadow economy may vary from sector to sector, it may also depend on the nature of the business: in some spheres, the advantages of illegal activities outweigh the disadvantages while in others, it is more profitable to operate legally than to dodge tax liabilities by moving into the shadows. In some spheres, illegal activities are all but impossible: for example, there is a common view that in state and municipal administration, the share of the shadow economy is negligible.

The shadow economy negatively affects national economic development because it results in the loss of tax revenues and creates conditions conducive to terrorist and criminal activities. As the shadow economy spreads more widely, it starts to transform the institutional norms of doing business and thus unregistered activities become the rule rather than the exception.

This study aims to bring to light the differences in the extent and amount of unreported activities in various sectors of economy and identify the sectors characterized by the largest proportion of such activities as well as the reasons behind this situation. An important part of this study consists of the analysis of financial flows between the sectors with a significant portion of shadow transactions.

Our hypothesis is that intersectoral linkages involving sectors with a large share of shadow activities lead to increasing 'shadowization' (shadow economy growth) of national economy. If a sector has a large share of shadow activities (a high degree of shadowization), it may influence other sectors due to a multiplier effect. Furthermore, financial flows between the sectors with a large share of shadow activities make the non-observed economy more stable in these sectors, as companies find it more convenient to do business through cash transactions that leave no record. In its turn, the cash they use for these ends also comes from unregistered transactions with other companies. Such business transactions are usually accompanied by tax evasion, since, in case of long-lasting business contacts, partner companies have more mutual trust and tend to be more willing to take the risks associated with illegal operations and concealment of the tax base. All of the above makes it a pertinent task to study economic connections involving shadow sectors as it would allow tax authorities to detect operations with higher risks of tax evasion and monitor them more closely.

2. Sector-specific approach to studying the shadow economy

The shadow economy is a long-standing problem, which has attracted considerable scholarly attention. However, most studies focus on the aggregate shadow

economy and comparatively little attention has been given to shadow activities in individual sectors, which can be explained by the lack of the relevant sector-specific data. While state statistical agencies regularly publish the national accounts information that can be used to estimate the overall size of the shadow economy, there are relatively few indicators that characterize the size of specific shadow sectors.

Guidelines for measuring the non-observed economy in specific sectors are provided by the handbook published in 2012 by the OECD, ILO, IMF, and the International Statistical Committee of the Commonwealth of Independent States[1]. In 2008, the United Nations Economic Commission for Europe made a survey of practices of measuring the non-observed economy (NOE) in national accounts[2]. A more recent survey of methods used for measuring the NOE in different institutional sectors was published by the OECD (2012). The survey relies on the ISIC – International Standard Industrial Classification of All Economic Activities. The NOE can be estimated in terms of size and sector (2012) (according to the Eurostat's tabular approach to estimating the production output in the structure of national accounts[3]) (for an example of the 2012 OECD report[4]).

One of the widely cited international studies containing comprehensive data on this topic is the study of Friedrich Schneider (2012) [2], who uses different sources of information to estimate the size of the shadow economy. As the analysis of current research literature shows, direct methods appear to be the most applicable to measure the size of the shadow economy on the level of individual sectors: such studies were conducted by P.M. Smith for Canada [3], C. Williams for the UK [4], and T. Putnins and A. Sauka for Latvia [5]. B. Nastav proposes to estimate the size of the shadow economy in Slovenia [6] by looking at GDP structure.

Some sectors of unobserved economy attract more scholarly attention. For example, J. Kocjančič and Š. Bojnec [7] concentrate on the *forestry* sector. They study the influence of staff reductions and the shrinking size of large companies on the shadow economy in Slovenia. For their estimates they rely on the data provided by B. Nastav [6]. *Extraction of mineral resources*, including artisanal or small-scale mining, which is mostly spread in developing countries, is discussed in the widely cited report published by T. Hentschel et al. [8]. Snowdon analyzes the situation in the sphere of *alcohol manufacture and sale* [9] (we believe, however, that following the OECD classification, the sale of counterfeit alcohol should be classifed as an illegal rather than shadow activity). L. Burroni et al. [10] investigate the situation in the *textile and clothing industry* and highlight the factors shaping the shadow activities of small and medium-sized enterprises in central Poland and southern Italy. O. Cooke et al. [11] consider shadow activities in *construction* in one of the US states by analyzing a set of parameters and propose to estimate the size of the shadow economy as the average of the 'conservative' and 'more aggressive' estimates. The conservative estimate assumes that the size of the shadow construction sector is proportional to this sector's share of total state GDP while the more aggressive estimate, assumes that the size of the shadow economy is twice the construction sector's share of total state GDP. Other

[1] *Measuring the non-observed economy: A Handbook*. Paris, OECD Publishing. 2002. DOI: 10.1787/9789264175358-en; *Measuring the non-observed economy: A Handbook*. 2002. (In Russ.) Available at: https://www.gks.ru/metod/izmer.pdf

[2] *Non-observed economy in national accounts. Survey of country practices*. New York and Geneva, UN, 2008. Available at: http://www.unece.org/fileadmin/DAM/stats/publications/NOE2008.pdf

