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The Evolving Concept of Market Power in the Digital Economy – Note by Greece

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Greece

1. Economic power is multidimensional. The traditional concept of "market power" reflects a specific yet pervasive form of economic power in which a firm can affect equilibrium quantities or prices in a market by reducing the extent of competition with its rivals selling substitutable products or services ("horizontal competition").

2. However, other forms of economic power particularly relevant to understanding power relations in value chains and ecosystem exist. For example, "architectural market power", where a firm is able to influence the industry architecture by its technological, institutional or social interphase; or "panopticon power", where a firm exerts economic power by strategically using information it can obtain through its privileged position in an ecosystem or value chain[1].

3. In this note, we present another form of economic power that allows to measure bargaining power within value chains and ecosystems: "vertical market power". Moreover, we illustrate how it can help improving the measurement of economic power at the firm and the ecosystem or value chain levels using real data from a supermarket sector inquiry led by the Hellenic Competition Commission in 2021[2].

1. The concept of vertical market power

4. Resource dependence in the context of a dyadic exchange relation (e.g. a firm selling an input to another) or a network (e.g. a value chain or an ecosystem) is a source of economic power that is not linked to the exceptional ability of an actor to raise prices or reduce output beyond the equilibrium level, as is assumed in the horizontal power paradigm (where firms producing substitutes compete for customers), or to exclude rivals, as is for exclusionary/bottleneck power. Dependency is observed from the way in which the value in the exchange, dyadic or at the level of the network or organization, is divided between the different actors *at the equilibrium level*. This division is the result of another form of competition, "vertical competition", which takes places between firms belonging to the same value chain or ecosystem. We posit that the way the value is divided results from the distribution of dependencies between actors that underpins vertical competition.

5. Let us illustrate with an example. Consider a value chain or ecosystem with three firms: A, B and C. Firm A and B produce a component that is complementary to firm B's, while the latter sells the final good made of three components to final customers. The three firms need to cooperate to jointly generate value, for example by agreeing on technical standards, the pacing of their production processes, etc. However, they are also in vertical competition for the repartition of the jointly-generated surplus, which manifests in the relative prices of their inputs and the final good sold to the consumer. Suppose that firm A's component is more difficult to reproduce or replace than the other firms'. Then, although firm A depends on firms B and C (its component has no value without B's and C's), the latter depend on firm A *to a greater extent*, as their components are more easily

[1] This section builds on Lianos, I., & Carballa-Smichowski, B. (2022). A coat of many colours. New concepts and metrics of economic power in competition law and economics. *Journal of Competition Law & Economics.*

[2] See https://www.epant.gr/en/enimerosi/press-releases/item/1338-press-release-publication-of-hcc-s-final-report-on-sectoral-inquiry-into-basic-consumer-goods.html

replaceable or reproductible. Hence, firms B and C have a higher *differential* dependency on firm A. As a result, firm A will have superior vertical market power over firms B and C, and will therefore be able to extract a higher share of the jointly-generated surplus by charging high prices for its input. Because horizontal competition also operates (i.e. firm B has to compete for clients with rival firm D, which produces a substitute final good), firm B will not be able to raise prices above a certain equilibrium price. Hence, firm B and/or firm C will reduce their share of the total surplus generated through the sale of the final good.

2. Measuring vertical market power on the bases of differential dependencies: an illustration from the Greek supermarket sector inquiry

6. In this section we will present two indicators that allow us to measure the concept vertical market power presented in the previous section. The first one measures a firm's vertical market power (i.e., it is a firm-level metric), and the second one measures how unevenly distributed power is within a value chain or ecosystem (i.e., an ecosystem- or value-chain-level metric). For the first one, we show how its use can reduce false positive and false negatives when assessing dominance in a market, as opposed to using traditional market shares. For the second one, we illustrate what insights can be derived from applying the indicator. All the illustrations are based on real data used in the context of a supermarket sector inquiry led by the Hellenic Competition Commission in 2021.

2.1. A metric at the firm level

2.1.1. The indicator

7. Before starting to develop the indicator, let us briefly indicate how we will represent the problem in terms of network theory. Firms are denoted by nodes (which are graphically represented as circles) and commercial transactions between them (selling/buying a good or service, licensing a patent, and so forth) as weighted directed vertices (graphically represented as arrows linking the dots). When firm A sells a good or service to firm B, the arrow goes from firm A to firm B. The weight of the vertices represents the unitary cost for purchaser node B of acquiring a good from selling node A. It is graphically represented as the length of the vertex so that the costlier the input is, the longer the vertex is.

