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**Economic Analysis of the Vodafone / Nowo Decision by the
Portuguese Competition Authority**

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Abstract: Arguments behind the AdC's prohibition of Vodafone's acquisition of Nowo are examined. Market structure analysis is conducted, and effects on concentration are compared with thresholds in the merger guidelines of the EC, AdC and DoJ. A cross-section empirical study, using own collected data estimates Nowo's presence effect on probability of discounts for the largest operators, estimated by linear probability models and propensity score matching. The impact of Digi's entry is considered, as market structure analysis is re-estimated to account for a 5 to 4 merger. The main results of this analysis corroborate AdC's decision of blocking the merger.

Keywords: Competition, Telecommunications, Portugal, Horizontal concentrations, Cross-section, Competition authority

1. Introduction

On the 7th of November 2022, Vodafone notified the *Autoridade da Concorrência* (AdC) of the acquisition of Carbonitel, Nowo's parent company. After competition concerns were raised, three remedy packages proposed by Vodafone were rejected by the AdC, as they were deemed not enough to mitigate anti-competitive effects. The operation was blocked in July 2024, as the parties failed to justify why the merger would not have significant negative effects on competition.

The goal of this paper is to provide an economic analysis of some of the main arguments leading to this decision. Section 2 provides a review of relevant literature to study merger cases in markets similar to Portuguese telecommunications.

Section 3 approaches the methods used by the AdC to define relevant product and geographic markets.

In section 4, market structure analysis featuring changes in market shares and concentration indexes at the national level is conducted. The section also discusses the developments in the 2021 spectrum auction promoted by ANACOM, and how the merger between Vodafone and

Nowo may undermine the objectives of the auction. A theoretical model of likelihood of coordinated effects arising from acquisition of the smallest firm in the market by one of two asymmetric larger firms is used to explain why the threshold of change in concentration should be lowered when analysing this merger specifically, in order to correctly assess concerns arising from coordinated effects.

Section 5 features an empirical analysis showing that discounts for the three biggest operators are significantly more likely in municipalities within Nowo's footprint, suggesting that the merger eliminates a maverick firm.

In section 6, evidence of coordinated behaviour is discussed, as well as the reason why Vodafone is, out of the historical operators, the one with the highest interest in acquiring Nowo. Section 7 approaches the impact of Digi's entry in the Portuguese telecommunications market, with a recalculation of previously computed market shares and concentration indexes to account for Digi's presence, and how Digi's acquisition of Nowo proves that the failing firm defense argument used by Vodafone is not valid.

2. Literature Review

According to the "Guidelines for Economic Analysis of Horizontal Mergers", developed by the AdC, the goal of the market definition exercise is to capture all relevant competitive constraints to the strategy of merging parties. It is a necessary tool to understand what the market is, calculate the market structure, support market structure analysis, allowing to identify participants, market shares and concentration indexes, especially important for concentrations in markets of homogeneous goods. It is a crucial instrument to verify notification criteria related to market share, according to Art. 37 of Decree-Law no. 19/2012 of 8 May, which states mergers creating or reinforcing market shares above 50%, or between 30%-50% if at least one of the parties has a turnover above €5 million. The guidelines also provide an overview of relevant theory for various approached topics (Autoridade da Concorrência 2013).

Literature often characterizes telecommunications markets as being characterized by heterogeneous products (Claici et al. 2017), with differentiation taking place on both supply and demand side.

It is key to review theory on mergers in highly concentrated markets. On one hand, in those markets, *ceteris paribus*, concentrations increase market power more than in fragmented industries since firms face less competitive restraints from rivals (Motta 2004). On the other hand, in such markets, mergers may increase the risk of coordinated effects. This is supported by both economic theory (Tirole 1988) and evidence (Levenstein and Suslow 2004). Potential reasons are that, because these markets are characterized by a low number of powerful firms, eliminating one of them means that there are less potentially disruptive forces to collusive agreements and that it is easier to punish firms that deviate from cooperation.

Motta and Peitz (2020) state that market share stability is generally regarded as evidence for a collusive environment in a market.

Klemperer (1987) demonstrated that in markets with switching costs prices are lower in the initial period, i.e., before the subscription takes place, while in subsequent periods, prices are higher, meaning that, theoretically, prices are higher than the competitive level in markets with switching costs after subscriptions take place.

Motta (2004) also brings an interesting discussion about concentration and collusion, including the concept of symmetry, arguing that, for the same number of firms, “*the more firms are asymmetric (...) the less likely collusion will be*”, adding that the HHI index raises as a result of asymmetry, creating an ambiguous relationship between concentration and collusion, while Nocke and Whinston (2022), argued that thresholds established by the 2010 DoJ Guidelines, which increased the Delta threshold for highly concentrated markets from 50 to 100, are “*likely too lax*”, requiring efficiency levels of approximately 5% to produce gains in consumer surplus.

Baker (2000) points that the pricing strategy is a strong indicator of maverick behaviour, since this kind of firm generally undercuts prices of other players in the market, especially when collusion takes place, having potential to block or soften price increases

3. Market Definition

Generally, the AdC defines relevant markets based on the activity of the acquired firm. Exceptions to this rule include operations for which eliminating potential competition is an important factor of concern.

Relevant product market definition consists of the identification of products susceptible to exert significant competitive pressure on each of the parties, the focal product. It is important to assess substitutability from the demand and supply sides, considering evidence such as product characteristics and usages, opinion of market agents, price elasticities and diversion ratios, on the demand side, and existence of excess capacity, know-how and technology on the supply side, as well as entry conditions.

The relevant geographic market is equal to the geographic area for which the strategy of both parties is susceptible to be influenced by competitive pressure with other market agents. The area where parties are active is named focal area. When it is impossible to engage in price discrimination based on consumer location, the exercise is done with reference to supplier location, while when it is possible, the exercise is done with reference to consumer location. Evidence regarding transportation and distribution costs, preference of consumers by geographic area, product characteristics, and homogeneity of rules and regulations is particularly relevant for the definition of a relevant geographic market.

Helpful techniques in market definition include hypothetical monopolist tests, the most remarkable example being the SSNIP (Small but Significant Non-transitory Increase in Price) test, natural experiences, and analysis of price series. Competition authorities may also refer to former decisions to define relevant markets.

3.1 Relevant Product Market

To define the relevant product market, the AdC referred to former decisions by both the AdC and the European Commission (EC) in telecommunications. Additionally, the AdC considered the activity of the acquired firm, Nowo, in the development of the exercise.

The AdC considers different product markets in which both parties operate: fixed telephony, mobile telephony services, fixed access to internet, subscription television services, multiple play bundle offers. According to the AdC, additional analysis on the effects of the merger on the corporate telecommunication services, i.e., B2B, is not necessary, since Nowo only offers these services residually, without evidence signalling that it could be a relevant entrant in the future. Hence, the impact of the operation in this specific market will not be addressed here.

Following previous decisions, fixed telephony markets include access to public telephonic network in a fixed location,¹ phone services publicly available at fixed locals and phone services destined for non-geographic numbers publicly available in fixed locations.