[3] *Eurostat's tabular approach to exhaustiveness. Guidelines*. Eurostat/C1/GNIC/050 EN. 2005. Available at: http://www.dst.dk/ext/739814884/0/intconsult/Annex-C1a-Eurostat-Guidelines-Tabular-Approach-part-1-2_ENG---pdf; *Summary of the OECD survey on measuring the non-observed economy*. STD/CSTAT/WPNA (2012)21. 2012. Available at: http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=STD/CSTAT/WPNA(2012)21&docLanguage=En

[4] *Reducing opportunities for tax non-compliance in the underground economy. Information note*. 2012. January. Available at: www.oecd.org/tax/forum-on-tax-administration/publications-and-products/sme/49427993.pdf

sectors include *finance*, in particular the so-called 'shadow banking' [12]; *health care* (J. Kornai [13] gathered quantitative data on gratitude payments to doctors in the health care sector through a series of surveys in Hungary); *tourism* (O. Kesar and K. Čuić [14] analyze the factors that determine the shadow tourism sector; these authors also provide an overview of the previous research on this topic and formulate recommendations for reducing the size of the shadow economy in this sector); and the *do-it-yourself activities* (A. Buehn et al. [15] estimate the size and development of the shadow economy and DIY activities in Germany by applying the MIMIC-method).

Since the shadow economy is mostly associated with tax evasion, its size is reflected in the tax evasion and tax fraud figures reported by tax authorities. It is this connection between the shadow economy and tax crime that underlies the method of tax audit used to measure the size of the shadow economy. To estimate the mutual influence between the indicators characterizing the size of the shadow economy and the level of economic crime, we conducted a correlation analysis in our previous research (see A. Kireenko et al. [16]). The results point to a strong connection between the following indicators (significant at the level of 0.05)

– 'Adjustment of the sector's GDP for the NOE' (financial indicator, %) and 'Economic crime damage/sector's gross value added (GVA)' (financial indicator, %);

– 'Adjustment of the sectors' GDP for the NOE' (financial indicator, %) and 'Number of tax crimes per 1,000 workers employed in the sector' (quantitative indicator, units);

– 'Number of tax crimes per 1,000 workers employed in the sector' (quantitative indicator, units) and 'Number of registered tax evasion crimes per 1,000 workers employed in the sector'. This connection was demonstrated by our analysis of the statistical data from the 'Consolidated Statistics on Convictions in Russia': we found that the proportion of people convicted for tax evasion was 53.7% of the total number of tax crimes in 2017.

We believe that the indicator 'Number of tax crimes per 1,000 workers employed in the sector' can be used for measuring the size of the shadow economy. We found that there is a moderate connection between the 'Economic crime damage/sector's GVA' and the 'Number of tax crimes per 1,000 workers employed in the sector'. In our view, criminal statistics can provide us with a more accurate picture of the shadow economy than the financial data, which depend on a multitude of factors subject to change throughout the year.

Regarding Russia and its neighbours, the current research includes the study of S. Kyurzhiev et al. [17], who developed an econometric regression mathematical model for calculating the degree of shadowization in different sectors. Their methodology relies on the evaluation of connections between nominal GDP growth amount and the amount of cash in the money supply. Their results have shown that in 2007–2017, the largest share of the shadow economy in Russia was observed in construction with the shadowization coefficient of 47.3%; followed by transport and communications (28.3%). In the manufacturing sector and agriculture, the size of the shadow economy was relatively small – 6.3% and 5.9% respectively.

A. Abroskin and N. Abroskina developed a methodology for measuring the shadow economy in different sectors by estimating the ratio of the dynamics of value added to the dynamics of manufacturing costs. They believe that 'a decline in resource intensity (energy, electricity, materials, metal, and so on) is likely to lead to a decrease in the scale of actual production costs in the sector and, therefore, the corresponding adjustments for shadow activities should be raised' [18, p. 94]. They found that in Russia the sectors with the largest shares of shadow activitity are agriculture, retail and wholesale trade, land transport, accommodation and food industry, extraction of raw hydrocarbons.

R. Shumyatsky and D. Terre calculated the contribution of specific sectors to the country's GDP and assessed the profitability of production within each sector

[19]. However, since no calculations are provided, it prevents us from retesting the results of the ranking regarding the amount of illicit activities in different sectors of the Russian economy. What raises doubt is the fact that the shadow industry ranking is headed by extraction of mineral resources and manufacturing.

A. Polovyan and M. Zanizdra developed a methodology for calculation of coefficients of the shadow sectors in different industries of Ukraine by building a logistic dependency between the coefficient and the quantitative value of the national economy in Doing Business Ranking of Economies. As a result, it was found that the largest shadow sectors in 2014 were found in construction, trade, machine engineering and coal extraction [20].

