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HEARING ON OLIGOPOLY MARKETS

-- Note by Portugal --

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PORTUGAL

1. Overview of the Contribution

1. Competition authorities are posed with the challenge of competition law enforcement in markets where a few players strategically interact, entailing some degree of interdependence in firms' actions. These characteristics often raise the issue of market power - the ability of a firm or group of firms to raise and maintain price above the level that would prevail under competition (or otherwise deteriorate conditions of supply, e.g. by lowering quality). Whether in merger control, abuse of dominance or market studies, oligopolies will likely account for a great deal of the market environments in the range of proceedings undertaken by competition agencies.

2. Mergers in oligopolistic markets may change the degree of interdependence of firms' actions, potentially strengthening the conditions that enable them to extract the rents associated with a cooperative equilibrium. The analysis of coordinated effects in merger control poses important challenges to competition authorities. This contribution first focuses in addressing those challenges, to later broaden the discussion to the wider oligopoly problem.

3. The note is structured into two main parts. Section 2 is devoted to mergers' coordinated effects. It describes two paradigmatic cases of coordinated effects analysis in the Portuguese Competition Authority's (PCA) decisional practice. It then draws from the illustration provided by the description of those two cases to discuss the challenges in coordinated effects assessment, namely addressing the keys to efficient merger control, and providing the PCA's views on potential overstated risks and fallacies which may jeopardise optimal competition law enforcement.

4. The central issue in coordinated effects is the degree of firms' market power in an oligopoly and the potential of a merger to enhance the likelihood that firms will coordinate their behaviour and soften competition. That raises the broader issue of firms' strategic interaction and market power in oligopoly markets. Competition Agencies' concerns with market power are likely more acute in oligopolistic markets with very few firms – referred to in this note as “*Polyoligopolies*”. As such, section 3 widens the scope of the contribution by reviewing developments of the last twenty years of the structural empirical industrial organization literature on how to measure market power through an encompassing framework for the assessment of market power in an oligopoly.

2. Coordinated Effects in Merger Control

2.1 *A tale of two PCA's merger cases involving coordinated effects analyses*

5. There is a variety of ways in which a merger can raise competition concerns due to coordinated effects. The analytical approach to their analysis must be chosen so as to properly frame a potential theory of harm. This can entail very distinct approaches.

6. In its decisional practice, the PCA highlights two – a horizontal and a vertical – merger cases where the nature of the potential coordinated effects theory of harm was very different. These two cases raised very different challenges in terms of coordinated effects assessment and required different analytical approaches, including in terms of the balance between quantitative and qualitative elements.

2.1.1 *The BCP/BPI Merger*

7. The first of these cases concerns the merger between banks BCP and BPI, notified to the PCA in March 2006¹. BCP and BPI were the 2nd and the 5th biggest banks in Portugal, respectively, in a concentrated market structure where the seven biggest banks accounted for 95% of the total loans and 91% of the industry assets.

8. Portuguese banking markets presented a number of characteristics that could make them vulnerable to coordination: high concentration, strong barriers to entry, cross shareholdings amongst market participants and multi-market contacts. Portuguese banks offer a similar portfolio of products. Furthermore, although pricing in banking markets is complex (which entailed price opacity for consumers), the PCA considered that this was less likely to have an impact on banks' ability to timely identify rivals' pricing strategies (given the expertise of their personnel in understanding the sometimes complex price lists and extract information from the simulation tools available on banks' websites).

9. The merger would reduce the number of players in the market, lead to a substantial increase in concentration and eliminate a player which, despite the high switching costs that characterise the sector, seemed to have an important role in contesting rivals' market shares. For some of the markets, namely those involving the provision of banking services to SME's, the merging parties were found to be close competitors. BPI was shown to engage in business stealing strategies that led to a substantial diversion of clients from rivals (especially BCP) to BPI.

10. The PCA considered it was important to further clarify the merger's potential for coordinated effects by undertaking a thorough quantitative assessment of the added incentives for coordination generated by the merger. The analysis² conducted followed the approach proposed by Kovacic, Marshall, Marx, and Schulenberg (2009)³. This methodology consists in quantifying the payoffs associated to a collusive equilibria and computing the change brought by the merger to these payoffs by simulating a hypothetical scenario of collusion in the market pre and post-merger.