Mobile telephony markets encompass national, international, and roaming voice services, SMS/MMS messaging services, as well as mobile phone internet access services.² It is worth to note that Vodafone operates as a Mobile Network Operator (MNO), meaning that it detains a wholly owned network. Nowo is currently a Mobile Virtual Network Operator, meaning that it relies on third party networks.³ However, since Nowo recently gained access to operating as a MNO by acquiring a significant amount of spectrum in the 2021 auction (more on this in section 4), we will assume the acquired firm is in able to operate in that manner.

¹ Ccent. 01/2022, Ccent. 41/2019, Ccent. 41/2018, Ccent. 46/2015, Ccent. 05/2014, Ccent. 19/2013 and Ccent. 05/2013.

² AdC: Ccent. 05/2014, Ccent. 05/2013, EC: COMP/M.9871, COMP/M.8864, COMP/M.9041, COMP/M/7758, COMP/M.7499, COMP/M.6990

³ Nowo operated as a MVNO using MEO's network.

Fixed internet access markets refer to the provision of fixed devices allowing customers to access internet. It includes all broadband internet access services, with no additional segmentation.⁴

Multiple play offers are bundles containing two or more services mentioned above. These are divided in double play (2P), triple play (3P), quadruple play (4P) and quintuple play (5P), according to the number of services provided and are charged in a single bill. Even though market segmentation could be a complex topic due to the variety of offers included in the market, the AdC analysed the effects of the merger accounting for any combination of services.

3.2 Relevant Geographic Market

The AdC states in its guidelines that the geographic market definition concerns the area in which the strategy of the merging parties could be affected by the commercial interaction with other suppliers. Hence, it is important to assess whether conditions of supply in some geographic areas are independent from the ones practiced in other geographic areas. The relevant focal area concerns geographic locations where merging parties are active, particularly, the acquired.

It is also relevant to assess whether it is possible to establish price discrimination according to location of consumers. For it to be possible, according to the AdC's guidelines suppliers must be able to distinguish consumers by location, which is the case if products are delivered at the customer's location and for there to be no arbitrage, i.e., no possibility of profitable resale. If this is the case, geographic markets can be defined with respect to customer location.

In the mobile telephony market, Nowo has access to virtually full coverage of Portuguese territory. In this specific market, it is impossible to distinguish consumers' location, making price discrimination impossible.

⁴ AdC: Ccent. 46/2015, Ccent.05/2014, Ccent. 19/2013, Ccent. 05/2013; CE: COMP/M.9871, COMP/M.6990.

However, for the rest of relevant product markets, since it is impossible for consumers to purchase from suppliers that are not active in their geographic location and that it is impossible to transact these services, the conditions for price discrimination hold, regardless of the adoption of a national strategic framework.

The AdC refers that ANACOM, the national telecommunication regulator, states that competition may not be homogenous between regions. Additionally, Nowo's footprint does not extend across the totality of the Portuguese territory. These conditions signal that a subnational analysis could be more appropriate. There is indeed publicly available evidence that consumer prices vary within the Portuguese territory. The 3 biggest firms (MEO, NOS, Vodafone) have coverage tests in their respective websites. By inserting different zip-codes, it is verifiable that offers for the same products have different pricing conditions depending on consumer location.

4. Analysis of market structure

In the perspective of the AdC, due to the almost universal usage of fixed telecommunication service and strategic role of the sector for economic growth, it is especially important to make sure that the merger does not have a negative impact on competition, which would harm sectors dependent on telecommunications and final consumers (households) alike. From this explanation, it is retrievable that the AdC was stricter compared to mergers in sectors perceived as less delicate, which could reflect in reduced tolerance for harmful effects from the operation. By observing the most recent numbers for market shares by revenue in telecommunications markets (ANACOM, 2024), it is seen that markets are highly concentrated, which is confirmed

by HHI values above 3000 in 2024 for all relevant product markets (Table A3),⁵ and by the fact as the three biggest firms (MEO, NOS, Vodafone) detain combined shares higher than 95%.⁶ Market shares figures from previous years also indicate that the market structure has been remarkably stable in recent years (Figure A1), which, as discussed in section 2, is often regarded as a sign of weak competition. This could signal that firms focus more on capitalizing on and retaining an existing client base than on competing for clients of other operators. The most significant developments are a slight decrease on the market share of the biggest firm, MEO, as well as a trend of convergence between the shares of the second and third biggest operators, respectively NOS and Vodafone. Simultaneously, there has not been significant breakthrough or growth from firms outside the 3 biggest ones, with Nowo, the largest firm outside of the three biggest ones, having a low market share that has decreased from 2% in 2018 to 1.5% of retail revenues in the market, in 2024. Another signal of lack of dynamism in the market is the fact that the number of operators and concentration indexes for the overall telecommunications market have remained largely unaltered in the past 6 years: The C3 index has remained in values above 97%, while the HHI sits persistently in values between 3200 and 3250 (Figure A2).

This could be an indicator of high barriers to entry and expansion. Indeed, telecommunications are a sector characterized by such obstacles. Economic barriers, including large sunk costs associated with infrastructure building costs, maintenance, updating and innovation are especially prevalent in the sector. Operation in fixed local services requires the establishment of a self-owned network with high installation costs.⁷ The existence of economies of scale creates a disadvantage for entrants, as established operators can benefit more from decreasing

⁵ The HHI, short for Herfindahl-Hirschman Index is a popular concentration measure that is equal to the sum of squared market shares. It ranges from 0, in a market of infinite equally sized suppliers and 10,000 in a monopoly. Generally, a market with a HHI lower than 1,500 is considered highly competitive and a market with a HHI above 2,500 is generally labelled as highly concentrated.

⁶ The C2 and C3 indicators measure concentration by summing the 2 and 3 biggest market shares, respectively. Here, I found it more appropriate to use C3, since the market shares of the second (NOS) and third (Vodafone) largest firms is similar, and thus, the C2 index would provide an inaccurate concentration index.

⁷ Such as fixed telephony and fixed internet access services.

average costs due to their bigger size. The sector is also associated with significant physical barriers, generally in the form of difficult access to buildings, that makes access to final customers harder. In some cases, operators need to get authorization from the residents to install needed technical components, which could raise objections. These barriers can be reduced with regulated access to local loops that effectively bypasses the need for these authorizations. Legal barriers also represent an obstacle, as establishing a wholly owned network generally requires licenses to perform works on public infrastructure at the municipality level. Access to the radio electric spectrum is also scarce and requires licensing. The access to the latter is currently limited. Entry barriers faced by MVNOs, such as Nowo, are different, as barriers associated with the establishment of a wholly-owned network are not a concern, while costs related to earning access to the network of a MNO represent a relevant economic barrier, while legal barriers associated with spectrum rights and regulated access also constrain MVNOs .

Additionally, operators have been recently creating incentives for subscription to multiple play package bundles, characterized by long customer loyalty periods. Reported switching costs are also high. Economically, they can be higher than 1,000 euros at earlier stages of loyalty periods, according to the AdC. While on one hand, customer loyalty programs have benefits such as the decrease in adhesion costs, on the other, they create demand rigidity that benefits players that are established in the market by making switching to new firms a costly procedure.⁸

The existence of such high sector-specific entry barriers justifies a more conservative approach to the effects of concentration on competition.