In Russia, informal activities are especially widely spread in agriculture, which is explained by the following: 'the limited inflow of available market assets; lack of financial market for the agricultural sector; severe competition between shadow agents of market relations for possession of the land resources belonging to the existing agricultural organizations and enterprises with a weak production capacity; and, finally, a large number of hidden in-kind transactions' [21, p. 55]. According to B. Voronin and A. Mitin, the shadow agriculture sector is generated by 'a large number of sale and purchase cash transactions. Moreover, the established model of management in agriculture in Russia is the "iron-hand" model characterized by suppression of competition' [22, p. 12].

Agriculture is closely connected to forestry, which also has a large shadow economy. Forestry, in its turn, has its own factors contributing to this situation: 'high taxes on logging operations, resulting in unequal economic conditions for timber companies. The tax burden on large businesses in forestry is heavier than on medium- or small-sized businesses. The second factor is recession in local economies and the slowdown of global economic growth. Moreover, it's easier for companies to operate in the informal sector. As for the business factors, these include increased pressure on forestry business, severe market competition and the growing number of independent workers' [23, p. 712].

There is a widely spread view among Russian economists that tourism and hotel industry have large shadow sectors (N. Zaitseva [24], I. Glazyrina and A. Peshkov [25], Y. Levina et al. [26]). M. Bedanokov and M. Nizaeva contend that this situation is especially typical of the tourism industry in Chechnya: 'the factor impeding the development of the tourism and recreation sector in the Chechen Republic is the high share of the shadow economy'. According to Rosstat, as of the end of 2014, in Chechnya there were registered 9.7 thousand firms. However, the financial performance data are available only for 1.2 thousand. Interestingly, just 15 of them had the revenue over 1 billion roubles in 2014 and 125 firms had the revenue over 1 million per year' [27, p. 19]. M. Bedanokov and M. Nizaeva consider this situation peculiar to Chechnya, which has an unfavourable public image and still suffers from the consequences of the North Caucasus Conflict. There are other studies showing that a large shadow tourism sector exists in other regions as well. For instance, the shadow tourism sector in the Republic of Crimea invariably remains at the level of 70% [28].

Another sphere with a large share of shadow activities is construction, which may be a natural reaction to high risks in this kind of business, since it is dependent on a number of unpredictable factors throughout the long investment cycle, which is typical of construction [29].

There is evidence that the oil and gas shadow sector in Russia is also large. 'Shadow economic activities at the stage of oil and gas extraction occur primarily in the form of illegal entrepreneurship, theft of oil and gas and other activities linked to illegal sale of oil' [30, p. 37]. Other examples of shadow operations in the oil and gas sector include the following: 'tax evasion by selling finished products as semi-finished; extraction of raw hydrocarbons above the limits set by federal exploration licenses to obtain excessive profits; usage of shell firms and in-house transfer pri-

ces by vertically-integrated companies to minimize their tax liabilities' [31, p. 198].

Some researchers attempt to estimate the size of shadow redistribution of financial flows between different sectors of economy: for example, V. Adviysky and V. Bezdenezhnykh consider different ways of measuring financial flows in the shadow economy and draw a scheme of interactions between the open economy and the criminal sector of the shadow economy. However, they failed to find out the amount of shadow financial flows and the amount of the shadow intersectoral redistribution of financial resources, explaining that 'it is hard to estimate the real size of the shadow economy due to the lack of access to the data reflecting the way it actually operates. The error may be tens of percents or even differ severalfold from the actual shadow economy in its various forms' [32, p. 13–14].

E. Baturina and A. Litvinenko conducted a micro-economic analysis of shadow financial flows through marker monitoring of these flows with the help of computer modelling tools. This methodology is used in forensic investigation of economic crimes. It is based on the analysis of the movement of money through the bank accounts of suspected individuals. However, in our view, this methodology alone can give only a fragmented picture of shadow financial flows since it requires prior knowledge about the participants of illegal transactions in order to mark their banking operations. It means that the majority of shadow financial flows will escape monitoring, especially those that do not involve credit organizations [33].

The perceived lack of effective methodology to estimate the intersectoral redistribution of shadow funds means that it is necessary to develop new approaches to address this research gap.

3. Methodology

The Federal State Statistics Service of Russia (Rosstat) uses only two indicators to measure the size of the shadow economy in different sectors:

1) share of undocumented workers in total employment;

2) adjustment of GVA for the NOE.

Rosstat calculates the share of workers employed in the informal sector by using sample surveys of the labour force. Workers in the informal sector are people employed at least in one production unit in the informal sector (that is, enterprises not registered as legal entities) in the given period.

Rosstat's adjustment of GVA values for the NOE gives us a clue as to the amount of illicit activities in the country. To make such adjustment, Rosstat analyzes the indicators absent from the official statistics based on the reports of companies and authorities. This is done by applying the balancing method to compare the macro-economic parameters of the Russian economy.

Table 1 shows the data on undocumented workers in total employment in Russia in 2009–2017. Such sectors as agriculture and forestry, trade, construction, accommodation and food services, storage and transportation had the highest figures of informal employment in Russia. In these sectors, the share of informal employment usually exceeded the average level for Russia.