11. The analysis undertaken focused on two markets, namely mortgage loans and short term corporate credit markets, where competition concerns were aprioristically more acute. The data requirements were substantial. Through an extensive effort of information collection, the PCA gathered a rich cross-section data set at the consumer level. Using this data set, the price elasticities of demand for both mortgage loans and short term corporate credit were estimated, using a multinomial logit model. Marginal costs were estimated, assuming that competition in the industry was best characterised by a Bertrand game. A model, calibrated with the estimates for banks' pricing strategies and marginal costs, was used to simulate the impact of the merger on prices (i.e., interest rates), market shares, banks' profits and consumer surplus.

12. The impact of the merger on banks' incentives to engage in coordinated behaviour was quantified by comparing collusive payoffs before and after the merger, i.e., by computing the difference in profits earned under coordination pre and post-merger, in each of the two markets.

13. The results of the simulations undertaken estimated that the merger would significantly enhance firms' incentives to coordinate in both markets. More specifically, the study found that the merger would entail an estimated increase of 54.2% on banks' aggregate profits in the mortgage loan market, under a hypothetical scenario of collusion amongst the three largest banks. The estimated loss from collusion to consumers was estimated to increase by 37.5%, i.e., amounting to an additional 456 euros, per household, per year.

¹ Case 15/2006.

² The study was later published as Brito, D., P. Pereira and T. Ribeiro, (2008).

³ The analysis refers to an earlier version of this paper.

14. For the short term corporate credit market, and again assuming coordination amongst the three largest banks, the merger would increase collusive profits by an estimate of 275.3% and the consumer welfare loss from collusion by an estimate of 226%.

15. The results of the analysis were combined with further elements concerning the expected dynamic evolution of the market. , The merger was cleared subject to commitments aimed at solving unilateral effects concerns, as, in the end, after balancing all evidence, the PCA decided not to pursue a coordinated effects theory of harm. This conclusion followed the analysis of the historical pattern of pricing strategies of other market players and their potential role in destabilizing the coordinated behaviour.

2.1.2 *The “Sport TV Merger”*

16. More recently, in July 2014, the PCA blocked a vertical merger whereby PT was entering an already existing joint venture between ZON Optimus and Controlinveste⁴. PT and ZON Optimus (currently named “NOS”) are the main telecom operators in Portugal. The Joint Venture was Sport TV, the longstanding monopolist supplier of Sports premium channels to telecom operators in Portugal until a recent entrant, Benfica TV (premium), started broadcasting in July 2013. Pre-merger, Sport TV was a 50/50 joint venture between ZON Optimus and Controlinveste. After the merger, ZON Optimus and PT would hold 25% of Sport TV each, sharing control over the joint venture with Controlinveste, the third party to the deal.

17. The merger raised serious competition concerns, both in terms of vertical and coordinated effects. PT and ZON Optimus are neck-to-neck competitors in downstream markets, in particular pay-tv (standalone or in bundle) and triple-play. At the time of the assessment, ZON Optimus and PT’s supplied 50% and 40% of pay-tv subscribers in Portugal, respectively.

18. The vertical and coordinated effects of the merger were highly entangled. The merger was found to raise issues of both customer and input foreclosure, and these theories of harm fed into the coordinated effects analysis. As such, prior to addressing coordinated effects concerns – the central issue in this note –, a brief description of customer and input foreclosure concerns is provided.

19. Customer foreclosure concerns were mainly related to the fact that prior to the merger non-vertically integrated telecom operators accounted for around 50% of the market. Given its high market share, PT had an important role pre-merger as itself, alone, could likely threaten the success of a customer foreclosure strategy led by ZON Optimus to block entry of rivals to Sport TV (where ZON Optimus held a 50% shareholding). However, this scenario would be radically changed after the merger as non-vertically integrated telecom operators would represent no more than 10% of the market. With the merger, PT’s incentives to promote/distribute a rival Sports premium channel would decrease. ZON Optimus, which was already a Sport TV’s shareholder pre-merger, would nonetheless have enhanced ability and incentives for customer foreclosure⁵. As such, the ability and capacity of Sport TV’s shareholders for engaging in customer foreclosure strategies would be strengthened by the merger.

⁴ Case Ccent. 4/2013 - Controlinveste*ZON Optimus*PT /Sport TV*Sportinveste*PPTV.