For market segments, the three biggest firms have a more than 95% market share. MEO is the single largest supplier in every segment, apart from 4P/5P packages, for which NOS is the leader, and mobile services, in which Vodafone has the highest share. Vodafone is third in every

⁸ According to the 2020 study by the AdC, households would switch operators only if it allowed for savings between 41% and 50% for single invoice services and 35% for multiple invoice services.

segment, apart from 2P packages, in which it ranks second, above NOS, and mobile services, in which it ranks first. The acquisition of Nowo would be enough to overtake NOS for second place in the 3P packages segment (Tables A1 & A2).

When comparing shares in revenues with shares in subscribers (Tables A5 & A6) for segments in which this is possible (Multiple Play, 3P, 4P/5P), the latter are higher for both Vodafone and Nowo, which is a signal that the parties have, on average, clients that generate lower revenues than the rivals NOS and MEO. This may indicate that the merging parties compete for the same type of customers, which can create competitive concerns.

Both the European Commission and the AdC raise competition concerns on horizontal mergers that create markets with a post-merger HHI superior to 2000, and a Delta, defined as the difference between post- and pre-merger HHI,⁹ equal or superior to 150. Concentrations resulting in firms with market shares of 40% or higher are indicators of dominant positions. The U.S. Department of Justice (DoJ) has stricter guidelines: post-merger HHI above 1800 and Delta higher than 100. Additionally, the DoJ also raises concerns about mergers that create a combined firm with a share greater than 30% and a Delta superior to 100.

By observing tables A3 and A4 the concentration is likely to create concerns according to the EC's (and the AdC's) guidelines for the Mobile Services (47.1%). Under DoJ criteria, 2P (32%) and the total telecommunications market (30.8%) are also deemed to be likely harmful for competition in the market.

Regarding changes in concentration, the merger would be susceptible of causing horizontal concerns according to EC guidelines for mobile services, (Delta of 180.40), and 2P (173.44). Under DoJ criteria, 3P also cause concerns (108.68).

In my view, it could be appropriate to lower the Delta threshold due to the abnormally high value for the Pre-Merger HHI (higher than 3000 for every segment and for the total market),

⁹ Can be interpreted as the effect of the merger on market concentration.

given that, as explained before, in markets that are characterized by a low number of powerful firms, and thus, highly concentrated, eliminating one firm, even if small, eliminates a potentially disruptive force for collusion, reinforcing concerns with coordinated effects.

Since the market was already significantly concentrated pre-merger, a merger has less room to increase concentration. This could lead to potentially harmful operations being deemed as non-worrying according to some guidelines, particularly the AdC's, especially when asymmetry is reduced, as is the case with Vodafone's acquisition of Nowo, as demonstrated by the model in Appendix B. A suggested method to obtain new Delta thresholds for markets with abnormally high pre-merger levels of concentration is explained with more detail in Appendix C.

However, it is necessary to acknowledge that calculating market shares for the national market has serial limitations, as Nowo's footprint does not coincide with the full Portuguese territory. Given this, market shares at each local market within its footprint is higher than the one estimated for the entire Portuguese territory. The fact that the coverage of the 3 largest firms in the market is wider than Nowo's would mean that at the footprint of the acquired, their market shares are lower than the ones estimated at a national level. By construction, lower shares from the biggest firms in the market would mean that each local market in Nowo's footprint would have lower HHI pre-merger than the national estimate. Similarly, the acquired firm is larger in each market within its footprint than at the full territory, and thus the operation would lead to a higher increase in concentration than what is estimated for the national market. Then, the Delta calculated at each market in Nowo's footprint is expected to be considerably higher than the one for the Portuguese territory, and thus, more likely to cause concerns.

The AdC's decision process, which uses data from 2T 2023, states that the pre- and post- merger HHI values for multiple play packages at Nowo's footprint are superior to 2000 for all segments, with values of Delta superior to 150 for all sub-segments, except for 4P packages. These values are sufficient to raise horizontal concerns according to the EC threshold. The AdC found out

that the combined market share of the parties is superior to 40% in several municipalities, with a Delta superior to 150 in 44 of them. This shows that it is likely that the operation will have significant negative impacts on competition in some municipalities within Nowo's footprint.

4.1. 2021 Spectrum Auction

ANACOM's 2021 auction (Table A7) for access to radio frequency spectrum, including the spectrum compatible with the development of 5G technology,¹⁰ had the goal of creating stronger competition in telecommunications markets. For that purpose, a spectrum cap was ensured, as well as geographic coverage and access expansion obligations for operators that acquired 5G compatible spectrum. Nowo, as MNO, and Digi entered the auction for the first time. The entrants acquired a significant amount of spectrum in 3.6GHz frequency, which will, according to ANACOM, approximate operations of entrants to the ones of the 3 historical MNOs.

If the merger between Vodafone and Nowo was cleared, the new entity would have access to a spectrum of 130MHz in the 3,6GHz frequency, which would be above the threshold defined in the auction. This particular concern could have been mitigated with a commitment to divest a part of the spectrum, which has happened in Spain, where remedies approved when clearing the merger between Orange and MasMóvil included the divestment of a part of spectrum held by the parties to entrant Digi (Orange, 2024). A similar commitment was proposed by Vodafone. Despite the commitment itself being considered appropriate, the package including this and other commitments, such as access to Vodafone's optical fiber Network across Nowo's footprint, was not deemed enough to alleviate competition concerns. The events in Spain were not mentioned in the AdC's decision.

¹⁰ 700MHz and 3.6GHz are particularly compatible with the development of 5G technology.

5. Nowo as a maverick firm

Even if the estimated figures were not of concern, the EC and the AdC identify several special circumstances that could apply to this case. Particularly, it is relevant to assess whether the merger eliminates a maverick firm. A maverick is a firm that, through their strategy, has the potential to disrupt collusion within a certain market. Operations eliminating maverick firms are expected to have negative impacts for competition that are not captured by market shares. In this case, it would be interesting to understand if Nowo could be classified as a maverick firm, by analysing several indicators, such as its price and corporate strategy.

It is, thus, of interest to compare prices across municipalities in and out of Nowo's footprint. A significant difference in retail prices between the two groups would represent evidence that the acquired is indeed a maverick, and that the merger would lead to its elimination, reinforcing competition concerns.

The AdC found out that the 3 biggest operators (MEO, NOS and Vodafone) all have special offers, i.e., discounts conditional on geographic region, in areas adding up to 20% of their footprints. Moreover, the AdC also states that the availability of such offers is concentrated on Nowo's footprint, which reinforces concerns that Nowo may be a maverick firm. A firm such as Vodafone could have an incentive to acquire Nowo instead of introducing special discounts across the footprint overlap if, through the acquisition, a significant competitive force disrupting coordination is eliminated, allowing for increases in prices that are high enough to offset the costs associated with the acquisition.

Nowo's offers are differentiated from the rest of operators in the market, which provide very similar offers among one another, as argued by the competition authority. The AdC also verified that Nowo has consistently charged lower prices than the other competitors. ANACOM stated to the AdC that offers supplied by Nowo do not lack in quality compared to its peers, which is

to be expected, given Nowo's status as a MVNO reliant on MEO's network. Neither ANACOM nor the AdC provide evidence contrary to the idea Nowo behaving as a maverick.

