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# Deceptive evidence: The experience of product market definition for the purpose of competition law enforcement

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**Abstract**

Could identical goods sold by the same company on the same territory and at the same time be attributed to different product markets? In our paper we take a closer look at the case of the wrought-steel wheel industry, which became the subject of an antitrust investigation initiated by the FAS Russia in 2020. During a shortage, one of the largest wrought-steel wheel producers sold small batches of wheels to minor buyers at relatively high prices compared to the industry average. FAS Russia assumed this price difference to be evidence for abuse of market power. In contrast to FAS Russia's conclusions, we suggest that wrought-steel wheels sold to major and minor buyers constitute at least two separate markets. To test this hypothesis, we define a relevant product market employing a price correlation analysis. To conduct robustness check we also provide a stationarity test on the log price ratio and a cointegration test which fall within the results of correlation analysis. As consumers actually did engage in side transactions, the revealed price difference is not related to price discrimination. We explain this price difference using the new institutional economics, assuming that goods sold to a large buyer do possess special transaction characteristics which do not meet the characteristics of the batches consumed by minor buyers. Another explanation is differences in bargaining power between large and minor buyers. Our result shows that there can be identified at least two wrought-steel wheel product markets: one with Russian Railways as the main buyer and the second one with smaller undertakings.

*Keywords:* competition policy, market borders, wrought-steel wheels, quantitative price tests.
*JEL classification:* K21, L11, L41, L61.

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## 1. Introduction

Industrial organization theory uses numerous models to describe various interactions between buyers and sellers in different markets. Therefore, there emerges one of the most fundamental issues in selecting the best suitable model for each case and market. This issue has not only theoretical consequences, but practical ones as well, especially when it comes to economic policy, in particular to antitrust enforcement, when inconsistencies between different judgements are solved by means of industrial organization theory. Within this stepwise approach of theory, updating even seemingly obvious aspects of market functioning is often called into question. Such a seemingly evident suggestion on market boundaries underlies this study: that is whether identical goods sold by the same company on the same territory and at the same time could be attributed to different product markets.

This question became particularly important in 2019 when the Federal Antimonopoly Service of Russia (hereinafter referred to as FAS Russia) had launched an investigation into one of the Russian producers of wrought-steel wheels with running tread diameter 957 mm (hereinafter referred to as WSW-957) — Vyksa Steel Works (hereinafter referred to as VSW) — on signs of dominant position abuse. In 2020, FAS Russia accused the company in question of raising prices (fixing or maintaining monopoly high prices).[1] In spite of the fact that FAS Russia failed to protect its position in court,[2] its opinion on product market definition related to this case should be taken into consideration even though FAS's approach to market definition related to WSW-957 lacks sufficient clarity.[3]

FAS drew its conclusion that VSW abused its dominant position based on one piece of evidence resulting from price monitoring: WSW-957 were sold to different buyers at steady and substantially different prices. Nonetheless, we claim here that from the regulatory point of view, differences in prices can be attributed not only to the abuse of dominant position, but to other reasons as well.

One of the reasons for setting different prices could be volume discounts. This argument, however, was considered by FAS Russia, which concluded that the price difference in WSW-957 sector was too significant to be explained by volume discounts.[4]

Charging different prices could also be a part of price discrimination. Yet there is a standard assumption that price discrimination arises when consumers are not able to resell the purchased product (namely in situations of arbitrage restriction). Turning to the WSW-957 market analysis provided by FAS Russia, the consumers were able to, and actually did, engage in side transactions, which eliminated opportunities for price discrimination.

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[1] According to the Paragraph 1 of the Part 1 of the Article 10 of the Law on Protection of Competition monopoly high prices are prohibited.

[2] Case No. A40-172652/21-144-1265 decision of the Moscow Arbitration court dated 22 December 2021. https://ras.arbitr.ru/Document/Pdf/01bbd90e-9723-40ab-9b87-83742d0ddeed/6189decf-99a4-4a19-aa1d-b21d0e0bb5b4/%D0%9040-172652-2021__20211222.pdf (in Russian).

[3] Decision No. 05/69872/20, Case No. 05/01/10-16/2019 dated 21 July 2020. https://br.fas.gov.ru/ca/upravlenie-kontrolya-promyshlennosti/6699d910-3e7f-4ad1-8b8d-37bdb2753b2c/ (in Russian; hereinafter — the Federal Antimonopoly Service decision).

[4] Ibid.

In such a case charging different customer groups different prices could be explained by two alternative reasons unrelated to price discrimination or volume discounts. The first reason was different contract terms and other conditions that customers could have taken into consideration when buying WSW-957 (transaction characteristics). The second reason to explain price differences could be the varying bargaining power of customers.

This conjecture can indicate that the product in question is consumed in different product markets. Based on this assumption, we formulate our hypothesis as following: WSW-957 sold in Russia are part of at least two product markets where buyers are represented by: (1) Russian Railways and (2) other customers.

In order to test the hypothesis, we test product market boundaries by conducting multiple quantitative price tests using data from FAS report and information on WSW-957 prices for Russian Railways provided by a large seller. We perform price correlation analysis which shows that WSW-957 are consumed on different markets within the borders of the Russian Federation. We carried out a number of alternative tests to check the robustness of our results: these include stationarity tests on the log price ratio and cointegration analysis. The tests' results prove that WSW-957 are consumed on at least two different product markets.

We relate our paper to three broad strands of literature: (i) new institutional economics, (ii) industrial organization, (iii) antitrust economics.

First, our paper contributes to the existing literature in the field of new institutional economics on the selective assignment of transactions to different mechanisms of governance (Williamson, 1985; 1996). We show that differences in prices may be caused by differences in transaction costs that influence switching costs and thus consumer choice (Tambovtsev, 2005) so that the consumers are not able to substitute one product for the other if the price increases.

Second, we use the notion of bargaining power to provide a possible explanation of differences in prices, which arise regardless of market power. This outcome occurs particularly in the instance of bilateral monopoly (Bowley, 1928; Blair and DePasquale, 2011). Our research naturally relates to the literature in industrial organizations, studying the market outcomes in industries with bargaining power asymmetry (Inderst and Valletti, 2011; Shastitko and Pavlova, 2017).

Our paper also relates to the wide topic of market definition techniques in antitrust economics. Most of the commonly discussed advanced methods used to define market boundaries are time and data demanding as they require estimation of full-fledged demand models (Ribeiro and Castor, 2019). Yet another group of methods, despite wide critique (Davis and Garcés, 2009), is able to provide useful information to primary market definition (Forni, 2004; Hosken and Taylor, 2004; Donath, 2009; Katsoulacos et al., 2014). We conduct several of these tests to provide evidence on possible multiple market setting in the Russian WSW-957 industry.