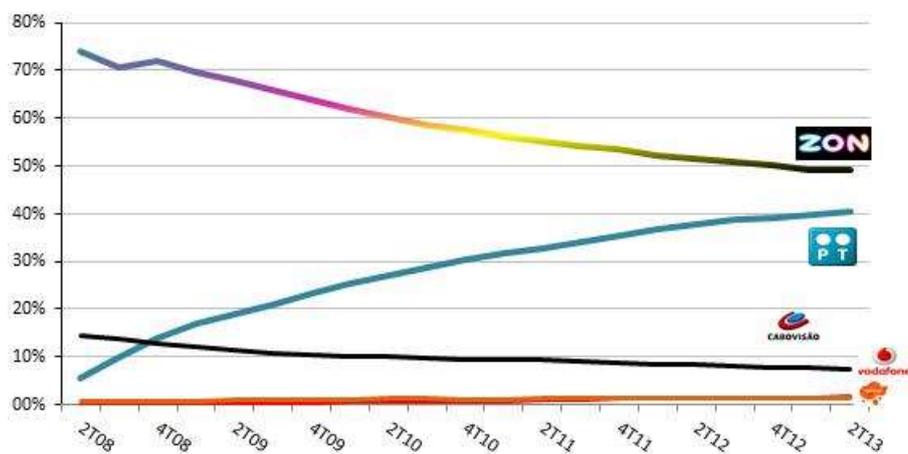
⁵ While the share of ZON Optimus in Sport TV’s profits after the merger would be lower, this decrease would be more than offset by the net gains, accruing to ZON Optimus, from strategies aimed at foreclosing Sport TV’s rival’s. These added net gains were mainly related with the absence, post-merger, of foreclosure driven customer diversion from ZON Optimus to PT, decreasing ZON-Optimus losses in downstream markets. This diversion would, in fact, likely render a pre-merger foreclosure strategy led by ZON-Optimus unsuccessful.

20. Input foreclosure was already a concern in the market⁶ pre-merger. Nonetheless, the merger was found to strengthen Sport TV's market power, thereby reinforcing the ability of its integrated shareholders (ZON Optimus and PT) to partially foreclose their downstream rivals' access to must-have sports premium channels.

21. The assessment of the merger's coordinated effects followed closely the methodology set forth in the PCA's Guidelines for the Economic Evaluation of Horizontal Mergers (draft). As stated in the draft Guidelines, the PCA evaluates coordinated effects in a stepwise approach. The analysis entails an evaluation of the market's characteristics and their potential interplay in enhancing the likelihood that the three well established conditions for coordination are met (ability to reach the terms of coordination and internal and external sustainability of the coordination). The analysis then focuses on the specific impact of the merger, assessing whether it makes coordination easier, more stable or more effective. Furthermore, a coordinated theory of harm should identify the likely coordination mechanism, which should also set the frame for the assessment of the specific changes brought about by the merger.

22. A comprehensive and articulated evaluation of the relevant characteristics of pay-tv and triple-play markets led to the conclusion that together they made these markets vulnerable to coordinated behaviour. Furthermore, the analysis showed that, at the time of the assessment, the market structure was more prone than ever before to coordinated behaviour, given the striking convergence of ZON Optimus and PT's market shares, which almost split the Pay TV market. Figure 1 illustrates this evolution.

Figure 1 – The evolution of Pay TV market shares in Portugal



23. The merger would strengthen several of the market characteristics that favour coordination: it would deepen the structural links between ZON Optimus and PT and harmonize their degree of vertical integration, their cost structures as well as their level of information on rival telecom operators. The merger would create privileged fora for information exchange amongst ZON Optimus and PT, thereby increasing information transparency. Furthermore, the merger would eliminate a source of contention between ZON Optimus and PT – namely the conditions of PT's access to Sport TV channels. The merger's vertical effects – input and customer foreclosure – strengthened barriers to entry in upstream and downstream markets, further strengthening the external sustainability of coordination.

⁶ In June 2013, the PCA issued a decision fining Sport TV for an abuse of a dominant position for engaging in price discrimination in the provision of premium sports channels to pay-tv telecom operators, from 2005 to April 2011.

24. In the post merger scenario, the three conditions for coordination would be met for pay-tv markets, in a coordination mechanism likely led by ZON Optimus and PT – the two main telecom operators accounting for around 90% of the market and nearly identical market shares –, to which remaining players, Cabovisão and Vodafone, would probably accommodate. As a result, competition would be softened with less aggressive business stealing strategies, less frequent competitive price offers (e.g., discount packages) and lower variety as the incentives for differentiation of the sports channel portfolio would be reduced.