8. If a central firm was to leave the value chain, the value loss for the latter would be greater than if a noncentral easy-to-replace firm left. Because 'a node [firm] with high betweenness centrality has a great capacity to facilitate or constrain interactions between other nodes [firms] (Freeman, 1979), its removal affects the network more than the removal of a node (firm) with a low betweenness centrality. This means that central firms are those on which all other firms of the value chain or ecosystem depends more to function because they perform tasks and/or handle a considerable volume of transactions (sales, user traffic, and so forth).

9. As network theory shows, a node's (firm's) centrality, in turn, is a property of the topology of the network (value chain or ecosystem). If we wanted to establish which node is the most central in a network, there would be many ways to do so. Of all the measures of centrality mentioned above, the one that is pertinent to us, as we anticipated a few lines ago, is betweenness centrality. Then, if we notate a node as Nx where x identifies a particular node in the network, its betweenness centrality can be calculated using Equation (1).

Equation 1: Formula of betweenness centrality of node X

$$\mathrm{BC}(\mathrm{N}_X) = \frac{Number\ of\ paths\ passing\ through\ \mathrm{N}_X}{Number\ of\ paths\ in\ the\ network}$$

where BC stands for 'betweenness centrality' and N_x for 'node *X*'.

10. Let us note that in most value chains and many ecosystems, because all the vertices have to be transited (that is, all the nodes have to be transited to arrive the final consumer, as all the firms—nodes—participate in value creation at some stage and level), all paths are shortest paths in terms of network theory. In that case, the denominator of Equation (1) is always equal to one, as there is only one path in the network leading to final consumers. However, this is not necessarily the case. In digital ecosystems, for example, users can choose which complementary services (for example, a smartphone that can connect to a smart TV to stream a video, to a connected air conditioning, and so forth) to combine. Nonetheless, the existence of one or more shortest paths does not affect the interpretation of the indicator. Since vertices represent a firm performing a transaction or task (buying something to another to continue with the production process, providing content to users coming from another firm, and so forth), the bigger the share of shortest paths that pass through firm *X* relative to other firms in the network, the more essential that firm's contribution to the value chain/ecosystem is relative to other firms'. In other words, a firm's betweenness centrality relative to other firms' ('relative centrality' hereafter) translates its differential dependency within the value chain/ecosystem. Hence, our metric has to be able to give us two different values for two firms that belong to different value chains/ecosystems and have the same betweenness centrality but different relative centralities. Equation (2) provides an indicator that meets this requirement.

Equation 2: Resource-based vertical market power based on differential dependency for a node x

$$SSBC(\mathrm{N}_X) = \frac{SBC(\mathrm{N}_X)}{\sum_{i=1}^{n} SBC(\mathrm{N}_i)}$$

where 'SSBC' stands for 'share of square betweenness centrality', 'SBC' stands for 'square betweenness centrality', N_x for 'node *x*' and *n* is the total number of nodes/firms in the value chain or ecosystem.

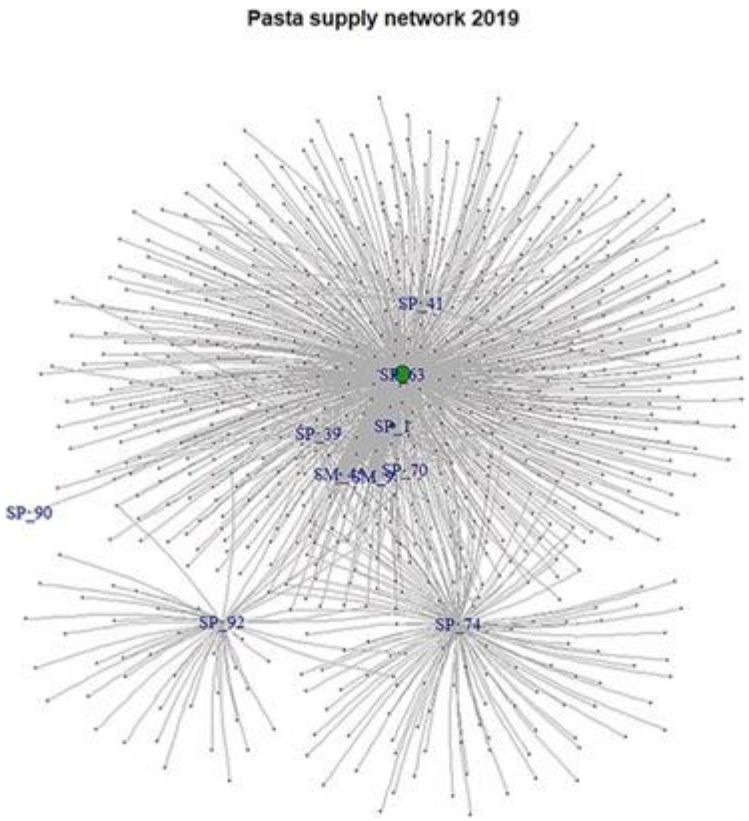
11. In other words, Equation (2) poses that the level of a firm's vertical market power can be measured as its share of the sum of the square betweenness centralities of each node (firm) of the value chain/ecosystem. It should be noted that given that the indicator is built as a share and that it includes firms downstream and upstream of the entire value chain/ecosystem, it can be interpreted as the share of vertical market power each firm holds within the value chain or ecosystem.