The rest of the paper is organized as follows. The first part describes the Russian WSW-957 industry and the case initiated by FAS of Russia against one of WSW-957 producers, followed by the development of our hypothesis. The second part of the paper covers the data and the empirical strategy used to test our hypothesis. Part 3 presents the results of different tests followed by the 4th part of the paper where we provide a discussion of the results.

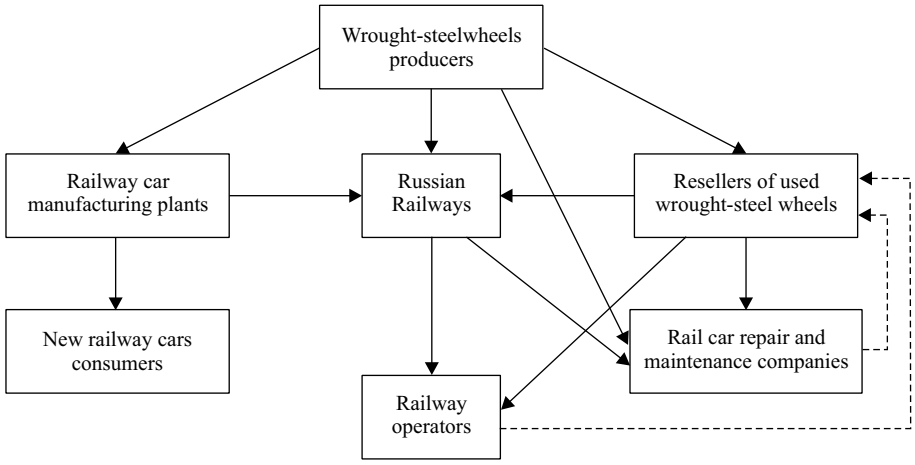


**Fig. 1.** Transactions in industries related to WSW-957 consumption.

*Note*. The dashed line represents vertically integrated companies.
*Source:* Compiled by authors.

## 2. Case description

### *2.1. Wrought-steel wheels*

Wrought-steel wheels with running tread diameter 957 mm (WSW-957) are particularly used in building and repairing all types of trains ranging from passenger, subway, and freight cars to locomotives all over the world.

In Russia, WSW-957 meets demand from railcar repair and maintenance companies, railway car manufacturing plants and railway operators (Fig. 1).

Russian Railways is the major buyer of WSW-957 and at the same time it acts as a railway operator, railcar repair company and WSW-957 reseller (selling some volumes of wrought-steel wheels or wheel pairs).

By reselling WSW-957 Russian Railways acts as a competitor (or at least a potential one) to other WSW-957 sellers as the company buys and sells the same wheels (or wheel pairs) at the same time to the same buyers and therefore it has a potential to influence competitors by changing reselling volumes. In 2018 and 2019 RZD Trading Company (subsidiary of Russian Railways (RZD Holding)) sold to companies outside the holding 81.3 and 108.3 thousand of WSW-957 accordingly (WSW-957 supply for repair purposes is not included).[5] In addition to Russian Railways, there are traders which also resell WSW-957. These traders act as intermediaries — they purchase wheels from manufacturers and then sell them, carrying the costs of storage and/or transportation. The resale volume of Russian Railways is comparable to the total volume of resales in the WSW-957 industry: for example, from January to September 2019 there were totally resold 77.9 thousand of WSW-957.[6] For the above reasons later in this paper we will pay additional attention to the special role of Russian Railways in the WSW-957 industry.

[5] According to the Federal Antimonopoly Service decision.
[6] Appendix to the Federal Antimonopoly Service decision.

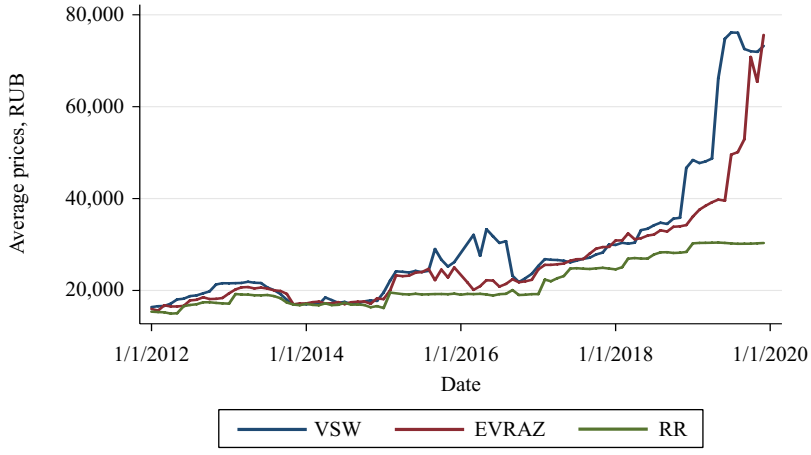


**Fig. 2.** WSW-957 prices dynamics of two major WSW-957 producers — Vyksa Steel Works (VSW) and EVRAZ Nizhniy Tagil Iron and Steel Works (EVRAZ), shipped to smaller consumers* and to Russian Railways (RR).

*Note:* * Shipments to the smaller consumers include shipments to all other firms except Russian Railways, Uralvagonzavod and United Wagon Company.
*Source:* Compiled by authors using FAS Russia data and information provided by one of the major sellers.

## *2.2. Antitrust investigation*

In 2019 FAS Russia launched an investigation into VSW, one of two major Russian wrought-steel wheels producers. FAS argued that in 2019, when consumers faced shortage of WSW-957 the company in question (VSW) sold small batches of wheels that had not been sold to other clients via price request procedure.[7]

According to FAS, "WSW-957 prices established by price request procedures held since the second quarter of 2019 were significantly higher than weighted average prices set by VSW in the first quarter of 2019." FAS accused VSW of setting monopoly high prices on WSW-957 market, whereas, in fact, prices were different.

One of the possible explanations for price differences is volume discounts. This practice is common for the industry in question. Indeed, Russian Railways and other major WSW-957 consumers[8] expect to buy wheels at lower prices compared to those companies who buy lower volumes and purchase less regularly.[9] However, this argument is not able to explain the difference in prices and in the course of its changes after the first quarter of 2015 solely by volume discounts (Fig. 2).

Furthermore, while analyzing price request procedure by VSW for about 1% total volumes sold, FAS Russia found that WSW-957 price markups for VSW

[7] Price request procedure is a goods allocation mechanism close to an auction by its nature: the seller offers a lot, and buyers set their price offers for it.

[8] Among major WSW-957 buyers FAS highlighted inter alia such companies as Uralvagonzavod and United Wagon Company.