5.1. Empirical analysis of the effect of Nowo's presence

To assess the effect of Nowo's presence on the prices of the 3 historic operators, a cross-section econometric study at the municipality level was conducted. The analysis consisted in three specifications, for which the dependent variable in each of them was the existence of special discounts in a municipality for each historical operator (MEO, NOS and Vodafone), a dummy equal to 1 if special discounts are offered in a municipality, and 0 otherwise.

The data collection process was implemented in the following way: data regarding population per civil parish (and municipality) was collected using data from the 2021 Census, retrieved from INE (2021). Zip-codes were obtained using Google Maps, with reference to the location of the parish council of the most populated parish of each municipality. If this was not possible, zip-codes were collected from highlighted locations near the parish council, such as restaurants or shops. This specific part took approximately a week. Data regarding presence of Nowo was obtained from the map of Nowo's footprint in the study conducted by Indera for AdC, in the appendix of the decision process. The major obstacle in the data collection process was collecting information regarding presence and discounts of the 3 historical operators. For each municipality, the zip-code previously obtained had to be plugged in, alongside a phone number and an e-mail address. For MEO in particular, progressively longer and harder CAPTCHA tests as more observations were collected, significantly slowed the process. In the case the obtained zip-code did not yield any results, the process was repeated with alternative zip-codes in the municipality, up to a limit of 5, which made the process remarkably long. In total, this step took approximately two weeks, leading the original idea of using civil parishes as observations instead of municipalities being aborted, which led to a reduced number of observations.

Since own-collected reference MEO and Vodafone package prices,¹¹ obtained using the respective coverage tests, were of €47.99 and €47.9, respectively, with the presence of discount, and of €49.99 and €49.9, respectively, when discount is absent, the value of 1 in case of presence of discounts in a municipality for the concerned operator if their prices for the were, respectively, €47.99 and €47.9, and 0 otherwise.¹²

<i>Explanatory Variables</i>	<i>Description</i>
Nowo Effect	Dummy variable equal to 1 if Nowo is present in a municipality, and 0, otherwise.
Population	Population of a municipality according to the 2021 Census.
Presence 1	Dummy variable equal to 1 if the largest competitor by share is present in a municipality, and 0, otherwise. For NOS and Vodafone, the largest competitor is MEO, and for MEO, it is NOS. Omitted in NOS and Vodafone specifications, as MEO is present in all municipalities across their footprints.
Presence 2	Dummy variable equal to 1 if the second largest competitor by share is present in a municipality, and 0, otherwise. For NOS and MEO, the second largest competitor is Vodafone, and for Vodafone, it is NOS.
Discount 1	Dummy variable equal to 1 if the largest competitor by share offers special discounts in a municipality, and 0, otherwise. For NOS and Vodafone, the largest competitor is MEO, and for MEO, it is NOS.
Discount 2	Dummy variable equal to 1 if the second largest competitor by share offers special discounts in a municipality, and 0, otherwise. For NOS and MEO, the second largest competitor is Vodafone, and for Vodafone, it is NOS.

Table 1: Explanatory Variables and Description

The method raises potential concerns with measurement error, as it could be the case that special discounts are specific to certain parts of a municipality. Since a value of 1 was assumed for the presence of special discounts if one is available at any part of a municipality, it could be the case that municipalities assumed to have no special discounts may actually have locations where special discounts exist. To mitigate potential issues with this, coverage tests were conducted for 3 or more postal codes per municipality. After dropping observations relative to

¹¹ Reference prices for this study were the 4P packages for MEO and Vodafone, “*M4e 1 cartão 10GB*” and “*fibra4 Light*”, respectively, since these were the easiest prices in common to collect from the websites.

¹² As for NOS, prices were not directly given in the coverage test, but different messages would pop up in the case of presence and absence of discounts: in case of presence of special discounts, the message “*Tens Fibra com descontos exclusivos na tua casa*” would show up, while if no discounts were available, the message “*Tens fibra na tua zona*” would show up. The dummy variable for presence of discounts would be coded according to these messages.

municipalities in the autonomous regions Açores and Madeira, which are not considered in the AdC's decision, the process leads to the production of 279 observations for each of the three biggest firms.

<i>Dep. Var.</i> <i>Operator</i>	<i>Probability of special discounts</i>								
	Vodafone			MEO			NOS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Nowo Effect	0.744*** (0.0882)	0.310*** (0.0996)	0.240*** (0.0352)	0.806*** (0.0592)	0.431*** (0.135)	0.308*** (0.0348)	0.687*** (0.0734)	0.432** (0.199)	0.622*** (0.241)
Population	-1.14e-06** (4.39e-07)	-6.51e-07* (3.19e-07)		-9.39e-07** (4.18e-07)	-2.84e-07 (3.04e-07)		-1.45e-06*** (2.18e-07)	-1.19e-06** (5.12e-07)	
Presence 1				-0.0408* (0.0213)					
Presence 2	0.0669* (0.0364)			0.0558** (0.0221)			0.0689** (0.0289)		
Discount 1		0.565*** (0.150)			0.207 (0.156)			0.381* (0.218)	
Discount 2		-0.0412 (0.0786)			0.332*** (0.111)			-0.0423 (0.0870)	
Observations	197	196	196	275	198	198	254	193	193
Strategy	LPM	LPM	PSM	LPM	LPM	PSM	LPM	LPM	PSM
Clustered S.E's	District	District	No	District	District	No	District	District	No

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 2: Regression output of estimated models.

Note: For specifications (3), (6), and (9), observations were matched using existence of discounts for other operators, population, and district. The explanatory variable in all 3 specifications was Nowo's presence. In case the coefficient for the variable is positive and significant, there would be evidence that Nowo is capable of increasing the probability of price discount by a major firm, despite its relatively small market size, and that the merger would eliminate a maverick firm, and thus, would raise more competitive concerns.

Specifications (1), (4), and (7) in Table 2 also include several control variables, such as presence of the other operators, to assess whether the biggest 3 operators discipline each other's prices, as well a municipality-specific control, population. Standard errors were clustered by district, as it is expected that errors are correlated in each district, due to similarity in observations (Angrist and Pischke 2008).

A potential problem with this approach is that, since the study is based on cross-section evidence, causality may be difficult to extract. It is likely that differences in fixed costs of serving different subnational geographical markets are not accounted for using this approach. In a case where firms enter the market as long as profits are non-negative and behave competitively, in markets with a higher cost, there is less entry, as prices cannot decrease too much in order to cover fixed costs. This means average price is lower when there are more firms, not because a maverick is present, but rather because of fixed costs. Since Nowo is smaller in size compared to its competitors, in markets characterized by economies of scale, and thus, less efficient, it can create a tendency that Nowo enters markets with lower fixed cost of serving, for which prices are lower, even though Nowo's MVNO status may help mitigating these disadvantages, as it does not have to incur in costs related to the creation of infrastructure. This generates a problem of self-selection into treatment.

A way to solve this could be by simply replacing controls for presence of other operators by controls for existence of special discounts for other operators.¹³ These controls consider not only the presence of an operator, but also their pricing in each market, which takes costs into account, mitigating the bias in the estimated Nowo effect. This method is used in obtaining specifications (2), (5), and (8) in Table 2.