2.1.2. An illustration of how it can reduce false positives and false negatives when assessing dominance

12. Because this firm-level indicator incorporates differential dependency between upstream and downstream firms, it could diminish the false negatives and false positives in comparison to a simple market share when assessing a firm's dominance within a value chain or ecosystem. Let us illustrate this with an example.

13. We applied the SSBC indicator to assess suppliers and retailers' levels of vertical power for 11 product categories in the Greek supermarket sector in years 2015–2019. The results for the 'pasta' product category in 2019 illustrate how using the SSBC indicator could reduce the likeliness of false positives. Figure 2 below represents the network of purchases from retailers to suppliers of that product in 2019. Green nodes correspond to suppliers and red nodes correspond to supermarkets. Links' widths are proportional to the volume of net sales. Nodes' sizes are proportional to the corresponding firm's level of vertical market power calculated using the SSBC indicator. It should be noted that the number of paths passing through a node (N_x) is equal to the share of sales/purchases of the node (supplier/retailer). In other words, it represents the share of sales/purchases of the value chain that goes through a given supplier/retailer weighted by its volume measured in monetary terms.

Figure 1. Network of sales/purchases between Greek suppliers and supermarkets for the pasta product category in 2019.

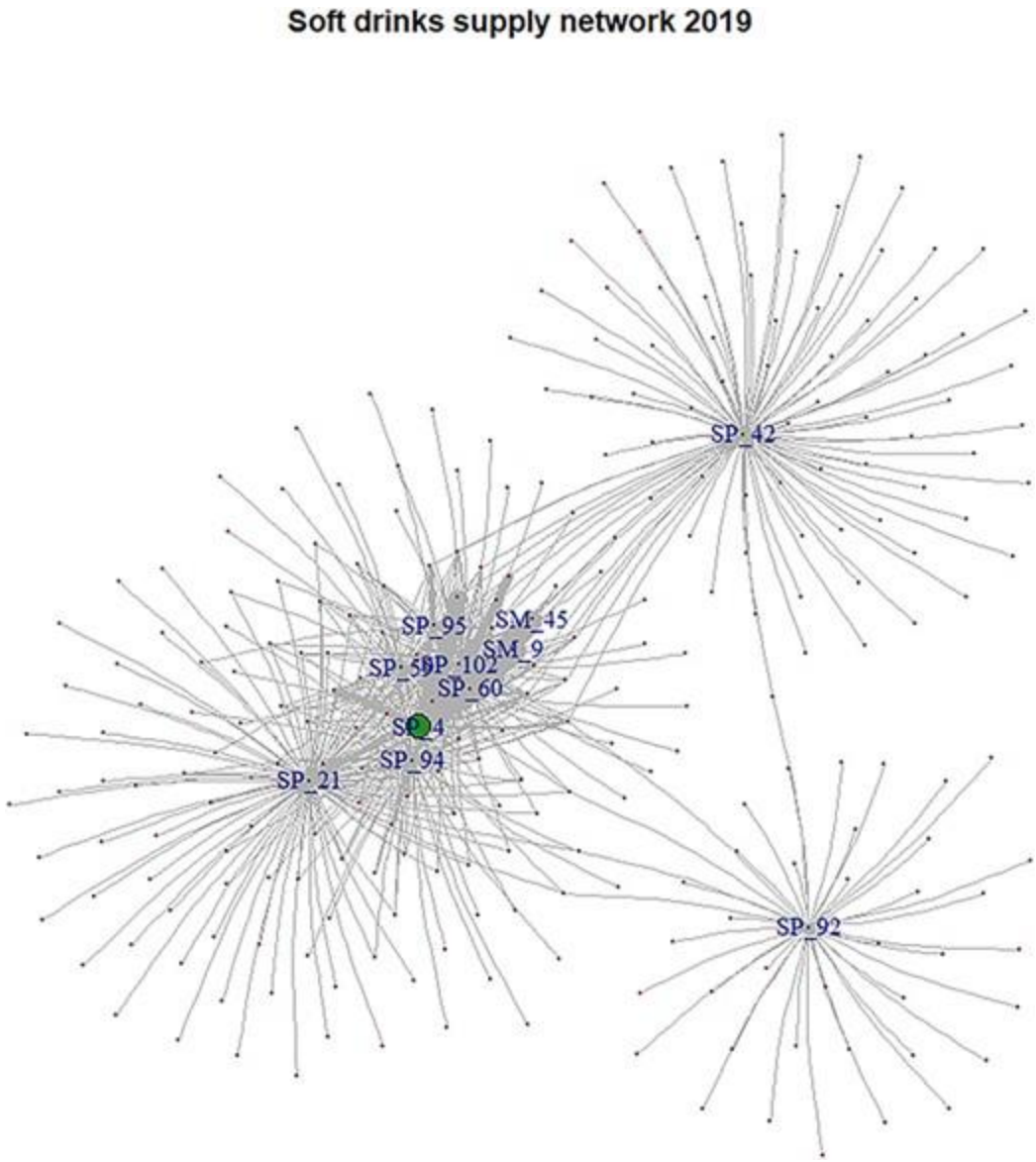


14. As Figure 1 shows, supplier 63 concentrates most (55 percent) of vertical power in the value chain. The second firm in terms of vertical power is supplier 1 with an SSBC indicator level of 21 percent. This contrasts with its market share of 36 percent, which would fall short of European Commission's threshold of 40 percent to establish dominance. The reason for this discrepancy between the two indicators lies in the fact that supplier 1's market share is highly concentrated in a single buyer: supermarket 45. The latter, in turn, divides its purchases more equally between suppliers 1 and 63. As a result, provided that we interpret both a market share and the SSBC indicator as shares of market power (a monopolist would have a 100 percent share of market power), we can conclude that supplier 1 has less bargaining power than its market share would suggest. This example