[9] See Russian Railways Annual report 2019 (P.10) as an example: "Thanks to the consolidation of significant volumes of goods purchased for the needs of Russian Railways subsidiaries, Russian Railways receives preferences from suppliers (manufacturers) on prices and terms of delivery."

were rather higher as compared to the cost of its production.[10] As a result, there was a gap between the prices offered in the request procedure and average market prices that made FAS Russia reach a conclusion that VSW was guilty of abusing its market dominance (in spite of the fact that VSW production capacities were overloaded precisely during the period investigated).

However, one cannot prove that a company has violated competition law by solely establishing the existence of such a deviation in prices — it is essential to determine whether such a deviation has been caused by the actions of the seller, who thereby abuses his/her dominant position. The possible explanations for the deviations observed in the case under consideration are discussed in the next section of the paper.

### *2.3. Reasons for different prices*

We can attribute the existing differences in the prices paid by distinct customer groups to (1) price discrimination, (2) differences in contract terms and conditions (transaction characteristics) and (3) different sellers and buyers' bargaining power on distinct markets.

*Price discrimination.* Price discrimination by dominant undertakings[11] is one of the possible explanations for price differences. Price discrimination arises when two or more similar goods are sold at different prices, or more formally which have different ratios of prices to marginal costs (Stigler, 1966).

For price discrimination to be a viable solution for the firm three necessary conditions should be met (Varian, 1989). First, the firm should have some market power. Second, it should be able to sort its customers into groups. And finally, there should be either no opportunity for resale, or the firm should block it. Resale opportunities are not limited on the WSW-957 market. Buyers can freely resell new as well as used wheels, including wheel pairs that some buyers consider as substitutes for new WSW-957.

The fact that Russian Railways resold WSW-957 (including wheel pairs) in 2019 serves as an argument to exclude price discrimination from the list of possible explanations of existing price differences.

*Contract terms and conditions (transaction characteristics).* The other possible explanation for price differences may be the fact that different customer groups choose different contract terms (besides prices). Thus, although the goods may be identical in terms of their physical characteristics, their transaction characteristics (regarding the contract terms) may be totally different — that limits the extent to which the goods can serve as substitutes for consumers. Such logic is based on the so-called "Buchanan's goods" concept, which implies that goods with equal physical (transformational) characteristics may be composed of different transactional ones (Tambovtsev, 2005) and for this reason be sold at different prices in one and the same place and time. Transactional characteristics may involve not only terms of sale that are explicitly stated in contracts, but also codes of conduct, personal rules, and business practices as well as other institutional settings within

[10] According to the Federal Antimonopoly Service decision.

[11] According to the Paragraph 6 of the Part 1 of the Law on Protection of Competition price discrimination is prohibited.

which people restrict their behavior (Buchanan, 1994). For example, a buyer may guarantee to acquire a large amount of goods and thus receives lower prices in return. On the contrary, the sellers' commitment to take back faulty goods pushes the price up. Products with distinct transactional characteristics can even become different products from the consumers' point of view and thus become a part of different relevant markets.

Considering contracts with Russian Railways and other buyers one can observe incomparable conditions and other non-price terms:[12] these differences not only include certification requirements but are also caused by Russian Railways' specific characteristics which "allows it to receive preferences," not to mention lower the price to allow for WSW-957 resale.

*Differences in bargaining power.* Sellers are not the only ones who can have an impact on prices, as buyers can do the same. Large buyers enjoy market power, enabling them to buy at lower prices. Nonetheless, even without market power a buyer has an opportunity to influence prices if he/she has relatively high bargaining power (in comparison with the seller).

There are several reasons why a buyer may enjoy significant bargaining power. First, bargaining power may appear as a consequence of a market structure. On such a market, a large buyer may create a credible threat of switching from one seller to another, and such a strategy enables the buyer to claim price reduction.

Secondly, buyers may benefit from special institutional conditions. For instance, there may exist such exchange rules that let buyers take the first move advantage or express their discontent over prices as well as buyers' possible additional commitments laid down by the law.

Thirdly, a buyer's strategic behavior may explain the appearance of bargaining power (Shastitko and Pavlova, 2017).

It should be noted that bargaining power is not always equivalent to market power. Thus, in a bilateral monopoly model only one seller and only one buyer function on the market and, accordingly, both of them enjoy equivalent market power. In the classic model with monopoly on both demand and supply sides of the market, sales volumes equal those ones that would have been set under monopoly or monopsony framework (in each case the results would be equivalent). However, the model cannot explicitly define the sales price — its particular level is to be established as a result of negotiations between the buyer and the seller (Bowley, 1928).

Taking into consideration the dominant position of both market participants, each of them is able to create a credible threat of rejecting the deal and following an "all-or-none" strategy, which consists of buying all the goods available or buying nothing. As a result, the volume of the transaction will correspond to the competitive one maximizing the aggregate surplus. Nonetheless, even in this situation the price remains indeterminate and depends on the balance of bargaining power (Blair and DePasquale, 2011).

Inderst and Valletti (2011) show that asymmetric exercise of buyer bargaining power can lead to a "waterbed effect" whereby a buyer with higher bargaining power obtains himself/herself a discount while prices set for other buyers rise.

[12] According to the Russian Railways Annual report 2019 (p. 11): "RZD Trading Company enjoys a stable business reputation and is perceived as a reliable partner, which allows it to receive preferences and be treated as the priority business partner for many manufacturers (suppliers)."

The existence of the "waterbed effect" rests on two main assumptions: first, the buyers should compete in the downstream market, and second, their size has to influence the size of an additional discount. The interactions between Russian Railways and its trading partners satisfy both assumptions.

All the explanations mentioned above provide for the possibility of setting different prices for different consumer groups, which may be objectively dictated by the peculiarities of companies' voluntary interaction. Thus, we can draw the following hypothesis.

*Hypothesis:* WSW-957 sold in Russia are part of at least two product markets where buyers are represented by: (1) Russian Railways and (2) other customers.

If we confirm this hypothesis then in no way should one compare WSW-957 prices offered in the request procedure with average market prices (the approach FAS Russia used during the investigation against VSW). To test the hypothesis, we define the market where WSW-957 are consumed using quantitative price tests.

## 3. Data and empirical strategy

A unified and straightforward approach to define a relevant market has been validated neither in Russian, nor in foreign antitrust law enforcement (Glasner and Sullivan, 2020).

Though it is necessary to define a relevant market when establishing dominant position (which is clearly stated in the FAS Order No. 220), there were only 57.6% antitrust infringement cases in Russia (concerning abuse of dominance[13]) that have been reviewed in commercial courts during 2008–2015 where relevant market analysis has been undertaken (either for basic or formal market delineation; Katsoulacos et al., 2020). The poor quality of economic analysis and, particularly, errors in market definition are often the reasons for overturning the antitrust decisions in court (Avdasheva and Golovanova, 2020; Avdasheva and Korneeva, 2018). Despite some drawbacks related to the use of survey data (Farrell and Shapiro, 2007) the hypothetical monopolist test is still considered as the priority way to define a relevant market (Pavlova and Shastitko, 2019; Katsoulacos et al., 2020).