Another approach to the issue would be to estimate the average treatment effect (ATE) of Nowo's presence in a municipality using propensity score-matching (PSM). Here, observations would be matched based on district, population and existence of discounts for other operators, with the objective of comparing markets that are similar across several dimensions, including underlying fixed cost, apart from the presence of Nowo, and retrieve the average effect. Results arising from the approach are found in regressions (3), (6), and (9) in Table 2.

¹³ Here, additional observations would have to be dropped, because of lack of missing information on discounts of other operators: 1, 77, and 61 observations are dropped from the Vodafone, MEO and NOS datasets, respectively.

Noticeably, Nowo's presence is associated with an average reduction of price of €6.5 a month in Vodafone's 4P package bundles, according to the AdC.

This analysis uses a linear probability model instead of a logit one. The results show large and significant Nowo effects for each of the 3 historical operators. The LPM model with presence controls finds that Nowo's presence in a municipality increases the probability of a Vodafone discount by roughly 0.74, if everything else is constant, while the estimated increase for probability of MEO and NOS discounts are of approximately 0.81 and 0.68, respectively, on average, *ceteris paribus*. Alternatively, the LPM model with discount controls estimates average Nowo effects of roughly 0.31 for Vodafone, and 0.43 for both MEO and NOS, *ceteris paribus*, while the average treatment effects estimated using PSM were of around 0.24, 0.31, and 0.62, all else constant, respectively. The differences in coefficients obtained by the different strategies seem to confirm that the LPM with presence controls yields biased estimates of the Nowo effect, and that both LPM with discount controls and PSM model yield more reliable estimates. All estimated coefficients were statistically significant at 5% significance level. These estimated results are compelling evidence for a significant disciplining effect of Nowo's presence in a municipality on prices of the 3 historical operators.

The previously calculated Nowo effect is reinforced by the likely expansion of Nowo generated by the 2021 spectrum auction, which could, not only become stronger in their current footprint, but also become more widespread across the national territory.

6. Coordinated behaviour and Vodafone's incentives

Since the market is highly concentrated pre-merger, it is especially vulnerable to coordinate effects in the event of this concentration.

The AdC has found evidence for coordinate behaviour between the 3 historic operators in the market, in both qualitative and quantitative terms.¹⁴ This coordination takes place through the alignment of types of offers, prices and marketing strategies.

Stability of market shares and concentration indexes indicates coordinate behaviour, as firms may focus on extracting surplus from their existing customers, rather than competing for customers of other suppliers.

It is also relevant to assess why Vodafone in specific has an incentive to purchase Nowo. As previously discussed, Nowo exerts significant competitive pressure on larger operators, with an expansion in footprint being plausible, which could harm Vodafone more than MEO and NOS.

An acquisition of Nowo by one of the two largest firms may increase asymmetry in the market, and thus, make coordination harder to sustain, which will harm profits for the historical operators, and could deter other firms from acquiring Nowo, making Vodafone the most suitable buyer out of the incumbents (see Appendix B for a formal model).

Knowing that Vodafone is currently the operator in the 3 biggest firms in the market that has the highest overlap with Nowo, in percentage of footprint (Table A12), it could be the firm with the highest interest in the acquisition.

From AdC's decision process, Vodafone regards Nowo as a relevant operator in the market in the firm's internal documents, and even in the event of Digi's entry, Nowo's competitive capacity is not disregarded by the acquiring firm.

The entry of Digi, however, could be a significant explaining factor in Vodafone's interest in purchasing Nowo since Vodafone's course of action exclusively focus on the imminent entry after the merger notification. An acquisition of Nowo could be perceived as a move that eliminates the possibility that Digi uses a purchase of Nowo to boost entry, and thus, mitigates

¹⁴ The AdC estimated a Lerner index of 50%, indicative of significant market power, as well as a congruence index of 18%, signalling a deviation from Nash equilibrium of 18% of the difference between Nash equilibrium price and monopoly price.

competitive constraints arising from Digi's entry. In Spain, Vodafone has sold its Spanish business to Zegona, with one of the reasons for this transaction being falling revenues (Sandle 2023). The fact that Digi, which has successfully entered and expanded in the Spanish market with an aggressive pricing strategy, may be the reason behind falling revenues leading to Vodafone's divestment from Spain, is not that strong of an assumption, and thus, an acquisition of Nowo may be seen as a way to protect the operator from a similar situation in Portugal.

7. A new entrant - Digi

The 2021 spectrum auction brought a significant change in the competitive landscape of the telecommunications market in Portugal. Digi bid for and acquired a significant amount of spectrum (Table A7), allowing it to start operations similar to historical MNOs in Portugal in the years following the bidding process.

Digi is a Dutch-Romanian telecommunications company with business operations in several European markets including Spain, Italy, and Belgium.

The firm has been gathering a reputation for being a fierce competitor in the aforementioned geographic markets, characterized by an aggressive pricing strategy. In particular, this is the case in Spain, where Digi registered significant growth over the past year. Despite the competitive price strategy, the financial performance of the company is strong, with a 16.5% growth in EBITDA in Q2 2024 compared to the same period in 2023 (Barac 2024).

This is a clear sign that the competitive pricing strategy is sustainable, making Digi a potential competitive force in the Portuguese market, if the strategy used in Spain is to be replicated, which currently seems to be the case, with Digi entering the Portuguese with prices significantly lower than the ones charged by historical operators (Caçador 2024).

A study performed by Analysys Mason has found that incumbents in Spain increased prices but suffered revenue declines because of Digi's presence and strategy, indicating that Digi is harming revenues of incumbent operators (Day 2024).

Combining the spectrum capacity resulting from the auction with the expected aggressive pricing strategy, it is reasonable to assume that Digi's entry will refresh the competitive environment in the telecommunications market. Thus, analysis of effects of the concentration in the medium to long run must take Digi's presence, size, and strategy into account.

It is, hence, relevant to analyse the case of a 5 to 4 merger, which would lead to a need for re-estimating market shares and concentration indexes, obtained in sections above. This view is shared by Alvim (2024), who criticises the AdC for not modelling this scenario, and focusing on the 4 to 3 merger scenario. In my opinion, the 4 to 3 analysis is still relevant, as there was still a 2-year interval between the notification of the operation in analysis (November 2022) and Digi's effective entry in the Portuguese market (November 2024), in particular if during this period, a 4 to 3 merger allows incumbents to increase barriers to entry and expansion, such as increased customer loyalty programs. For this exercise, one would need to come up with an estimation of Digi's market size.

Digi presents promising potential for expansion, evidenced by the successful entry in the Spanish market, with strong forecasted growth, the acquisition of a significant amount of spectrum in the 2021 auction and positive financial results even with a competitive pricing strategy. However, the existing high barriers to entry and expansion in the telecommunications market, associated with the current growth trend of customer loyalty programs with sufficiently high switching costs allowing historical operators to solidify and capitalize on their existing client base, are factors that will hamper Digi's expansion in the Portuguese market.

Given the factors exposed above and Nowo's financial struggles, it is expected that Digi's market share will overcome Nowo's in all segments, while remaining far from the approximately 9% of spectrum acquired in 2021. Thus, for simplicity, and to be conservative, a 3% market share will be assumed for Digi across the board, in the medium run.