25. This coordination mechanism would be externally sustainable, as the remaining competitors in the market would neither have the ability nor the incentives to deviate from the coordination. Cabovisão and Vodafone had an entangled set of commercial relationships with ZON Optimums and PT, namely for the supply of crucial inputs. This would provide wide scope for retaliation to deviations. Furthermore, their joint market share was below 10%, and the narrower geographic coverage of their networks limited their ability to destabilize the coordination.

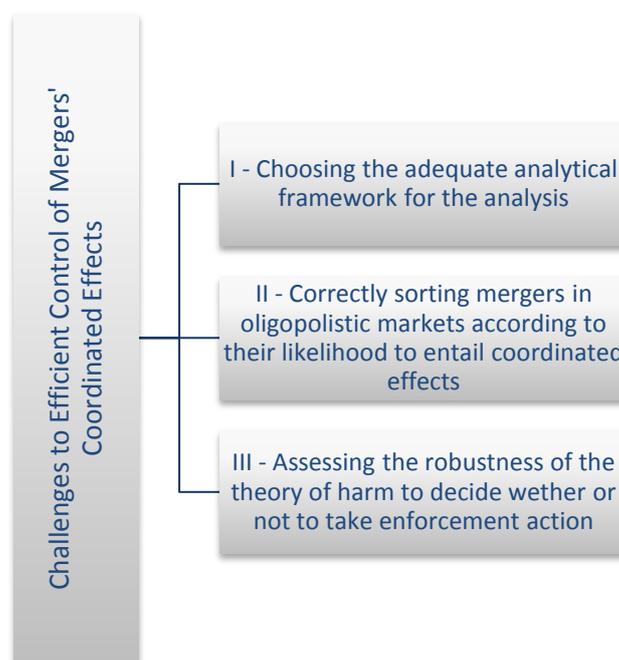
26. The above findings led to the conclusion that the merger would make reaching a consensus easier; the internal sustainability of coordination would be enhanced by more aligned incentives, common information on market players’ strategies and stronger retaliation mechanisms; and the external sustainability would be reinforced mainly through the merger’s vertical effects. The merger would thus strengthen the conditions for coordination in a market vulnerable to coordinated behaviour, and which had become increasingly so in years prior to the merger announcement.

27. The merging parties submitted a set of commitments to the PCA, which nonetheless were found to be neither sufficient nor adequate to eliminate the competition concerns identified regarding the merger’s vertical (input and customer foreclosure) and coordinated effects. The PCA thereby blocked the merger on the 31st of July, 2014.

2.2 Some thoughts on the main challenges in assessing a merger’s coordinated effects

28. From the experience it gathered, the PCA identifies the following three main challenges faced by competition enforcers in assessing a merger’s coordinated effects:

Figure 2 – Challenges faced by competition enforcers in assessing coordinated effects



29. These aspects are the three cornerstones of efficient merger control in cases where it is not prudent to rule out coordinated effects in a first screen.

30. In what concerns the choice of the adequate analytical framework, the two cases discussed above provide an illustration of how differences in the cases have determined the need to follow different approaches, in an exercise tailor made to the case at hand. The choice of an inadequate analytical framework may compromise subsequent assessments or entail unnecessary waste of time and resources. Both qualitative and quantitative analyses have a role to play, but the balance between them depends on the case specificities.

31. Complex quantitative techniques may provide further insights to the analysis. This is particularly the case in mergers (probably more so in those with a horizontal nature) in oligopolistic markets with few firms (referred to as “*polyoligopolies*” in section 3), which have several characteristics that enhance vulnerability to coordination, but where other red flags (e.g., elimination of a clear maverick) are absent. When a merger’s structural impact in a market vulnerable to coordination is substantial (e.g., brings about reductions in an already very low number of market players coupled with a considerable drive towards symmetry among the two largest players), complex quantitative tools may assist the enforcer by translating the structural changes into a quantitative measure of the change in firms’ incentives to collude. In the BCP/BPI merger case, the PCA considered that such quantification could provide useful insights. It is, however, crucial to ensure that the economic model used fits the relevant market characteristics and adequately captures the competitive process (e.g. structural models well calibrated to the market circumstances). Failing to do so might entail less informative (or even meaningless) results.

32. Furthermore, the information obtained needs to be combined with other quantitative and qualitative evidence for a robust assessment. Relying solely on one indicator does not provide a robust decision. Moreover, complex quantitative tools rely on economic models, and no attempt to stylise the market environment is free from potential shortcomings. Also, there are risks on the little weight courts may place on results of quantitative complex tools. As in any assessment, a coordinated effects analysis should be an articulate analysis of several elements of evidence.