Turning to the WSW-957 case we should highlight that though FAS Russia based its conclusions on estimates from the survey of market participants, the latter approach cannot be viewed as a reliable one as the number of buyers was limited (FAS interviewed 28 consumers who bought more than 75% and 60% of WSW-957 produced in Russia in 2018 and 2019 accordingly). This could have happened due to the shortage existing at that time which might have had an influence on the answers of the respondents who were willing to lower WSW-957 purchase prices.

Moreover, the hypothetical monopolist test related to competition analysis on WSW-957 market may be subject to the so-called toothless fallacy (Blockx, 2018), when a number of consumer groups cannot substitute new WSW with used ones or wheel pairs (like toothless people (little children or senior people) are not able to substitute bananas with other fruits). Whereas, for instance, railcar

[13] This conduct group included exclusive contracts, tying and non-price discrimination, by dominant companies.

repair and maintenance companies or railway operators can switch to the other products. Yet it is essential to find out whether price increase will be profitable for a seller.

What is more, the traditional hypothetical monopolist test does not include any questions related to contract terms and other transaction characteristics (the reason why such a question is omitted in the test goes beyond the main goal of this paper), still they may influence consumer choice.

Due to the limitations of the hypothetical monopolist test, we use other methods to define relevant market based on the analysis of monthly average contract prices.

### *3.1. Empirical strategy: Price tests*

One of the ways to define a relevant product market is to carry out a *price correlation analysis* (Stigler and Sherwin, 1985). The main idea of this test traces back to the so-called "law of one price" (Cournot, 1927; Marshall, 1961; McChesney et al., 2004). This concept rests upon an idea that goods traded on the same market experience mutual competition pressure, and that is why they usually have similar price dynamics. So, if consumers perceive two goods as substitutes, then, if there is price increases for the 1st item, they will be willing to switch from the 1st item to the 2nd one. As a result, the producer of the 1st item will have to lower its price. Thus, the two price time series will have the same dynamics. On the contrary, if the two goods do not substitute one another, ceteris paribus, the price decrease of the 1st item will not cause the price fall for the 2nd one as consumers will not switch between these two goods. Consequently, if price dynamics of two goods match, these goods can potentially belong to the same product market.[14] We will first use correlation analysis to test our hypothesis.

Correlation analysis is a common approach used to assess competitive pressure while defining product markets both in foreign (Hatzitaskos et al., 2012) and Russian law enforcement (Shastitko et al., 2019). The main idea that stands behind the correlation analysis is the following: if the prices of two goods change independently over time and/or price deviations from an average trend are not stable, then the correlation coefficient is expected to be low. Accordingly, if the two time series change simultaneously over time, then the correlation coefficient will be high.

It is worth noting that prices may be a subject to the so-called spurious correlation: thus, they can be false positive. It means that similar factors can impact prices that do not correspond with the consumer choice (Werden and Froeb, 1993). That is why correlation tests are more suitable for defining different product markets (Aleshin and Polozhykhina, 2007; Ribeiro and Castor, 2019) — if there is no correlation, then there are rather several markets than a single one.

Due to imperfections and comparative advantages of the different price tests we are conducting a series of them (Shastitko, 2019) to check the robustness of our results.

[14] It should be highlighted that similar price dynamics may be explained by cost levels changes, so the test results will show false correlation. However, data in first differences can eliminate the effect of cost levels changes.

An alternative method we use to define a market is the *stationarity tests on the log price ratio*. This method was proposed by Forni in his study of the Italian milk market (Forni, 2004). The logic of this test resembles the logic of correlation analysis: if two goods belong to the same product market (and are seen as substitutes by consumers), the ratio of their prices will be stationary.

Technically, this test checks whether the log of price ratio for two products is stationary. In contrast to the correlation analysis, the stationarity tests on the log price ratio can be applied to the two nonstationary time series: if the goods belong to one market then the short-term shocks that affect both of the goods will be eliminated in the long run; however, if the goods belong to different markets the shocks that influence them will also be different, so the price ratio of two goods will be nonstationary.

In spite of ruling out some of the correlation analysis cons, the stationarity tests on the log price ratio also have their shortcomings. In particular, the tests cannot be used if the time series are stationary because in this case the difference between product prices will also be stationary (Coe and Krause, 2008). In addition, the test cannot be used for analyzing small samples (Maddala and Kim, 1999) that are usually used by competition authorities.

The other price-test widely used in antitrust investigations is the error-correction model of Engle and Granger (hereinafter referred to as "ECM"), which implies that two goods belong to one market if their prices are cointegrated and do not drift much apart (Engle and Granger, 1987). This approach is widely used in defining relevant markets in energy industries (Warell, 2006).

There are two main approaches used to assess cointegration: bivariate test of Engle and Granger (Engle and Granger, 1987) and multivariate cointegration test (Johansen, 1988; Johansen and Juselius, 1989). The former has at least two limitations: first, it is used for pairwise comparisons, and, second, this approach is based on the assumption that one of the prices should be exogenous (Goodwin, 1992). Thus, we use the second approach — namely Johansen's testing procedure to analyze WSW-957 prices and identify if there is a cointegration relationship between the price series (via multivariate cointegration test; Johansen, 1988; Johansen and Juselius, 1989). Johansen's multivariate cointegration test estimates all cointegrating vectors that exist among the time series under consideration and shows the number of cointegrating relationships in the time series. The results of the test are used to find goods with the same stochastic trends — these can be interpreted as goods in the same market.

Prices of all WSW-957 products in question bear common costs, as the manufacturers of the WSW-957 in all possible markets are the same, have the same production structure and share similar costs. In this case, the price changes caused by the joint cost shock would lead to a spurious (false positive) correlation. Using this result one may mistakenly conclude that the goods in these markets are substitutes. However, our hypothesis implies the existence of several markets rather than one. Zero correlation will mean that we *confirm* the hypothesis. On the contrary, if there is correlation between prices and our hypothesis is *rejected*, then we cannot confidently define the exact reason for the existing correlation: the goods might actually be substitutes in the eyes of consumers or there is a type I error (false positive) that is a result of the joint cost shocks. This creates limitation of the method we use.

**Table 1**
Descriptive statistics.

| Variables | Observations | Average | Standard deviation | Min | Max |
|---|---|---|---|---|---|
| Russian Railways (prices set by one of the large sellers) | 95 | 21 367.88 | 4 936.30 | 14 960.14 | 30 423.75 |
| VSW | 94 | 29 302.17 | 15 364.88 | 16 385.0 | 76 150.0 |
| EVRAZ | 95 | 26 020.50 | 11 327.21 | 15 613.0 | 75 615.0 |

*Source:* Compiled by authors using FAS Russia and the large seller data.