Table 2 shows the NOE data measured by Rosstat through the adjustment of GVA for informal economic activities. The largest proportion of the NOE is characteristic of real estate, agriculture and forestry, accommodation and food services, construction. The sectors with the largest proportion of the NOE are practically the same as those with the highest levels of informal employment (see Table 1), with an exception of trade, where the share of the NOE is lower than the average level in Russia.

To test the comparability of different shadow sectors by applying the two methods described above, we analyzed the correlation between the share of the shadow economy and the percentage of undocumented workers (see Table 3). The coefficient of the correlation between the given indicators normally exceeded 0.5, which signifies a positive correlation. The value of the correlation coefficient was relatively low only in 2017, when it was

0.3036 due to the fact that the share of the NOE was higher than normal in real estate. Otherwise, the correlation coefficient would as usual exceed 0.5.

Our analysis has revealed the industries with the highest level of shadow activity in the Russian economy. The largest shadow economy is predictably found

Table 1

Share of undocumented workers in total employment in Russia in 2009–2017, %

№	Sectors	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Agriculture, forestry, hunting, fisheries and aquaculture	67.0	61.7	67.6	68.3	69.7	69.9	71.6	74.7	56.7
2	Extraction of mineral resources	1.2	0.8	1.0	1.2	1.4	1.4	1.5	1.6	1.9
3	Manufacturing	10.8	8.9	9.9	11.3	12.1	12.2	12.7	13.7	13.3
4	Energy, gas and steam supply, air conditioning	1.4	1.2	1.4	1.2	1.5	1.7	1.7	1.5	1.4
5	Construction	25.6	23.1	25.1	26.5	29.0	30.8	31.7	31.8	31.6
6	Wholesale and retail trade; repairs of vehicles and motorcycles	42.5	34.6	38.4	40.2	40.6	40.6	40.8	41.2	40.5
7	Accommodation and food services	20.6	16.3	19.3	22.7	24.1	25.3	26.2	27.8	28.6
8	Transportation and storage	18.0	15.8	17.2	18.5	19.9	21.0	21.2	22.6	22.9
9	Finance and insurance	2.2	1.8	1.7	1.9	1.9	2.4	2.4	2.3	2.2
10	Real estate	6.2	5.3	5.9	6.1	6.6	7.9	8.1	7.0	7.6
11	Education	1.5	1.1	1.2	1.2	1.4	1.6	1.7	2.2	2.2
12	Health care and social services	2.0	1.7	1.8	1.9	2.0	2.3	2.2	2.7	3.4
	Total	19.3	16.4	18.2	19.0	19.7	20.1	20.5	21.2	19.8

The table is compiled by the authors by using the data from: *Labour Force, Employment and Unemployment in Russia (Sampling Observation Data). 2018: Statistical Yearbook/Rosstat*. Moscow; 2018, pp. 48, 95.

Table 2

Adjustment of GVA for the NOE (% of GVA, by sector) in 2011–2017

№	Sectors	2011	2012	2013	2014	2015	2016	2017
1	Agriculture, hunting and forestry	57.3	55.3	56.2	46.6	43.0	38.7	38.1
2	Extraction of mineral resources	0.4	0.6	0.6	0.6	0.6	0.8	0.7
3	Manufacturing	7.2	8.7	8.5	7.7	4.8	5.9	5.9
4	Production and distribution of electricity, gas, and steam	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	Construction	14.2	12.7	14.6	15.7	18.6	17.0	15.8
6	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	8.8	10.8	11.4	11.5	8.0	9.1	10.3
7	Accommodation and food services	18.3	11.7	10.8	10.6	16.9	16.5	16.9
8	Transport and communications	8.9	9.0	6.7	6.8	4.6	4.3	4.2
9	Finance	1.0	0.8	1.1	1.1	1.3	1.2	1.1
10	Real estate, renting and business activities	52.7	52.9	48.3	46.8	45.0	45.0	70.6
11	Education	2.4	5.0	5.1	5.0	6.4	5.4	4.4
12	Health care and social services	5.0	3.7	2.9	2.8	2.6	2.5	3.0
	Total	14.6	14.8	14.3	13.8	13.2	13.2	12.7

Compiled by the authors by using the official data of Rosstat (http://www.gks.ru)

Table 3

Correlations between the share of the NOE and share of undocumented workers in Russia in 2011–2017

	2011	2012	2013	2014	2015	2016	2017
Coefficient of the correlation between the share of the NOE and share of undocumented workers	0.6133	0.5896	0.6348	0.6020	0.5835	0.5409	0.3036

Compiled by the authors by using the official data of Rosstat (http://www.gks.ru)

in the real estate sector since property owners have ample opportunities for engaging in undocumented real estate sales and rental transactions. Leaving some transactions unregistered does not inhibit the development of their business.

Large shadow sectors are found in agriculture and forestry. A lot of production operations of agricultural firms may go unregistered. These organizations, however, have to report their performance if they apply for a bank loan. They also use a part of their production for their own needs. Official statistical reports normally feature the physical indicators such as animal and plant production values, which agricultural companies do not need to hide. The value indicators on GVA, however, are not always included in the official statistics.