illustrates how using an indicator that translates relative dependency could diminish the likeliness of false positives when assessing dominance.

15. Inversely, the SSBC indicator could reduce false negatives. Let us illustrate it with another example from the Greek supermarket sector. Figure 2 below shows the network of purchases of soft drinks from supermarkets to suppliers in 2018. The same graphic interpretations and underlying calculations employed for Figure 1 apply.

Figure 2. Network of sales/purchases between Greek suppliers and supermarkets for the soft drinks product category in 2019



16. Supplier 21 concentrates most of the vertical market power with an SSBC indicator of 52 percent. However, its market share is 50 percent because the main buyers, supermarkets 45 and 9, are highly dependent on it to obtain their supply. Although slight, provided that we interpret both the market share and the SSBC indicators as shares of market power (we will develop on this below), this discrepancy would have a considerable impact in the less interventionist courts of the United States, which have used a 50 percent

threshold to establish dominance. A market share of 50 percent (49.82 percent to be precise) could have raised doubts regarding supplier 21's dominance in the eyes of these courts. However, if the SSBC indicator was to be used, even the less interventionist courts would conclude supplier 21 is dominant in the soft drinks wholesale market. As this example illustrates, using the SSBC indicator could reduce false negatives when assessing dominance.

17. These two examples illustrate why the SSBC indicator could reduce false positives and false negatives in respect to market shares when assessing dominance in the context of firms located in the same value chain or ecosystem. If these two alternative indicators are used to assess dominance in such cases, they can lead to opposite conclusions, as illustrated above with the example of the Greek supermarket sector. Given SSBC's capacity to capture relative dependency, it should be a better indicator of dominance than market shares. Hence, using SSBC instead of market shares in such circumstances should lower the probability of false negatives and false positives when assessing dominance.