### *3.2. Data*

We apply the above-mentioned tests to the WSW-957 industry using monthly data on average contract prices of: (1) two main Russian WSW producers[15] (namely VSW and EVRAZ) for all the consumers except for the largest ones[16] and (2) a large seller that trades with Russian Railways. The data covers the period from 2012 to 2019. Table 1 presents descriptive statistics for the data used. The data underpinning the analysis reported in this paper are deposited at self-publishing repository Inter-university Consortium for Political and Social Research (openICPSR).[17]

Before proceeding directly to price correlation analysis to obtain coherent results, we need to check whether the time series are stationary. There are two reasons why time series can be nonstationary: trends (deterministic and stochastic trends) and structural breaks. Deterministic trend represents a non-random function of time, can be identified using Dickey–Fuller test while stochastic trend has a random nature and may change over time.

To understand whether the times series we use is stationary we carry out the Dickey–Fuller unit root test. The null hypothesis of the test is an assumption that the time series is nonstationary (the results are presented in Table A1, Appendix A). The Augmented Dickey–Fuller test (Dickey and Fuller, 1979) results show that time series are nonstationary (both with drift and lags as well as deterministic trend)

Structural breaks caused by various exogenous shocks (economic policy changes, new technologies introduction, structural changes in industries, etc.) can also lead to nonstationarity of a time series. In the WSW industry a wide range of events could have caused structural breaks (changes of maintenance and replacement rules of railway cars, introduction of anti-dumping duties for some manufacturers and changes in the production capacities of others) (Fig. 3).

From 1 January 2016 the Ministry of Transport of Russia has banned utilization of freight car fleet with extended service life[18] to support railway car manufacturing plants. The rules for utilizing freight cars with extended service life had

[15] All prices are converted into 2012 prices by FAS.

[16] FAS Russia has include in the largest WSW-957 buyers tree companies: Russian Railways, Uralvagonzavod and United Wagon Company.

[17] https://doi.org/10.3886/E175182V1

[18] Order of the Ministry of Transport of the Russian Federation No. 382 dated December 25, 2015 "On Amendments to the Rules of Technical Operation of Railways of the Russian Federation approved by Order of the Ministry of Transport of the Russian Federation No. 286 dated December 21, 2010."

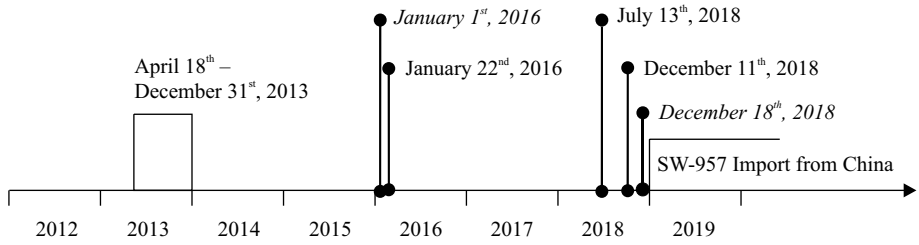


**Fig. 3.** Events that could have influenced prices in WSW industry in 2012–2019.

*Note:* The dates in italics indicate the appearance of used wheels due to the changes in legislation.
*Source:* Compiled by authors.

already been changed earlier — for example, in 2013[19] the allowable term for utilizing such cars was reduced up to 1 year.[20] As a result of the above mentioned changes some consumers (except for railcar manufacturers) got an opportunity to switch from new to already used wheels.

Also from 18 December 2018 the minimum allowable wheel flange thickness has been reduced from 25 mm to 24 mm.[21] During the operation of the wheel, its flange is worn away. So reducing the allowable flange thickness prolonged the service life of wheels.

In addition, on 22 January 2016 The Eurasian Economic Commission introduced an anti-dumping duty on WSW-957 imports from Ukraine (Interpipe). As a result, the average WSW-957 prices rose.

During 2012–2019, several producers also changed their capacities. On 11 December 2018 Prommashkomplekt (Kazakhstan manufacturer) put into service production complex "with a capacity of 200,000 wheels a year",[22] although the company was able to produce the declared volumes belatedly.[23] Also, on 13 July 2018 EVRAZ launched[24] the fifth full section wheel machining line.

In addition to this, one cannot clearly define an exact date when a structural break occurs. On the one hand, all of the shocks mentioned above could have had a delayed impact on the time series, as both buyers and sellers were able to make stockpiles and the majority of them had long-term contracts. On the other hand, some events could have had dual influence on the market. For example, used wheels cover a part of demand from some consumers for wheels; however, due to the reduced service life of such wheels these consumers return to the market earlier (in 2–3 years). This makes demand for wheels unstable as new wheels' service life is relatively longer and averages up to 6–7 years. So, there can be a reverse influence of used wheels consumption on the volumes demanded and thus prices in different periods.

[19] http://static.government.ru/media/files/41d45e58450b921d8806.pdf (in Russian).
[20] http://government.ru/news/1566/ (in Russian).
[21] Order of the Ministry of Transport of the Russian Federation No. 349 dated 05.10.2018 "On Amendments to the Rules of Technical Operation of Railways of the Russian Federation Approved by Order of the Ministry of Transport of the Russian Federation No. 286 dated December 21, 2010."
[22] https://www.inform.kz/en/kazakhstan-launches-rail-wheels-production_a3476760 (in Russian).
[23] https://www.rzd-partner.ru/zhd-transport/comments/rynok-ispytyvaet-defitsit-starogodnikh-tselnokatanykh-koles/ (in Russian).
[24] https://www.evraz.com/ru/news-and-media/press-releases-and-news/evraz-ntmk-zapustil-novuyu-avtomatizirovannuyu-liniyu-po-obrabotke-zheleznodorozhnykh-koles_7508837/ (in Russian).

What is more, the influence of shocks can be either temporal or permanent so there can be a more realistic way to consider a model of our time series as including both stationary and nonstationary (stochastic) component. Via differencing we can extract a stationary series. Such an approach is usual for correlation analysis (Boshoff, 2011). In the rest of the paper, we will use data in first differences that is stationary (the results of the tests to check the stationarity of our data in first differences are presented in Table A2, Appendix A).

## 4. Results

In this part of the paper, we present the results of the price correlation test. We then check the robustness of our estimations by applying stationarity of price ratio and cointegration analysis.

### *4.1. Price correlation test*

Since price correlation tests are widely used to define a relevant antitrust market, we will start with simple pairwise correlations between VSW and EVRAZ weighted average contract prices (set for all buyers except for the large ones) and prices of a large seller that trades with Russian Railways.