Construction traditionally has a large informal sector. Construction companies tend to employ low-qualified workers, including undocumented migrants, in order to dodge social security contributions. Moreover, construction companies are often used by third parties in their fraudulent encashment practices for it may be quite difficult to verify the actual costs of construction works.

Such parts of the services sector as trade and hotel industry often use cash transactions, which are particularly convenient if a company intends to withdraw from the formal sector and move into the shadows.

It should be noted that not only in Russia but also in Europe the above-described sectors have a high share of shadow activities. Figure 2 illustrates the results of Friedrich Schneider's study of EU countries, highlighting the sectors with the highest proportions of shadow activity. In Europe, the size of the shadow economy in agriculture and forestry as well as in real estate is slightly smaller than in Russia. On the other hand, in European countries, manufacturing, transport, health care and utility services have a larger informal sector than in Russia.

In the following sections, we are going to consider economic linkages and financial flows between the sectors with the highest proportion of shadow activities and other sectors of Russian economy. The following industries have the largest shadow sectors:

1) real estate;
2) agriculture and forestry;
3) construction;
4) trade;
5) hotel industry.

For each of them, we analyzed the financial flows related to purchase of goods, works and services by organizations belonging to these sectors from organizations from other sectors. Such operations were classified as belonging to the primary financial flows. Then we analyzed the financial flows associated with the supply of goods, services and works by organizations of the five sectors identified above to organizations from other sectors. These operations were classified as belonging to the secondary financial flows. Our research relies on the data from

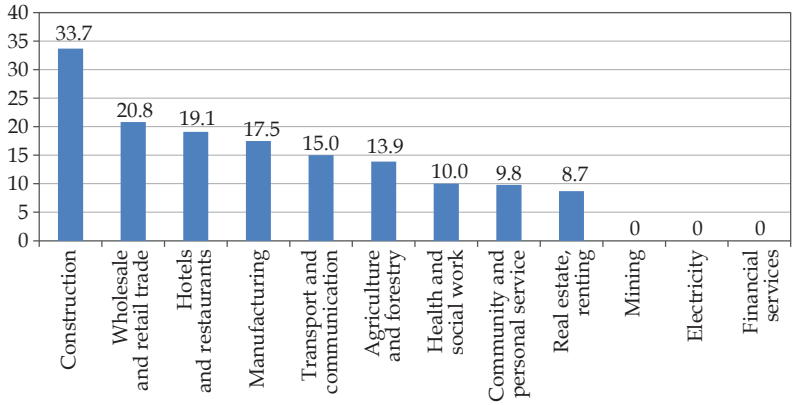

Fig. 2. **Sectors with the highest levels of shadow activity in Europe, % of GDP [2]**

the input-output tables compiled by Rosstat on the basis of current and capital expenditures of different types of economic entities. Input-output tables contain the data about the intersectoral redistribution of products (goods, works and services). The most recent data can be obtained from the input-output tables published on the official website of Rosstat.

4. Results

Analysis of Rosstat's input-output tables has led us to identify the following characteristics and trends of intersectoral financial flows. First, we analyzed the financial flows between the five sectors with a large proportion of shadow activities (see Table 4). As Table 4 illustrates, these sectors include primarily real estate and agriculture and forestry. In 2017, 44.6% of economic operations of real estate companies were conducted with companies from the other sectors in our list; in agriculture and forestry, such operations accounted for 40.7%, which means that a substantial part of operations, including cash operations, in these sectors went undocumented. The other sectors – construction, trade, and hotel industry – have much less business connections: for example, the hotel industry accounted for 28.7% economic operations; trade, 24.5%; and construction, only 7.0%. This means that a significant part of operations in these sectors were legal as long as the counterparties to these transactions avoided doing business 'in the shadows'.

Second, we analyzed the primary financial flows involving sectors with a large proportion of shadow activities and other sectors. Table 5 shows the groups of industries which supply most goods, works and services (not less than 5%) for the five sectors identified above. The secondary financial flows were analyzed in a similar way. Table 6 shows the groups of industries which supply most goods, works and services for the five sectors. Comparing the data in Tables 5 and 6, we found a certain imbalance between the primary and secondary financial flows in trade. More than a half of the financial flows (51.3%) of trade organizations are payments for commercial services provided by other trade organizations, for example, retail stores pay wholesale companies for the delivery of goods. Only 5.6% of services provided by trade organizations were the services rendered to other trade organizations. This can be explained by the fact that when trade organizations purchase goods, works and services, they tend to make large payments (20.6 trillion roubles in 2017), while the amount of services rendered was much smaller (1.3 trillion roubles in 2017).