Since Digi and Nowo are both perceived to be low-cost operators due to aggressive pricing strategies, it is to be expected that they would compete for the same type of clients, and Nowo would lose a significant part of its market share. However, this is only expected to happen for mobile 1P segments (telephony and broadband), since according to the AdC, the geographical footprint overlap will be limited. Thus, I will assume that, for the mobile segments, all incumbents lose the same amount of percentage points in market share, and, for fixed segments and packages, limited diversion from Nowo (translating in a 0.2 percentage points loss for those segments and total national market), while the three historical operators register an equal percentage point loss in market share among each other (Tables A8 & A9).

Compared to the analysis of market shares and concentration indexes in the scenario pre-Digi's entry, it is possible to conclude that, while the market remains heavily concentrated, the merger is less likely to create competitive concerns. According to the aforementioned EC and AdC guidelines, the only market susceptible to cause concerns is the 3P multiple play packages market, with a HHI Delta of 167.04, while under DoJ criteria, the fixed internet market is also susceptible to cause concerns, with a Delta of 109.93 (Tables A10 & A11). It is worth to remember that the effects are underestimated, since these market shares are estimated at the national level, while the relevant geographical markets are subnational, and both Nowo's and Digi's footprint do not span across the entire national territory. This analysis also does not consider the fact that Vodafone could use an acquisition of Nowo to hinder Digi's entry, by foreclosing access to its assets, which could decrease Digi's expected market share, which leads to higher-than-expected Delta values and affect competition negatively.

7.1. Failing firm defense argument

During the process, Vodafone has alleged that the conditions for the failing defense argument to be considered are met.

The EC's guidelines, cited by the AdC, state that this argument should only be considered if, and only if, all of three criteria are met: the failing firm would be forced out of the market due to financial problems in the near future if the operation does not take place; there is no alternative operation causing less horizontal competition constraints than the notified merger; in the absence of concentration, the failing firm's assets would inevitably exit the market.

While the first condition may be true, as Nowo has been facing financial problems, which may be worsened by the fact that Lorca, Nowo's biggest shareholder, wanted to leave the Portuguese market if the merger with Vodafone was not cleared, when analysing the second condition, the absence of operations that would cause less concerns than the notified, the argument collapses.

In February 2024, when the failing firm defense argument was used by Vodafone for the first time, it would be possible to argue for the inexistence of potential acquisitions of Nowo that would create less competitive concerns. After all, the acquiring firm stated that Nowo attempted to explore other possibilities, and that Vodafone was the only possible buyer. This implied the possibility of concentration with MEO or NOS was considered, unsuccessfully, despite there being no proof any of these operators declined an acquisition of Nowo.

In hindsight, it is clear that Digi was, indeed, an alternative buyer for Nowo. On August 2024, Digi announced an agreement with MASMOVIL for the purchase of Nowo for €150 million (Gonzalez and Goncalves 2024).

Thus, it is necessary to assess whether concentration with Digi would lead to reduced competitive concerns, compared to the Vodafone acquisition scenario, assuming market exit if neither operation takes place.

An acquisition by Digi could lead to the maintenance of a maverick firm in the market if the acquiring firm behaves in the same way. As discussed earlier, the company has been characterized as an aggressive competitor in other European markets where it has made an

entrance, most notably, in Spain. The strong financial results and fast growth in number of clients could be interpreted as an indicator that this competitive pricing strategy is sustainable. There is an argument to be made that Digi's acquisition of Nowo may not only raise less competitive constraints than the merger with Vodafone, but also have pro-competitive effects, when compared to the pre-merger scenario. If the pre-merger scenario is to be maintained, Nowo's financial situation could deter the firm from making the necessary investments in order to comply with the network expansion obligations resulting from the auction. This would likely result in a situation in which Nowo would not be able to exert as much competitive pressure in the future as expected with the results of the auction. By merging with Digi, a more financially sound firm, the combined operator would not only hold a significantly higher amount of spectrum but would also be able to realize necessary investments for the required network expansion, reinforced pressure on the prices of historical operators. The alternative scenario is also more susceptible of causing efficiencies. Separate, Nowo and Digi could struggle to achieve economies of scale due to their small sizes. However, merged, the resulting entity would be larger in size, which would lead to increased chance of obtaining economies of scale, and thus, enhance the ability to exert a disciplining effect on the price of larger operators.

Provided all of the existing evidence of an alternative scenario raising less concerns than the notified merger, the failing firm defense argument cannot, in my opinion, hold any validity.

8. Conclusion

To conclude, evidence seems to suggest that the merger between Vodafone and Nowo would have negative effects on competition in Portuguese telecommunication markets.

The telecommunications market is characterized by its strategic importance, which warrants caution when assessing the effects of such an operation. This is especially relevant given the lack of dynamism and high concentration registered in Portuguese telecommunication markets.

While structural analysis at the national level may paint a picture of a mostly unproblematic

merger, according to the AdC's and EC's guidelines, this is not the case when considering subnational markets. Using econometric analysis, it is found that the probability of special discounts for the 3 historical operators is significantly higher when Nowo is present in a municipality, showing evidence that the merger would eliminate a maverick. This effect is not captured by Nowo's market shares in the national market.

There are also signs of previous coordination in the Portuguese telecommunications market, with the 3 historical operators, MEO, NOS and Vodafone offering similar packages, prices and marketing strategies, which reinforce concerns related to coordinated effects arising from the concentration, especially, at Nowo's geographic footprint.

It is also relevant to assess the merger considering the entry of Digi, known for being a fierce competitor, aggressively undercutting prices of incumbents. While horizontal concerns may be lower than in the scenario without Digi, the reinforcement of barriers to expansion resulting from the merger may difficult the expansion of Digi's footprint, harming competition.

The failing firm defense argument is found to be invalid. Even if one accepts that Nowo faces serious financial problems which threaten viability, Digi's acquisition of Nowo evidences how there were alternative operations less harmful for competition, as Digi could use an acquisition of Nowo to leverage entry in the Portuguese market, and thus, have beneficial effects on competition.

The conclusions of this work project show how limited structural market analysis can be when analysing horizontal concentrations in markets of heterogeneous goods, as is the case of telecommunications markets in Portugal.