33. However, in other cases, a competitive assessment under stylised case specificities, conceptual analysis and other qualitative and quantitative evidence may dismiss the need for further complex tools. A merger’s impact may also be more difficult to capture in an economic model. This was indeed the case in the Sport TV merger where the robustness of the theory of harm would not significantly benefit from further quantitative analysis. Furthermore, the nature of the merger (vertical) and the specificities of its impact in the conditions for collusion would not be easily captured by an economic model. The merger’s induced effects did not imply an (at least immediate) change in the market structure (defined as the number and relative size of firms), but rather facilitated coordination in several other ways, which would pose particular challenges to appropriate economic modelling.

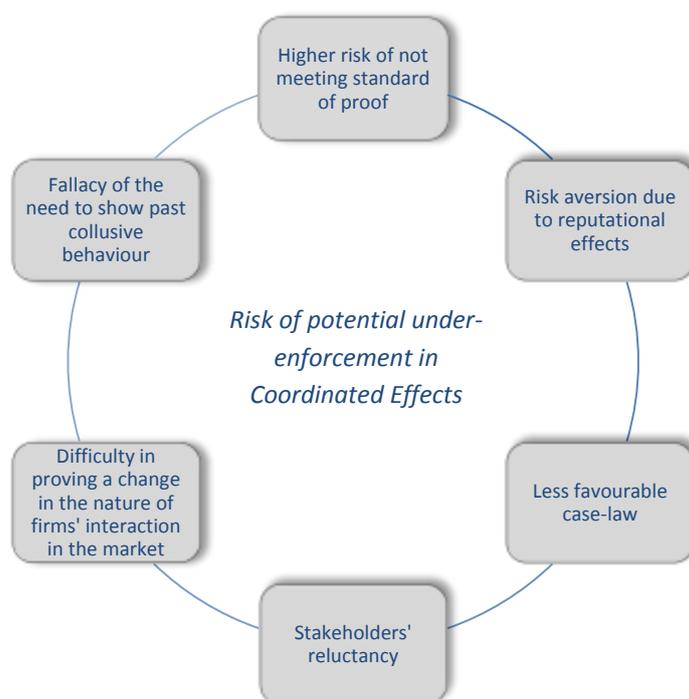
34. The decision to resort to complex quantitative techniques for assessing coordinated effects must be preceded with a balancing exercise which, on the one hand accounts for the added insights to the decision making process, and, on the other hand, accounts for data availability and the required collection effort, the constraints posed by legal deadlines, the resources required and any other obstacle to the likely robustness/usefulness of the insights obtained.

35. An adequate choice of tools and evidence, within a well-defined methodology, assist the competition enforcer in the challenge of sorting mergers in oligopolistic markets which indeed raise competition concerns with coordinated effects from those which do not introduce a significant change in the way firms interact (or will interact) in the market. A wise assessment and distinction between these two universes of merger cases is crucial in for optimal competition enforcement.

36. Failing to take enforcement action in mergers which entail coordinated effects will allow markets conditions where collusion will more likely emerge last longer and/or affect more products and more consumers, lead to higher prices or lower quality. On the other hand, over-enforcement will entail unnecessary costs for firms and negatively affect the efficiency of the market outcome. Once the appropriate analysis was carried out, the competition enforcer is faced with the task of assessing the robustness of the theory of harm and deciding whether or not to take enforcement action.

37. There are, however, a number of factors which contribute to an overly risk averse approach by the competition enforcer with regard to mergers involving coordinated effects. Stakeholders are often particularly resistant to coordinated effects theories of harm. Also, the perceived risk for competition agencies of not meeting the legal standard of proof as interpreted by Courts is higher in coordinated effects than in unilateral effects merger cases. This may be related with the intrinsic nature of coordinated effects analysis, namely the challenges of proving a likely change in the nature of firms' interaction in the market, the narrower *acquis communautaire*, previous rulings unfavorable to agencies' decisions, stakeholders' misconceptions, among other potential factors.

Figure 3 – Factors which may contribute to under-enforcement in coordinated effects



38. An example is the fallacy that a coordinated theory of harm can only be regarded as a solid case when it is accompanied with proof of past collusion in the market. This fallacy has two fundamental problems: i) it represents an unstated acquiescence that there will be under-enforcement as to coordinate effects and ii) may divert excessive efforts to a particular aspect of the fairly commonly accepted methodology for assessing coordinated effects.