Based on these data, we drew a scheme of intersectoral financial flows (see Fig. 3). Construction and trade companies accounted for the majority of economic linkages (12 in 2017) (see Table 7), which raises concerns about the ineffective use of public funds since the counterparties of

Table 4

Intersectoral purchases of goods and services by sectors with a high share of shadow activities in 2017, bln rbs

Products manufactured by the sector	Sectors of economy (according to the 'Russian National Classifier of Types of Economic Activity)					
	Agriculture, forestry, hunting, fisheries and aquaculture	Construction	Trade	Accommodation and food services	Real estate	Intermediate demand, total
Agriculture, forestry, hunting, fisheries and aquaculture	1224.7	6.1	13.7	74.8	1.9	**4052.8**
Construction	18.8	314.6	94.7	18.5	290.8	**2434.1**
Trade	39.8	14.9	499.3	0.6	5.0	**972.4**
Accommodation and food services	0.9	15.0	18.5	4.0	1.1	**327.8**
Real estate	15.1	95.8	1553.3	167.8	842.9	**4952.3**
Intermediate consumption, total	**3191.1**	**6378.5**	**8899.8**	**925.2**	**2561.9**	**83159.0**

Compiled by the authors by using the official data of Rosstat (http://www.gks.ru)

construction and trade companies include public sector organizations, for example, those operating in the sphere of public administration and defense, social security, health care, and education.

Our analysis of intersectoral financial linkages has revealed the multiplier effect from economic operations involving organizations from sectors with a large share of shadow activities. Tables 8 and 9 show the calculated arithmetic mean of the degree of shadowization in mutual settlement of accounts involving the five 'problem industries' in 2017. In this case, we assumed that involvement of organizations from different sectors in economic transactions led to spreading of the shadow economy to these sectors. In other words, in those sectors that had business connections with the 'problem sectors', the share of informal activities was likely to start growing as well. For example, for trade organizations with connections to real estate organizations, the share of shadow activities is expected to rise to 40.5% in primary financial flows while for hotels with connections to organizations from the agricultural and forestry sector, to 27.5% (see Table 8). The degree of shadowization already accumulated in the secondary financial flows (see Table 9)

Table 5

Sectors supplying most goods, works and services to sectors with a high share of shadow activities in 2017 (primary financial flows)

№	Agriculture, forestry, hunting, fisheries and aquaculture		Construction		Trade		Accommodation and food services		Real estate	
	Industries supplying the largest amount of products to shadow sectors	Share in total supply, %	Industries supplying the largest amount of products to shadow sectors	Share in total supply, %	Industries supplying the largest amount of products to shadow sectors	Share in total supply, %	Industries supplying the largest amount of products to shadow sectors	Share in total supply, %	Industries supplying the largest amount of products to shadow sectors	Share in total supply, %
1	Agriculture, forestry, hunting, fisheries and aquaculture	38.4	Non-metallic mineral product manufacturing	17.3	Land and pipeline transport	21.8	Food products, beverages and tobacco	38.0	Real estate	32.9
2	Food products, beverages and tobacco	14.4	Finished metal products, except for machinery and equipment	12.2	Real estate	17.5	Real estate	18.1	Electricity, gas and steam supply	14.0
3	Manufacture of coke and refined petroleum products	9.6	Metallurgical production	10.2	Warehousing and storage services, supporting and auxiliary transport activities	8.6	Agriculture, forestry, hunting, fisheries and aquaculture	8.1	Construction	11.3
4	Manufacture of chemicals and chemical products	8.5	Manufacture of rubber and plastic products	7.8	Trade	5.6				
5			Industrial machinery and equipment	5.4	Advertising and marketing	5.3				

Table 6

Industries consuming most goods, works and services supplied by sectors with a high share of shadow activities in 2017 (secondary financial flows)

№	Agriculture		Construction		Trade		Accommodation and food services		Real estate	
	Sectors consuming the largest amount of products supplied by shadow sectors	Share in aggregate demand, %	Sectors consuming the largest amount of products supplied by shadow sectors	Share in aggregate demand, %	Sectors consuming the largest amount of products supplied by shadow sectors	Share in aggregate demand, %	Sectors consuming the largest amount of products supplied by shadow sectors	Share in aggregate demand, %	Sectors consuming the largest amount of products supplied by shadow sectors	Share in aggregate demand, %
1	Food products, beverages and tobacco	59.5	Public administration and defence; social security	27.5	Trade	51.3	Public administration and defence; social security	30.4	Trade	31.4
2	Agriculture, forestry, hunting, fisheries and aquaculture	30.2	Construction	12.9	Public administration and defence; social security	8.2	Health care	6.4	Real estate	17.0
3			Real estate	11.9	Land and pipeline transport	6.2	Education	6.3	Land and pipeline transport	11.0
4			Extraction of mineral resources	8.5			Trade	5.6		
5			Health care	5.3						