As correlation test results in delineating market boundaries can be false positive, we concentrated our analysis on instances of no correlation. The correlation coefficients are rather low for all the time series (Table 2). Therefore, we can preliminarily state that *there exist at least two different WSW-957 markets in product boundaries: one for large buyers (including Russian Railroads) and another for small buyers.*

### *4.2. Robustness check*

To explore the robustness of our results we conduct two tests — we analyze the price ratio stationarity and carry out a cointegration test (including error correction model estimations).

*Stationarity tests on the log price ratio.* Time series analyzed in this paper are nonstationary and include both shock and relatively steady periods, hence we can conduct stationarity test on log price ratio to check the robustness on the abovementioned result (the results of the test are presented in Table 3).

**Table 2**
Pearson correlation for WSW-957 weighted average prices (data in first differences, in prices of 2012).

| | (1) | (2) | (3) |
|---|---|---|---|
| (1) VSW | 1.000 | | |
| (2) EVRAZ | –0.002<br>(0.983) | 1.000 | |
| (3) Russian Railways (prices set by one of the large sellers) | 0.039<br>(0.715) | 0.078<br>(0.462) | 1.000 |

*Note:* The level of statistical significance of correlation coefficients is adjusted for multiple comparisons by Bonferroni's correction and is reported in parentheses.
*Source:* Authors' calculations using data from FAS Russia decision and data provided by one of the large sellers.

**Table 3**
The results of the Dickey–Fuller test on the log price ratio (log of average prices ratio, in prices of 2012).
H0: there exists a unit root (the data series is not stationary).

| | (1) | (2) | (3) |
|---|---|---|---|
| (1) VSW | | | |
| (2) EVRAZ | Stationary*** (0.0037) | | |
| (3) Russian Railways (prices set by one of the large sellers) | Nonstationary (0.8808) | Nonstationary (0.9984) | |

*Note:* *** $p < 0{,}01$, ** $p < 0{,}05$, * $p < 0{,}1$; $p$-values are reported in parentheses.
*Source:* Authors' calculations using data from FAS Russia decision and data provided by one of the large sellers.

*Cointegration test.* In order to test cointegration between time series we first specify the number of lags to include in our analysis. For prices[25] of VMZ, EVRAZ (for both excluding prices set for large buyers) and one of large sellers set for Russian Railways we will use 2 lags for the multivariate cointegration test (Johansen test) because most of the conducted tests chose 2 lags (Table A3, Appendix A). Using all of the three price time series and a model with 2 lags, we find one cointegrating relationship in the multivariate cointegration test (Table A4, Appendix A). The results of bivariate tests show that there is a cointegrating equation only between prices series of VMZ and EVRAZ (excluding prices set for large buyers), whereas there is no cointegration between prices of the former with prices of one of large sellers set for Russian Railways (Appendix A).

The results of the stationarity test on the log price ratio and cointegration analysis fall within the results of correlation analysis — there can be identified at least two WSW-957 antitrust product markets: one with Russian Railways as the main buyer and the second one with smaller undertakings. However, the performed quantitative price test is not able to specify the source of the observed price differences which, in turn, may be attributed to various reasons beyond the fact that WSW-957 belongs to different markets. We analyze possible explanations for these differences in the following section.

## 5. Discussion

### *5.1. Explanations*

As was stated in section 1.3 there are two main explanations of observed price differences: contract terms and differences in bargaining power. We consider these explanations in the context of the industry in question and show that both can be appropriate.

*Explanation 1: contract terms (transaction characteristics).* WSW-957 production is capital-intensive and involves high fixed costs. A company will refuse to produce an item if it cannot contract enough volumes in advance to potentially recoup the costs.

All the WSW-957 producers are diversified companies, so that even in the period of excess supply they will at least reach their zero profitability. However, in order to launch a plant, one should be confident that sufficient volumes of

[25] The gaps in the time series are dropped.

production would meet demand. Therefore, to begin the production process WSW-957 producers need a "starting point"—a contract to ensure sufficient volume of sales. Russian Railways understands that and secures maximum price reduction.[26] Other buyers cannot buy volumes comparable with those proposed by Russian Railways or offer other guarantees to VSW. So Russian Railways not only enjoys its bargaining power to ensure lower prices, it also commits to buy those volumes, which, in fact, is a counteroffer (commitment).[27]

As a result, Russian Railways buys wheels and a commitment (to maintain production facilities loaded in sluggish market conditions) at the same time. Such a commitment stands as a bad (the opposite of a good) for Russian Railways, which results in a lower final price for the company.

Other market participants are not ready to buy the same commitments. During the excessive supply periods, Russian Railroads provided capacities' utilization of both large WSW-957 producers.[28] For example, Russian Railways bought every fourth wheel sold by EVRAZ.[29]

It is worth mentioning that in a highly volatile market consumers demand small volumes of wheels from time to time. These stem from information asymmetry that make it impossible to work out a complete long-term contract with effective mechanisms of adaptation to changing circumstances of transactions performed. Therefore, some buyers pursue speculative interests: they buy small volumes of wheels and, when the demand for them rises, resell the wheels.

*Explanation 2: bargaining power.* In the analyzed case, Russian Railways could have had greater bargaining power than other buyers who simply cannot affect prices. Interaction between WSW-957 producers and large buyers (especially Russian Railways, as the largest one) may be described by bilateral monopoly model whilst the rest of WSW-957 volume is sold on the competitive market.[30] WSW-957 price dynamics can be explained by the fact that market power which has been stable for a long period of time already determines price levels on the market with the large buyer (bilateral monopoly) while competitive market price levels are determined by other companies' small volumes supply and demand subject to significant fluctuations in the short-term.

### *5.2. Product difference*

Given that price discrimination opportunities on WSW-957 markets are limited, there are two explanations for different price levels set to different customer groups in the observed period: contract terms and conditions (transaction characteristics) and bargaining power imbalance.

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[26] Searching for buyers ready to purchase large volumes is a common practice for capital-intensive industries that nevertheless is characterized by a particular relationship between buyer and seller. That is the reason why we concentrate on the relationship between VSW and Russian Railways when testing the hypothesis.

[27] It is worth noting that the commitment should not necessarily be of legal character (but an economic one). As a result of such a commitment VSW forms certain expectations that further transform into particular plans and actions.

[28] The Federal Antimonopoly Service decision text, p. 57.

[29] The Federal Antimonopoly Service decision text, p. 58.

[30] First, the goods are to be sold exactly to large buyers as a dual monopoly implies the unambiguous establishment of the equilibrium volume at the maximum level. If the manufacturer primarily ensures other buyers' interests, then there is a risk of not achieving balance in relations with major market players. In addition, a large buyer can resort to an 'all-or-nothing strategy', completely refusing to buy smaller volumes.