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10. Appendix

10.1. Appendix A: Structural Analysis

Table A1: Telecommunication Market Shares (by Revenue) – Total and 1P Segments, 2T

2024

	TOTAL	Fixed Services	Mobile Services
MEO	37.1%	39.6%	34.0%
NOS	31.3%	38.6%	18.5%
Vodafone	29.3%	19.5%	45.1%
NOWO	1.5%	1.3%	2.0%
Vodafone + NOWO	30.8%	20.8%	47.1%
Others	0.8%	1.0%	0.4%

Source: ANACOM (2024)

Table A2: Telecommunication Market Shares (by Revenue) – Total and Multiple Play, 2T

2024

	TOTAL	Multiple Play	2P	3P	4/5P
MEO	37.1%	40.0%	41.3%	42.7%	38.8%
NOS	31.3%	39.4%	25.2%	28.2%	44.8%
Vodafone	29.3%	19.1%	28.8%	26.9%	15.4%
NOWO	1.5%	1.4%	3.2%	2.2%	1.0%
Vodafone + NOWO	30.8%	20.5%	32.0%	29.1%	16.4%
Others	0.8%	0.1%	1.5%	0.0%	0.0%

Source: ANACOM (2024)

Table A3: Concentration Indexes – Total and 1P Segments, 2T 2024

	TOTAL	Fixed Services	Mobile Services
C3 Pre-Merger	97.7%	97.7%	97.6%
C3 Post-Merger	99.2%	99.0%	99.6%
HHI Pre-Merger	3217.48	3441.06	3536.42
HHI Post-Merger	3305.38	3491.76	3716.82
Delta	87.9	50.7	180.4

Source: Own calculation based on ANACOM (2024)

Table A4: Concentration Indexes – Total and Multiple Play, 2T 2024

	TOTAL	Multiple Play	2P	3P	4/5P
C3 Pre-Merger	97.7%	98.5%	95.3%	97.8%	99.0%
C3 Post-Merger	99.2%	99.9%	98.5%	100.0%	100.0%
HHI Pre-Merger	3217.48	3519.14	3193.54	3356.66	3750.64
HHI Post-Merger	3305.38	3572.62	3366.98	3465.34	3781.44
Delta	87.9	53.48	173.44	108.68	30.8

Source: Own calculation based on ANACOM (2024)

Table A5: Telecommunication Market Shares (by Subscribers) – Total and 1P Segments, 2T 2024

	Multiple Play	3P	4P/5P
MEO	41.7%	39.3%	42.2%
NOS	35.0%	28.7%	39.9%
Vodafone	20.6%	28.8%	15.7%
NOWO	2.6%	3.2%	2.2%
Vodafone + NOWO	23.2%	32.0%	17.9%
Others	0.1%	0.0%	0.0%

Source: ANACOM (2024)

Table A6: Telecommunication Market Shares (by Subscribers) – Total and Multiple Play, 2T 2024

	Fixed Telephony	Fixed Internet	Subscription TV	Mobile Telephony	Mobile Broadband
MEO	44.9%	41.2%	41.8%	37.6%	35.6%
NOS	32.4%	33.6%	36.2%	30.1%	32.3%
Vodafone	19.7%	21.9%	19.3%	28.2%	27.7%
NOWO	2.1%	2.8%	2.7%	1.9%	2.1%
Vodafone + NOWO	21.8%	24.7%	22.0%	30.1%	29.8%
Others	0.9%	0.5%	0.0%	2.2%	2.3%

Source: ANACOM (2024)

Table A7: Spectrum resulting from 2021 auction and respective shares (MHz, %)

Operator/Type	700 MHz	3.6 GHz	5G Compatible	Total	Share 5G	Share Total
MEO	10	90	100	90	22%	19%
NOS	20	100	120	100	27%	21%
Vodafone	20	90	110	90	24%	19%
Nowo	0	40	40	70	9%	14%
DIGI	0	40	40	95	9%	20%
Other	0	40	40	40	9%	8%
Vodafone + Nowo	20	130	150	160	33%	33%
DIGI + Nowo	0	80	80	165	18%	34%
Total	50	400	450	485	100%	100%

Sources: Autoridade da Concorrência (2024)

Table A8: Telecommunication Market Shares w/Digi (by Revenue) – Total and 1P Segments, 2T 2024

	TOTAL	Fixed Services	Mobile Services
MEO	36.2%	38.7%	33.1%
NOS	30.4%	37.7%	17.6%
Vodafone	28.4%	18.6%	44.2%
NOWO	1.3%	1.1%	1.8%
Digi	3.0%	3.0%	3.0%
Vodafone + NOWO	29.7%	19.7%	46.0%
Others	0.8%	1.0%	0.4%

Source: Own calculation based on assumptions and ANACOM (2024)

Table A9: Telecommunication Market Shares w/Digi (by Revenue) – Total and Multiple Play, 2T 2024

	TOTAL	Multiple Play	2P	3P	4/5P
MEO	36.2%	39.1%	40.4%	41.8%	37.9%
NOS	30.4%	38.5%	24.3%	27.3%	43.9%
Vodafone	28.4%	18.2%	27.9%	26.0%	14.5%
NOWO	1.3%	1.2%	3.0%	2.0%	0.8%
Digi	3.0%	3.0%	3.0%	3.0%	3.0%
Vodafone + NOWO	29.7%	19.4%	30.9%	28.0%	15.3%
Others	0.8%	0.1%	1.5%	0.0%	0.0%

Source: Own calculation based on assumptions and ANACOM, “Factos & Números - 2.o Trimestre 2024.”

Table A10: Concentration Indexes – Total and 1P Segments w/Digi, 2T 2024

	TOTAL	Fixed Services	Mobile Services
C3 Pre-Merger	94.9%	94.9%	94.8%
C3 Post-Merger	96.2%	96.0%	96.6%
HHI Pre-Merger	3046.16	3269.82	3365.09
HHI Post-Merger	3119.91	3310.67	3524.09
Delta	73.75	40.85	159.00

Source: Own calculation based on assumptions and ANACOM (2024)

Table A11: Concentration Indexes - Total and Multiple Play w/Digi, national level (%), 2T 2024

	TOTAL	Multiple Play	2P	3P	4/5P
C3 Pre-Merger	94.9%	95.7%	92.5%	95.0%	96.2%
C3 Post-Merger	96.2%	96.9%	95.5%	97.0%	97.0%
HHI Pre-Merger	3046.16	3346.37	3015.14	3175.19	3577.09
HHI Post-Merger	3119.91	3389.97	3182.34	3279.06	3600.24
Delta	73.75	43.60	167.20	103.87	23.15

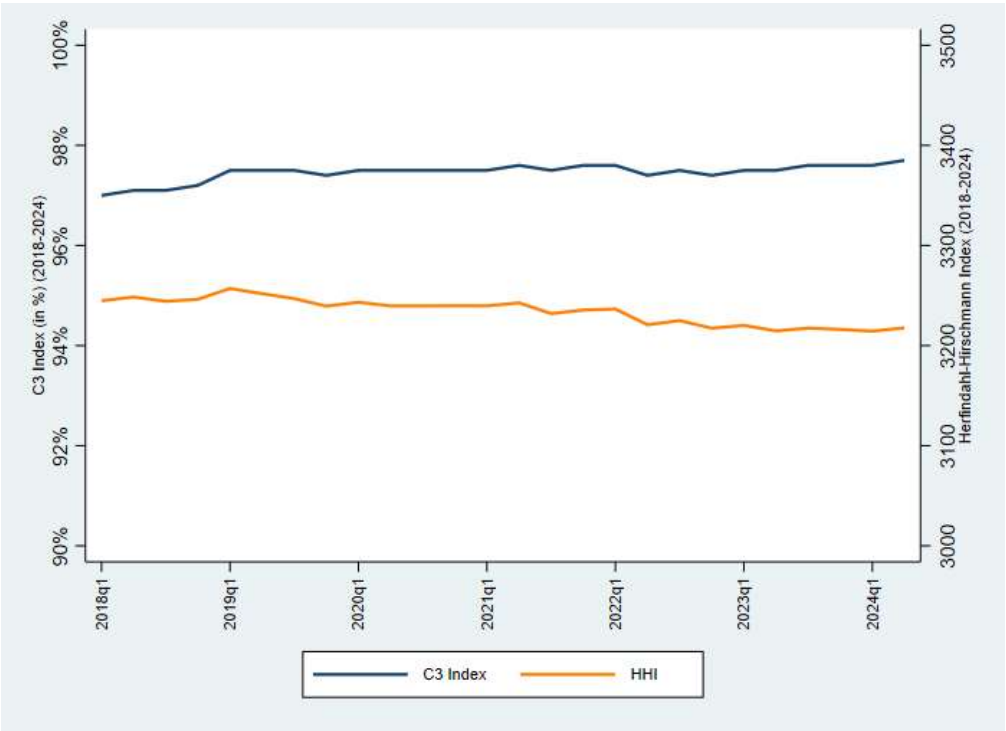
Source: Own calculation based on assumptions and ANACOM (2024)