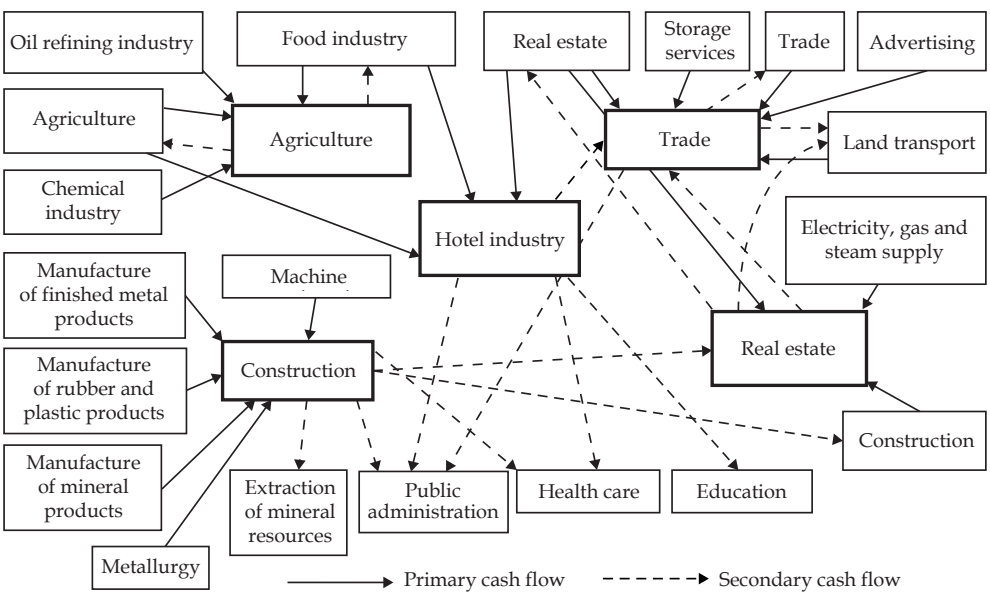

Fig. 3. **Intersectoral cash flows involving the sectors with a large share of shadow activities in 2017**

may lead to a rise in shadowization in the food industry through the connections of food companies with companies in the forestry and agriculture sector; in trade and transport, through connections with trade companies; in the hotel industry, through connections with trade companies; in health care and education, through connections with hotels and food companies; in trade and transport, through connections with real estate firms.

Thus, it would be logical to assume that business linkages involving sectors with a large share of shadow activities should attract more attention of tax authorities since these linkages may involve companies that are more prone to engaging in shadow economic activities.

Our results lead us to suppose that the tax ratio for the economic operations involving sectors with a large share of shadow activities should be lower. This indicator is used by tax authorities in Ukraine in the assessment of taxpayers when drawing tax inspection plans. Special attention is given to those taxpayers whose tax ratio for certain taxes is lower than the average level in the industry. In macroeconomic terms, the tax ratio corresponds to the tax burden and is calculated as the ratio of the amount of taxes paid by a certain number of taxpayers (in a region, sector or country in general) to GVA produced by these economic entities (or the gross domestic product if taken on a nationwide scale). The actual values of the tax ratio for different sectors of the Russian economy for 2011–2017 are shown in Table 10. In 2017, the tax ratio was higher than in 2016, which can be explained by the fact that in 2017, insurance contributions star-ted to be taken into account by the tax authorities when calculating the total amount of tax payments.

Table 7

Financial linkages between sectors with a large share of shadow activities and other sectors in 2017

№	Sector of economy	Number of financial linkages involving sectors with a large share of shadow activities		
		Suppliers	Consumers	Total
1	Agriculture, forestry, hunting, fishing	2	4	6
2	Food products, beverages and tobacco	2	1	3
3	Manufacture of coke and refined petroleum products	1	0	1
4	Manufacture of chemicals and chemical products	1	0	1
5	Non-metallic mineral product manufacturing	1	0	1
6	Finished metal products, except for machinery and equipment	1	0	1
7	Metallurgical production	1	0	1
8	Manufacture of rubber and plastic products	1	0	1
9	Industrial machinery and equipment	1	0	1
10	Construction	6	6	12
11	Land and pipeline transport	1	2	3
12	Real estate	5	3	8
13	Warehousing and storage services, supporting and auxiliary transport activities	1	0	1
14	Trade	4	8	12
15	Advertising and marketing	1	0	1
16	Accommodation and food services	4	3	7
17	Public administration and defence; social security	0	3	3
18	Health care	0	2	2
19	Education	0	1	1
20	Extraction of mineral resources	0	1	1
21	Energy, gas and steam supply, air conditioning	1	0	1
	Total	34	34	68

Table 8

Arithmetic mean value of the degree of shadowization in transactions involving sectors with a large share of shadow activities in 2017, % of GVA in the corresponding sector, in primary cash flows

№	Agriculture, forestry, hunting, fisheries and aquaculture		Construction		Trade		Accommodation and food services		Real estate	
1	Agriculture, forestry, hunting, fisheries and aquaculture	38.1	Non-metallic mineral product manufacturing	10.9	Land and pipeline transport	7.3	Food products, beverages and tobacco	11.4	Real estate	70.6
2	Food products, beverages and tobacco	22.0	Finished metal products, except for machinery and equipment	10.9	Real estate	40.5	Real estate	16.9	Electricity, gas and steam supply	35.3
3	Manufacture of coke and refined petroleum products	22.0	Metallurgical production	10.9	Warehousing and storage services, supporting and auxiliary transport activities	7.3	Agriculture, forestry, hunting, fisheries and aquaculture	27.5	Construction	43.2
4	Manufacture of chemicals and chemical products	22.0	Manufacture of rubber and plastic products	10.9	Trade	10.3				
5			Industrial machinery and equipment	10.9	Advertising and marketing	13.6				

Note: the industries where the level of shadowization has risen due to the multiplier effect of linkages with the shadow sectors are highlighted in yellow.