39. While proof/strong indicia of coordination in the past may be a particularly valuable element in assessing a market's vulnerability to coordinated behaviour, it is not a guarantee that coordination will take place in the future. Nor is the absence of such indicia/proof an indication that collusion will not arise in the future. The challenges in proving this may discourage agencies from pursuing coordinated effects theories of harm in mergers where they indeed pose a concern.

40. Abstracting from all other relevant market differences, the potential for consumer welfare loss is higher in the case of mergers whose specific impact will trigger a previously non-existing coordinated outcome. While this is impossible to assess as such, accepting that enforcement action can only take place in markets with proof of previous coordination necessarily fails to cover those cases.

41. The well-established methodology for coordinated effects assessments rather focuses on assessing a market's vulnerability and the specific impact of the merger. This was the approach followed by the PCA in the Sport TV merger, where a theory of harm was put forward without establishing whether or not collusion had previously occurred in the market.

42. The challenges to competition enforcers in the assessment of coordinated effects are vast but must be overcome in order to allow optimal merger control. Despite the fact that coordinated effects entail higher consumer welfare losses than unilateral effect, there are several factors that may contribute to an endemic under-enforcement in coordinated effects.

3. *Polyoligopolies: How to Measure Market Power*⁷

3.1 *Introduction*

43. There is a perception that: i) the exercise of market power reduces social welfare, and ii) the smaller the number of firms in an industry, the higher the exercise of market power. Based on this perception, Competition Authorities tend to worry about the exercise of market power in industries with very few sellers, i.e., in "*polyoligopolies*". While notions i) and ii) hold in many situations of interest, they are not always true.

44. To complicate matters further, market power can be exercised by: *a) unilateral actions*, *b) implicit collusion*, or *c) explicit collusion*. Explicit collusion, if properly identified, can be dealt with by Competition Law. Merger control can also prevent anticompetitive market changes. Unilateral actions and implicit collusion, however, are not unlawful⁸, nor should they be. So what are Competition Authorities to do in the latter cases? If market power is exercised at a low level, or temporarily, this will be less of a concern. It might be simply the result of the normal functioning of the market. If, however, market power is exercised at a high level and for a long period, it is worth investigating what the source of market power is. It might be some market dysfunction, susceptible of being corrected. In any case, the first step of any intervention by Competition Authorities should be a careful evaluation of the level market power.

45. This Note reviews developments of the last twenty years of the structural empirical industrial organization literature on how to measure market power. These methods rely on the availability of demand data, and some information about either the strategic environment or costs. The description is non-technical and non-exhaustive. It aims at bringing these methods to the attention of a broad audience.

46. Section 3.2 introduces several basic concepts. Section 3.3 discusses two methods of evaluating market power with different information requirements. Finally, Section 3.4 discusses several extensions.

⁷ This Section was prepared by Pedro Pereira, Autoridade da Concorrência, pedro.br.pereira@gmail.com.

⁸ This is so at least in some jurisdictions. Please note that, in this section, market power exercise through unilateral actions refers only to non-cooperative profit maximizing pricing strategies that do not otherwise constitute an abuse (as e.g., predatory pricing).

3.2 Preliminaries

3.2.1 Model

47. Next, a static differentiated products equilibrium model is developed. For expositional clarity, the model is very simple. However, it admits several extensions.

48. Consider an industry where $r = 1, \dots, R$ firms produce $j = 1, \dots, J$ differentiated products. Each firm r produces a subset \mathcal{R}_r of the J products. Firms sell directly to final consumers. Denote the price of product j by p_j , the price vector by $\mathbf{p} = (p_1, \dots, p_J)$, the quantity of product j by y_j and the constant marginal cost of product j by c_j . The demand of product $j = 1, \dots, J$ is:

$$y_j = D_j(\mathbf{p}). \quad (1)$$

49. The profit of firm $r = 1, \dots, R$ is: $\Pi_r = \sum_{j \in \mathcal{R}_r} (p_j - c_j) D_j(\mathbf{p})$. Firms choose the prices of their products simultaneously to maximize profits.

50. Let $\gamma_{jj'}$ be the *control parameter* that the firm that owns product j gives to the profit of product j' in its profit maximization problem. When firms play non-cooperatively, $\gamma_{jj'}$ takes value 1 if products j and j' belong to the same firm, and 0 otherwise.