Table A12: MEO, NOS and Vodafone municipality overlaps with Nowo

Operator	Footprint	Overlap with Nowo	Share of Overlap
MEO	279	75	27%
NOS	254	71	28%
Vodafone	198	65	33%

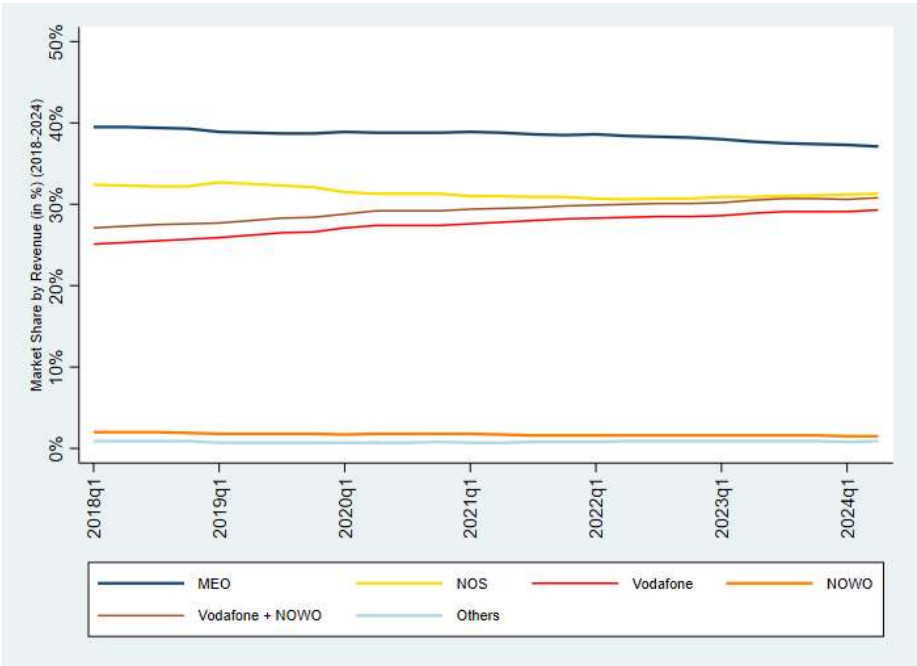
Source: Own estimation based on coverage test from MEO, NOS, and Vodafone, NOWO footprint from Autoridade da Concorrência (2024)

Figure A1: Evolution of concentration indexes (C3 and HHI) of total Portuguese telecommunications market (quarterly, 2018-2024)



Source: Own calculation based on assumptions and ANACOM, “Factos & Números - 2.o Trimestre 2024.”

Figure A2: Evolution of Market Shares by Total Revenue in Portuguese Telecommunications market (quarterly, 2018-2024)



Source: ANACOM, “Factos & Números - 2.o Trimestre 2024.”

10.2. Appendix B: Modelling likelihood of collusion with Nowo acquisition

As discussed in section 2, Motta, *Competition Policy: Theory and Practice* argues that if a merger increases both concentration and asymmetry, there will be an ambiguous effect on the likelihood of coordinated effects. In this subsection, a model similar to the one used by the author to prove that symmetry helps collusion will be used to show why an acquisition of Nowo by Vodafone would be make the market more susceptible to coordination.

In this setup, the market has 3 firms, named 1, 2, and 3. Firms are asymmetric, which is reflected in different market shares, such that $s_1 > s_2 > s_3 > 0$, $s_1 > s_2 + s_3$,¹⁵ and $s_1 = \lambda$. Similarly to Motta, *Competition Policy: Theory and Practice*, firms have similar technologies, with the same constant marginal cost, c , and same discount factor, δ . The fully collusive price is given by p_m and the incentive constraints (IC's) for each firm, i , is given by

$$[s_i (p_m - c)Q(p_m)]/(1 - \delta) - (p_m - c)Q(p_m) \geq 0. \quad (1)$$

Two diferent scenarios are compared: in the first, the smallest firm, 3, is acquired by the biggest firm, 1, and in the second, it is acquired by the second largest firm, 2. In the first case, the resulting share for firm 1 will be of λ^M , such that $\lambda^M > \lambda$, while the remaining competitor, firm 2, has a share of $1 - \lambda^M = s_2$. From rearranging equation (1), the resulting IC's will be:

$$\text{For 1: } \delta \geq 1 - \lambda^M \quad (2)$$

$$\text{For 2: } \delta \geq \lambda^M \quad (3)$$

Given that both firms need to have an incentive to maintain coordination, the binding constraint is equation (3). In the second case, the resulting share for firm 1 is the same as the pre-merger scenario, λ , while the one for firm 2 after acquiring 3 is equal to $1 - \lambda$. From rearranging equation (1), the resulting IC's will be:

$$\text{For 1: } \delta \geq 1 - \lambda \quad (4)$$

¹⁵ As a combined firm of Vodafone and Nowo is still smaller than both NOS and MEO.

For 2: $\delta \geq \lambda$ (5)

In this case, the binding constraint is equation (5). To compare the likelihood of collusion across the two merger scenarios, one must compare the critical value of the discount factor, δ , that is enough to maintain coordination. The critical value is obviously higher in equation (3) than in equation (5), $\lambda^M > \lambda$, meaning that coordination is less likely to be maintained when the smallest firm is acquired by the largest, while it is more likely when the acquisition is made by the second largest firm, since asymmetry in the market is reduced as a result of the merger.

10.3. Appendix C: Suggesting a new Delta threshold for highly concentrated markets

A possible way to define a more appropriate threshold for markets with abnormally high pre-merger levels of concentration, such as the Portuguese telecommunications markets, is adapting the Delta threshold to the pre-merger HHI. The EC's and AdC's guidelines define a Delta threshold of 150 for markets with a HHI above 2000. For a market with a post-merger HHI of 2000 and Delta of 150, the Delta represented roughly 2% of the difference between pre-merger HHI and the monopoly value of 10,000. For a market with a post-merger of 3000, as is the case of telecommunications markets in Portugal, the Delta that would cover the same proportion of the difference between pre-merger and HHI and 10,000 would be 131.25. Despite this new threshold value not changing which markets are susceptible of concerns when analysing concentration indexes, it represents a possible approach that is stricter to operations in highly concentrated markets pre-merger.