*An abstract to the research «Vertical collusion in public procurement: estimation based on data for R&D composite auctions».*

One of the key problems in public procurement research is identifying violation signs, including vertical collusion. Modern research has no universal criterion to identify vertical collusion between a customer and a supplier. However, it is argued that vertical collusion is associated with frequent interactions between the same customer and supplier. On the other hand, it is important to distinguish between frequent interactions due to vertical collusion and purchases from monopolies and reliable suppliers. This research introduces an approach to solve this issue. The thing is, we expect monopolies and reliable suppliers to supply to more than just one customer. Then frequent interactions of the customer with a certain supplier are treated as suspicious if this supplier interacts only with this customer.

This approach is also not universal. First, the supplier can have capacity constraints and may be unable to supply to someone else (for example, if the supplier is a small business). Secondly, there may be geographical boundaries of the market (for example, due to high transport costs), so on a certain territory there may be no one else to buy from and no one else to sell to. In any of these situations the proposed approach will indicate about a vertical collusion when there is no. For this reason, it was decided to test the approach on the public procurement of R&D results. R&D results are not subject to geographic restrictions. The problem of a sporadic contract for both the customer and the supplier is solved through, first, filtering by the frequency of interactions and, second, using data for the period of two years. This period is enough to make sure that the connections are stable over time.

Public purchases of R&D results in Russia are made through composite auctions (where the winner is selected based not only on price criteria, but also on quality ones). There is little research, especially empirical, of composite auctions for public procurement in both Russian and the world. At the same time, the probability of vertical collusion is expected to be higher in composite auctions since corrupt customers can ensure victory for an affiliated supplier by inflating quality scores.

In this research we used data on composite auctions for R&D results for the period from 16.12.2016 to 20.12.2018. The sample contains 2028 composite auctions. 1197 unique suppliers-winners participated in these auctions. 53 of them have won at least 5 times. Of these 53 suppliers, 20 have always won auctions of the same customer. There are 16 such customers, and they made 515 purchases (a quarter of all composite auctions held this period) with a total value of 24.1 billion rubles.

We treat a supplier as a potentially affiliated one (colluding with a customer) if it won at least 5 auctions, all only of the same customer, and never winning composite auctions of any other customers. The threshold of 5 auctions won is optimal considering the trade-off between the number of observations and the ability to separate potentially affiliated suppliers with independent ones.

The hypotheses of this research are:

1. Affiliated suppliers win auctions with a final price closer to the reserve price (hereinafter RP) than independent suppliers.
2. Affiliated customers inflate the quality scores of suppliers affiliated with them and understate the quality scores of independent participants.

To test the first hypothesis, we estimated the following equation:

$$Y=αT+βX+ε$$

where $Y$ is the percentage difference between the final price and the RP; $T$ is a binary variable that equals 1 if the supplier that won this auction also won at least 5 times and always only with this customer; $X$ is a set of control variables: the price criterion weight, the number of participants, the application period, the order of the winner’s application, the customer and the supplier from the same region binary variable, the distance between the customer and the supplier; and factor variables: customer, purchase object type, auction month, and the supplier region.

The equation was estimated using the OLS method with heteroscedasticity robust coefficient errors. The model was also estimated using Tobit regression to take into account that the dependent variable is censored (the percentage difference between the final price and the RP cannot be less than zero). There is also a problem that the potential affiliation may not be independently distributed conditional on the characteristics of the auction. To account for this issue, the model was estimated using the nearest neighbor propensity score matching method. In addition, the robustness of the results was tested using alternative indicators of affiliation - the concentration index based on the Herfindahl-Hirschman concentration index. In all specifications the first hypothesis was confirmed - if there is an indirect sign of potential affiliation in public purchases of R&D results, the percentage difference between the final price and the RP is significantly lower (by 4.6–5.3 p.p., according to the most reliable estimates).

To test the second hypothesis, we estimated the following equation:

$$Q\_{ij}=αP\_{i}+βC\_{j}+γP\_{i}C\_{j}+ε\_{ij}$$

where $Q\_{ij}$ is the normalized quality score of participant i in auction j, $P\_{i}$ is a binary variable that equals 1 if participant i is potentially affiliated in some auctions, $C\_{j}$ is a binary variable that equals 1 if auction j with a potentially affiliated customer, $P\_{i}C\_{j}$ is the product of binary variables, which equals 1 if potentially affiliated participant i participates in auction j, where he is potentially affiliated with the customer.

The model was also estimated using Tobit regression, since the normalized quality score is censored and cannot take a value greater than 100%. The second hypothesis is confirmed: in auctions with potential affiliation, independent participants, who usually have higher quality scores, receive abnormally low scores (21 percentage points lower), while a potentially affiliated participant receives 34 percentage points higher score.

So, a new indirect approach to identify vertical collusion between customer and supplier, based on the frequency of their interactions, is proposed in this research. It is found that if there is an indirect sign of potential affiliation in public purchases of R&D results, the percentage difference between the final price and the RP is significantly lower. One of the reasons to this is that a potentially affiliated customer manipulates and inflates the quality scores of affiliated suppliers.