According to Demsetz, a transaction can be considered as an exchange of bundles of rights. "A bundle of rights often attaches to a physical commodity or service, but it is the value of the rights that determines the value of what is exchanged" (Demsetz, 1974, p. 163). Since rights are an object of market exchange, a difference in the bundle of rights can help to distinguish one good (service) from another when consumers do not see these bundles as substitutes.

In this context, our explanations lead to the following two corollaries.

First, as WSW-957 supply contracts with Russian Railways contain additional obligations or commitments, the parties of the contract exchange different bundles of rights compared to the contracts with other buyers. Hence, WSW-957 sold to Russian Railways (denoted as WSW-RR) and the ones sold to other buyers (WSW-OB) are distinct products and therefore they constitute different markets.

Second, Russian Railways is able to use its bargaining power to buy WSW-RR instead of WSW-OB at a lower price. Thereafter, Russian Railways may resell WSW-957 to other buyers without imposing additional obligations on the buyers, in such a way that WSW-957 (with all the rights attached to it) resold by Russian Railways become a substitute to WSW-OB, so resold WSW-957 and WSW-OB belong to one relevant market.

Nonetheless, the hypothesis that there exist distinct WSW-957 product markets was verified. This also explains why VSW did not use the opportunity (if there was any) to sell WSW-957 contracted with Russian Railways to other buyers at higher prices.

In the case of the Russian wrought-steel wheel industry we consider commitments to purchase a certain volume of goods as an example of special contract terms, although in fact there may be other contract terms that impose additional obligations on the contract parties and serve as a ground to test the hypothesis of different relevant markets. What is more, it may be even impossible to define the whole bundle of rights that may help to distinguish one product from the other since, on the one hand, the contracts' terms are usually confidential, and, on the other hand, not all contract terms and conditions are codified or explicitly articulated (probably some terms and conditions may be a part of the established business practice or personal agreements). The question of the exact contract terms that formed a core of differences in the products' bundle of rights requires additional research (for example, using a case study or a survey of consumers).

## 6. Conclusion

Two goods identical from a physical point of view and traded on the same territory and at the same time are often considered to belong to the same product markets. However, such simplicity can be obviously deceptive: proving that these goods are traded at the same territory, at the same time and have completely equal physical (transformational) characteristics is not enough for attributing these goods to the same product markets.

We conducted several quantitative price tests (correlation analysis, stationarity tests on the log price ratio and cointegration analysis) that showed no correlation between WSW-957 prices set in contracts with Russian Railways and other buyers. This may indicate that Russian Railways rather belongs to a separate product market with narrower boundaries compared to those defined by the FAS Russia.

There are two explanations for the observed price differences: (1) the wheels sold to different consumers could have different transaction characteristics which might have had an influence on consumers' decisions; (2) Russian Railways might enjoy bargaining power that enables it to obtain lower WSW-957 prices in the bilateral negotiations. That allows Russian Railways to keep reselling wheels to the consumers on other WSW-957 markets.

This finding is important and has a practical application to the competition policy litigation as it provides a higher quality of economic analysis that may lower the probability of enforcement errors (Avdasheva, 2012). This paper brings up evidence that not only physical characteristics but also contract terms and conditions that have a potential impact on buyers' decision should be taken into consideration when defining a relevant market.

The fact that only customers other than Russian Railways bought WSW-957 via price request procedure combined with the findings of our paper indicates that prices set in this procedure should be compared to prices set for other buyers excluding data on Russian Railways prices. These may reverse the conclusions made by the FAS Russia.

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## Appendix A

**Table A1**

The results of ADF (Augmented Dickey-Fuller) test on average prices.

| H0: nonstationary time series<br>MacKinnon approximate *p*-value for *Z*(*t*) | EVRAZ[a)]<br>*N* = 93 | VSW[a)]<br>*N* = 92 | RR[b)]<br>*N* = 93 |
|---|---|---|---|
| No constant | 1.0000 | 0.9972 | 0.9586 |
| With drift | 0.9999 | 0.9201 | 0.5002 |
| With drift and 1 lag | 1.0000 | 0.7949 | 0.5159 |
| With drift and 2 lags | 1.0000 | 0.8110 | 0.4676 |
| With drift and 3 lags | 0.9921 | 0.8913 | 0.4907 |
| With deterministic trend | 1.0000 | 0.9911 | 0.7699 |

[a)] FAS data, excluding Russian Railways, Uralvagonzavod and United Wagon Company.
[b)] Prices set by one of the large sellers.

**Table A2**

The results of ADF (Augmented Dickey-Fuller) test on first differences of average prices.

| H0: nonstationary time series<br>MacKinnon approximate *p*-value for *Z*(*t*) | EVRAZ[a)]<br>*N* = 91 | VSW1[a)]<br>*N* = 90 | RR[b)]<br>*N* = 91 |
|---|---|---|---|
| No constant | 0.0000 | 0.0000 | 0.0000 |

[a)] FAS data, excluding Russian Railways, Uralvagonzavod and United Wagon Company.
[b)] Prices set by one of the large sellers.

**Table A3**

The lag-order selection statistics for VAR model of VSW[a)], EVRAZ[a)] and RR[b)] average prices: preestimation.

| Lag | LL | LR | df | p | FPE | AIC | HQIC | SBIC |
|---|---|---|---|---|---|---|---|---|
| 0 | –2682.989 | – | – | – | 3.283e+22 | 60.359 | 60.393 | 60.443 |
| 1 | –2351.968 | 662.042 | 9 | 0 | 2.364e+19 | 53.123 | 53.258 | 53.458 |
| 2 | –2328.475 | 46.986 | 9 | 0 | 1.708e+19[c)] | 52.797[c)] | 53.034[c)] | 53.384[c)] |
| 3 | –2321.004 | 14.941 | 9 | 0.093 | 1.771e+19 | 52.832 | 53.170 | 53.670 |
| 4 | –2310.918 | 20.172[c)] | 9 | 0.017 | 1.734e+19 | 52.807 | 53.247 | 53.898 |

[a)] FAS data, excluding Russian Railways, Uralvagonzavod and United Wagon Company.
[b)] Prices set by one of the large sellers.
[c)] Optimal lag, Endogenous: VSW, EVRAZ, RR; Exogenous: _cons.

**Table A4**
The results of multivariate cointegration test (Johansen test for cointegration) on VSW[a], EVRAZ[a] and RR[b] average price (2 lags).

| Hypothesized number of CE (maximum rank) | parms | LL | Eigen value | Trace statistic | 5% critical value |
|---|---|---|---|---|---|
| None (r = 0) | 12 | –2413.6165 | – | 70.1732 | 29.68 |
| At most 1 (r ≤ 1) | 17 | –2382.6193 | 0.49402 | 8.17870[c] | 15.41 |
| At most 2 (r ≤ 2) | 20 | –2378.9922 | 0.07662 | 0.92460 | 3.76 |
| At most 3 (r ≤ 3) | 21 | –2378.5299 | 0.01011 | | |

[a] FAS data, excluding Russian Railways, Uralvagonzavod and United Wagon Company.
[b] Prices set by one of the large sellers.
[c] Optimal lag.