Table 9

Arithmetic mean value of the degree of shadowization in transactions involving sectors with a large share of shadow activities in 2017, % of GVA in the corresponding sector, in secondary cash flows

№	Agriculture, forestry, hunting, fisheries and aquaculture		Construction		Trade		Accommodation and food services		Real estate	
1	Food products, beverages and tobacco	30.1	Public administration and defence; social security	7.9	Trade	25.4	Public administration and defence; social security	8.5	Trade	55.6
2	Agriculture, forestry, hunting, fisheries and aquaculture	38.1	Construction	15.8	Public administration and defence; social security	5.2	Health care	10.0	Real estate	70.6
3			Real estate	43.2	Land and pipeline transport	8.8	Education	10.7	Land and pipeline transport	39.0
4			Extraction of mineral resources	8.3			Trade	28.7		
5			Health care	9.4						

Note: the industries where the level of shadowization has risen due to the multiplier effect of linkages with the shadow sectors are highlighted in yellow.

Table 10

Tax ratio in sectors of the Russian economy in 2011–2017 (ratio of taxes paid to GVA), %

Sector of economy	2011	2012	2013	2014	2015	2016	2017
Agriculture, hunting and forestry	2.5	2.1	2.1	2.4	2.6	2.6	8.2
Extraction of mineral resources	55.5	56.4	55.3	60.3	59.5	52.2	59.0
Manufacturing	24.3	24.5	25.8	24.9	24.0	27.2	37.4
Production and distribution of electricity, gas, and steam	17.8	15.3	17.0	18.5	19.4	22.1	34.3
Construction	13.0	13.4	13.1	13.0	12.6	14.1	19.6
Wholesale and retail trade	11.1	13.1	11.1	12.0	12.4	12.9	21.1
Accommodation and food services	14.0	12.7	13.6	13.0	13.1	14.8	22.2
Transport and communications	18.7	17.8	13.7	14.5	13.8	13.9	21.2
Finance	22.8	20.4	19.1	19.0	18.8	24.0	33.0
Real estate	12.2	10.1	9.8	10.5	11.5	11.9	7.9
Education	12.8	13.5	14.3	14.7	15.1	15.0	31.2
Health care and social services	8.3	8.7	8.8	8.2	8.6	8.4	26.4
Total	18.7	18.6	17.7	18.3	18.3	18.6	27.6

Compiled by the authors by using the official data of Rosstat (http://www.gks.ru)

Table 11

Expected values of the tax ratio in transactions involving sectors with a large share of shadow activities in 2017, %

Sector of economy	Actual tax ratio	Tax ratio in transactions involving sectors with a large share of shadow activities	Growth rates, %
Wholesale and retail trade	21.1	5.4	25.6
Accommodation and food services	22.2	13.6	61.3
Transport and communications	21.2	2.3	10.8
Education	31.2	12.8	41.0
Health care and social services	26.4	7.9	29.9

Presumably, the tax ratio in transactions involving 'problem sectors' will be lower than the average sectoral tax ratio. Table 11 shows our calculations of the expected values of the tax ratio in transactions involving 'problem sectors' in 2017. In our calculations, we assumed that in such transactions, the degree of shadowization rises to the level specified in Tables 8 and 9, which leads to significant tax losses. The larger is the share of shadow transactions, the lower becomes the tax ratio of these sectors (see Table 11).

5. Conclusions

In our estimation of the size of the shadow economy in Russia, we used as an indicator the adjustment of GVA for the NOE used by Rosstat. We identified the following industries with a large share of unobserved economic activities: real estate, agriculture and forestry, construction, trade and hotel industry. Each of them has its own factors contributing to the growth of the shadow sector: for example, firms in agriculture and forestry tend to resort to in-kind payments.

The input-output tables compiled by Rosstat show financial flows involving sectors with a large share of shadow activities. Most economic connections between such sectors were observed in trade and construction. Long-standing linkages with shadow sectors create a multiplier effect as organizations in these sectors tend to conduct illicit transactions (including cash transactions) and thus shadowization spreads to other sectors of economy, even though previously these sectors had only an insignificant share of shadow activities. We found an increase in the share of the shadow economy in transport and com-

munications, education, health care and social services. Thus, our results confirm the hypothesis that the shadow economy spreads to other sectors as a result of their business connections with the sectors with a high degree of shadowization.

Our calculations have shown that the tax ratio is reduced considerably in transactions involving sectors with a large share of shadow activities because illicit economic transactions tend to be accompanied by tax evasion. Therefore, it would be logical to conclude that business linkages involving these sectors should be closely monitored by tax authorities.

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