51. When firms play cooperatively, $\gamma_{jj'}$ takes value 1 if products j and j' belong to the same firm or if the owners of products j and j' collude, and 0 otherwise. Denote by $\mathbf{\Gamma}$ the set of control parameters for $j, j' = 1, \dots, J$. Control parameters embody information about both: i) the ownership structure, and ii) the game firms play.

52. The equilibrium is characterized by the $j = 1, \dots, J$ first-order conditions:

$$y_j + \sum_{k=1}^J \gamma_{jk} (p_k - c_k) \frac{\partial D_k(\mathbf{p})}{\partial p_j} = 0. \quad (2)$$

3.2.2 Measure of Market Power

53. If firms compete in prices, or quantities, economic theory defines *market power* as the ability of a firm, or a group of firms acting jointly, to profitably raise price above the competitive level. The concept of market power is formalized by the *Lerner index*:

$$\mathcal{L}_j = \frac{p_j - c_j}{p_j}, \quad (3)$$

which measures the proportional deviation of price from marginal cost (Lerner, 1934).

54. From (3), to compute the Lerner index one needs to observe both: i) the price, and ii) the marginal cost. Measurement problems associated to either of them, but particularly to marginal costs, usually hinder the direct computation of the Lerner index.⁹ However, it is possible to compute the Lerner index indirectly, as shown in Section 3.3.

3.2.3 Relevant Benchmarks

55. In what follows, two benchmarks for the Lerner index are presented. This section follows Nevo (2001) and Slade (2004).

⁹ Regarding the price, the services in question may involve complex tariff plans. Regarding the marginal cost, the problems are typically more severe, since the source of information about firms' costs is accounting data, which is seldom appropriate for economic analysis.

56. Value \mathcal{L}_j varies between 0 and 1. However, from the perspective of both industrial organization and competition policy, those are not the relevant lower and upper bounds. Under oligopoly, product differentiation, search or switching costs, fixed costs, etc. may lead to strictly positive margins, $\mathcal{L}_j > 0$, even when firms do not collude. Similarly, the existence of alternatives constrains the firms' ability to set prices strictly less than infinitely higher than marginal cost, $\mathcal{L}_j < 1$.

57. From the perspective of competition policy, the relevant lower and upper bounds for (3) are: i) a Nash equilibrium, and ii) joint profit maximization. Index these two cases by superscript, $e = n, c$, respectively, and denote the associated sets of control parameters by Γ^n and Γ^c , and Lerner indices by $\mathcal{L}_j^n = \frac{p_j - c_j^n}{p_j}$ and $\mathcal{L}_j^c = \frac{p_j - c_j^c}{p_j}$.

58. In the first case, multi-product firms non-cooperatively set the prices of their products to maximize their profits. This case involves two sources of market power: *i) the product differentiation effect*, i.e., a firm able to differentiate its product from those of its rivals can sell it at a higher price, than a firm whose product is a close substitute of those of its rivals, and *ii) the portfolio effect*, i.e., a firm producing two substitute products sells them at higher prices than two separate firms, because it internalizes the diversion of sales. The sum of these two effects is the *unilateral effect*. In the second case, firms cooperatively set the prices of their products to maximize joint profits. The source of market power is the *coordinated effect*, i.e., firms maximizing the joint profits of their substitute products, sell them at higher prices than firms maximizing individual profits, because they jointly internalize the diversion of sales.

3.2.4 Information Requirements

59. In what follows, a brief discussion on the information required to estimate market power. Evaluating market power requires information about: i) preferences, ii) technology, and iii) the game firms play. Nonetheless, less information about one of these aspects can be compensated for with more information about another.

60. The structural methods reviewed in this Note explore this principle. However, it is assumed throughout that: i) the equilibrium of the game firms play can be framed in terms of system (2), and ii) there is enough information to estimate a demand function.¹⁰ Assumption ii) implies that there is information about prices and quantities, as well as estimates of the demand function, namely its price derivatives.

3.3 Measuring Market Power

3.3.1 No Cost Information

61. A brief description of how to measure market power without cost information is undertaken in this section.¹¹ The lack of information about costs has to be compensated with information about the game firms play, and in particular the control parameters. This means that either one: i) observes the actual control parameters, or ii) is prepared to assume a particular set of control parameters. Denote the actual, or assumed, set of control parameters by Γ^o .

¹⁰ Demand estimation is beyond the scope of this Note. Currently, the standard approach to estimating differentiated product demand systems consists of using discrete choice models, represented by, e.g., Domencich and McFadden (1975), McFadden (1974), McFadden (1978), and McFadden (1981), or in the industrial organization side by, e.g., Berry (1994), Berry et al. (1995), Goldberg (1995), and Nevo (2001).