**Table A5**
The lag-order selection statistics for VAR model of EVRAZ[a] and RR[b] average prices: preestimation.

| Lag | LL | LR | df | p | FPE | AIC | HQIC | SBIC |
|---|---|---|---|---|---|---|---|---|
| 0 | –1783.254 | – | – | – | 9.080e+14 | 40.118 | 40.141 | 40.174 |
| 1 | –1529.664 | 507.18 | 4 | 0 | 3.329e+12 | 34.509 | 34.577 | 34.677 |
| 2 | –1514.369 | 30.588 | 4 | 0 | 2.583e+12 | 34.255 | 34.368 | 34.535[c] |
| 3 | –1508.56 | 11.619 | 4 | 0.02 | 2.481e+12 | 34.215 | 34.373 | 34.606 |
| 4 | –1501.779 | 13.563[c] | 4 | 0.009 | 2.332e+12[c] | 34.152[c] | 34.355[c] | 34.656 |

[a] FAS data, excluding Russian Railways, Uralvagonzavod and United Wagon Company.
[b] Prices set by one of the large sellers.
[c] Optimal lag.

**Table A6**
The results of multivariate cointegration test (Johansen test for cointegration) on EVRAZ[a] and RR[b] average price (4 lags).

| Hypothesized number of CE (maximum rank) | parms | LL | Eigen value | Trace statistic | 5% critical value |
|---|---|---|---|---|---|
| None (r = 0) | 14 | –1506.4031 | – | 9.2491[c] | 15.41 |
| At most 1 (r ≤ 1) | 17 | –1501.8505 | 0.09725 | 0.1439 | 3.76 |
| At most 2 (r ≤ 2) | 18 | –1501.7786 | 0.00162 | | |

[a] FAS data, excluding Russian Railways, Uralvagonzavod and United Wagon Company.
[b] Prices set by one of the large sellers.
[c] Optimal lag.

**Table A7**
The lag-order selection statistics for VAR model of VSW[a] and RR[b] average prices: preestimation.

| Lag | LL | LR | df | p | FPE | AIC | HQIC | SBIC |
|---|---|---|---|---|---|---|---|---|
| 0 | –1813.6 | – | – | – | 1.796e+15 | 40.8 | 40.823 | 40.856 |
| 1 | –1538.355 | 550.491[c] | 4 | 0 | 4.047e+12[c] | 34.705[c] | 34.772[c] | 34.872[c] |
| 2 | –1535.289 | 6.132 | 4 | 0.190 | 4.133e+12 | 34.726 | 34.838 | 35.005 |
| 3 | –1534.569 | 1.440 | 4 | 0.837 | 4.451e+12 | 34.799 | 34.957 | 35.191 |
| 4 | –1533.578 | 1.981 | 4 | 0.739 | 4.766e+12 | 34.867 | 35.070 | 35.370 |

[a] FAS data, excluding Russian Railways, Uralvagonzavod and United Wagon Company.
[b] Prices set by one of the large sellers.
[c] Optimal lag.

**Table A8**
The results of multivariate cointegration test (Johansen test for cointegration) on VSW [a] and RR [b] average price (1 lag).

| Hypothesized number of CE (maximum rank) | parms | LL | Eigen value | Trace statistic | 5% critical value |
|---|---|---|---|---|---|
| None (r = 0) | 2 | –1591.3427 | – | 7.4486 [c] | 15.41 |
| At most 1 (r ≤ 1) | 5 | –1587.6189 | 0.07776 | 0.0010 | 3.76 |
| At most 2 (r ≤ 2) | 6 | –1587.6184 | 0.00001 | | |

[a] FAS data, excluding Russian Railways, Uralvagonzavod and United Wagon Company.
[b] Prices set by one of the large sellers.
[c] Optimal lag.

**Table A9**
The lag-order selection statistics for VAR model of VSW [a] and EVRAZ [a),b)] average prices: preestimation.

| Lag | LL | LR | df | p | FPE | AIC | HQIC | SBIC |
|---|---|---|---|---|---|---|---|---|
| 0 | –1861.03 | – | – | – | 5.214e+15 | 41.866 | 41.888 | 41.922 |
| 1 | –1646.527 | 429.006 | 4 | 0 | 4.600e+13 | 37.135 | 37.203 | 37.303 |
| 2 | –1629.086 | 34.882 | 4 | 0 | 3.402e+13 | 36.833 | 36.946 | 37.113 [c] |
| 3 | –1625.456 | 7.260 | 4 | 0.123 | 3.432e+13 | 36.842 | 37.000 | 37.233 |
| 4 | –1612.315 | 26.282 [c] | 4 | 0 | 2.796e+13 [c] | 36.636 [c] | 36.839 [c] | 37.14 |

[a] FAS data, excluding Russian Railways, Uralvagonzavod and United Wagon Company.
[b] Prices set by one of the large sellers.
[c] Optimal lag.

**Table A10**
The results of multivariate cointegration test (Johansen test for cointegration) on VSW [a] and EVRAZ [a),b)] average price (4 lags).

| Hypothesized number of CE (maximum rank) | parms | LL | Eigen value | Trace statistic | 5% critical value |
|---|---|---|---|---|---|
| None (r = 0) | 14 | –1622.6410 | – | 20.6513 | 15.41 |
| At most 1 (r ≤ 1) | 17 | –1615.5072 | 0.14812 | 6.3837 | 3.76 |
| At most 2 (r ≤ 2) | 18 | –1612.3154 | 0.06921 | | |

[a] FAS data, excluding Russian Railways, Uralvagonzavod and United Wagon Company.
[b] Prices set by one of the large sellers.

**Table A11**
The results of multivariate cointegration test (Johansen test for cointegration) on VSW [a] and EVRAZ [a),b)] average price (2 lags).

| Hypothesized number of CE (maximum rank) | parms | LL | Eigen value | Trace statistic | 5% critical value |
|---|---|---|---|---|---|
| None (r = 0) | 6 | –1692.2011 | – | 56.3360 | 15.41 |
| At most 1 (r ≤ 1) | 9 | –1665.7656 | 0.44066 | 3.4649 [c] | 3.76 |
| At most 2 (r ≤ 2) | 10 | –1664.0331 | 0.03736 | | |

[a] FAS data, excluding Russian Railways, Uralvagonzavod and United Wagon Company.
[b] Prices set by one of the large sellers.
[c] Optimal lag.