2.2. A metric at the value chain or ecosystem level

18. Because the metric presented above is firm-centric, it does not tell us what is the level of vertical power differentials within a value chain or ecosystem, a piece of information that could be useful to do a more aggregated analysis of power, especially from an antitrust perspective. Consequently, with this indicator, we cannot say if there is more power concentration in a certain value chain, or ecosystem, than in another one. Therefore, in this subsection, we will adapt this metric to overcome these difficulties.

2.2.1. The indicator

19. Given that each firm's level of power corresponds to its share of the sum of the square betweenness centralities of all of the firms (nodes) of its value chain/ecosystem, a simple way of assessing the level of power imbalances within a value chain/ecosystem consists in calculating the HHI index for all the firms of the value chain/ecosystem using their SSBC instead of their market shares. In that manner, the resulting indicator, 'vertical HHI' (VHHI), measures how (un)evenly vertical power is distributed within a value chain or ecosystem. It is calculated following Equation (3).

Equation 3: Vertical HHI indicator for a value chain or ecosystem with **n** *firms*

$$VHHI = \sum_{i=1}^{n} [SSBC(\mathrm{N}_i)]^2$$

where $SSBC(\mathrm{N}_i)$ stands for 'share of square betweenness centrality' calculated as given by Equation (2).

20. Then, the higher the indicator in Equation (3) is, the more imbalanced power is in the value chain, or ecosystem. This indicator would then be analogous to HHI. Whereas the latter measures the level of market power in a market resulting from market concentration, the indicator in Equation (3) measures the level of vertical power in a value chain or ecosystem resulting from differential dependency over a resource. Moreover, because the VHHI indicator is, like the HHI, based on shares, it also ranges from 0 (total absence of vertical power imbalances) to 10,000 (absolute concentration of vertical power by one firm). However, as explained for the SSBC indicator, this does not mean that the thresholds established for HHI to assess the competitive level of a given market should apply to assess the degree of (vertical) competition within a value chain or ecosystem.

2.2.2. An illustration of the use of the indicator

21. In this section, we illustrate how the VHHI indicator can be used by presenting the results of its application to the above-mentioned supermarket sector inquiry. In particular, using panel data, we calculate the distribution of vertical market power across 11 relevant markets for years 2015 to 2019 using the VHHI index. The results are shown in Table 1.

Table 1: VHHI index for the 11 relevant markets (2015-2019)

	Sliced bread	Breakfast cereals	Pasta	Cured meat	Yogurt and yogurt desserts	Feta cheese	Pulses	Coffee	Soft drinks	Powdered laundry detergents	Toilet paper
2015	6 185	2 791	3 321	2 299	1 990	5 647	6 856	6 996	6 320	2 791	1 929
2016	5 749	2 578	3 339	2 117	1 991	5 057	6 873	6 187	3 427	2 452	2 271
2017	5 229	2 417	3 302	2 232	1 642	2 466	6 656	5 921	4 446	3 868	1 909
2018	5 346	2 360	3 617	2 330	1 360	2 276	6 425	5 757	3 258	4 014	1 960
2019	5 454	2 464	3 720	2 053	1 396	2 191	6 248	5 803	5 764	6 231	2 152

NB: the coloring of the cells does not follow any particular threshold. Its only purpose is to facilitate the reading of the results.

22. In essence, calculating the VHHI index with panel data allows us to compare the level of vertical market power within a relevant market across time and between markets at a given time.

23. Table 1 provides two major insights. First, while some markets have been characterized by relatively stable and low[3] levels of vertical market power between 2015 and 2019 (breakfast cereals, cured meat, yogurt and yogurt desserts and toilet paper), others (sliced bread, pulses and coffee) have shown relatively high levels of vertical market power all along the same period. The pasta market, in turn, has shown a stable medium-low level of vertical market power between 2015 and 2019.

24. Second, some markets have experienced considerable evolutions of the level of vertical market power during the period. The feta cheese sector presented a medium-high level of vertical market power from 2015 to 2016; however, in 2017 it dropped by almost 50% to stabilize into a low level since. Symmetrically, in 2017 vertical market power started to rise from low levels to attain one of the highest recordings of the sample in 2019 for the powdered laundry detergents sector. Finally, the soft drinks sector presented a swinging evolution of its level of vertical market power. The latter started at a high level in 2015 and has since alternated considerable year-to-year increases and decreases. In 2019, it reached a rather high level.

[3] The uses of expressions such as “low”, “medium” or “high” are based merely on the comparison of the VHHI index of the above-mentioned 11 product categories for years 2015 to 2019.