¹¹ Rosse (1970) pioneered using output and price data and equilibrium conditions to estimate marginal costs.

62. Equilibrium system (2) includes: i) prices, p_j , ii) quantities, y_j , iii) demand derivatives, $\frac{\partial D_k(\mathbf{p})}{\partial p_j}$, iv) control parameters, \mathbf{F} , and v) marginal costs, c_j . By assumption, i) and ii) are observed and there are estimates of iii). Also by assumption iv) is “known”. With this information, the J equations of system (2) can be used to compute the marginal costs c_j^o for the J products. Given the observed prices and the estimated marginal costs, one can then compute the Lerner indices: $\mathcal{L}_j^o = \frac{p_j - c_j^o}{p_j}$.

63. By replacing the set of control parameters \mathbf{F}^o , by sets \mathbf{F}^n and \mathbf{F}^c , this procedure can be used to compute the Lerner indices of the benchmarks of Section 3.2.3: \mathcal{L}_j^n and \mathcal{L}_j^c . By comparing \mathcal{L}_j^o with \mathcal{L}_j^n and \mathcal{L}_j^c , one can evaluate the level of market power.

3.3.2 Some Cost Information

64. In this section, a brief description of how to measure market power with some cost information is provided.¹² Control parameters embody information about: i) the ownership structure, and (ii) the game firms play. The former is usually observable. The latter is usually not, and has to be assumed. Incorrect assumptions about the control parameters lead to biased estimates of the marginal costs and thereby of the Lerner index. Hence, it is important to have a way to evaluate which set of control parameters describes the industry best.

65. This approach does not require data on marginal cost, but requires data on cost characteristics of the products. The latter are easier to obtain than the former. Denote the vector of cost characteristics of product j by Z_j . The marginal cost function of product $j = 1, \dots, J$ is:

$$c_j = C(Z_j). \quad (4)$$

66. Replacing equation (4) in equation (2) gives:

$$y_j + \sum_{k=1}^J \gamma_{jk} (p_k - C(Z_k)) \frac{\partial D_k(\mathbf{p})}{\partial p_j} = 0. \quad (5)$$

67. Implementing this approach consists on the following four steps. First, specify the set of the $s = 1, \dots, S$ proposed games, i.e., the games that are believed to describe the actual industry best. Each game has associated a given set of control parameters \mathbf{F}^s . Second, for each \mathbf{F}^s , estimate simultaneously equations (1) and (5). This procedure generates estimates of (1) and (4) for each \mathbf{F}^s , given the equilibrium condition. Third, use the estimates of (1) and (4) for $s = 1, \dots, S$ to perform the pairwise non-nested hypotheses test of Rivers and Vuong to select which of the proposed games explains the data best.¹³ Let \mathbf{F}^σ be the set of control parameters of the selected game and let $\{c_j^\sigma\}$ be the associated estimates of marginal costs. Given the observed prices and the estimated marginal costs, one can then compute the Lerner indices $\mathcal{L}_j^\sigma = \frac{p_j - c_j^\sigma}{p_j}$. The latter can be compared with \mathcal{L}_j^n and \mathcal{L}_j^c to evaluate market power. This approach generates estimates of the marginal costs, and also indicates which set of control parameters describes the industry best.¹⁴

¹² This Section follows Bresnahan (1987) and Gasmi et al. (1992).

¹³ The pairwise tests for non-nested hypotheses of Rivers and Vuong (2002) offer a general framework for assessing the statistical significance of the difference in model selection criterion values for two competing models. They test the null hypothesis that two competing models adjust equally well the data versus the alternative hypothesis that one model fits the data best, without requiring either model is correctly specified.

¹⁴ Nevo (2001) and Slade (2004) proposed a variation of this approach, the *Menu approach*, that relies on an exogenous estimate of marginal costs. Brito et al. (2013) proposed an alternative that also requires an estimate of marginal costs, and uses the equilibrium conditions to estimate a constrained version of the control parameters. The new empirical industrial organization, e.g., Bresnahan (1989), proposed an approach which consisted of

4 References

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estimating simultaneously a demand and an equilibrium equation. The latter, in addition to cost parameters, included a conjectural variations parameter, which measured the degree of competition. This approach was criticized by Corts (1999), Genesove and Mullin (1998) and Nevo (1998).

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