

Evaluating a mobile telecommunications merger in Portugal

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ABSTRACT

This paper evaluates the impact of the merger between Optimus and TMN, within the context of the December 2006 decision by Portugal's Competition Authority to authorize the merger between their respective parent companies, Sonaecom and Portugal Telecom. The results suggest that the Optimus-TMN merger would have been welfare-enhancing.

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1. Introduction

Since 2001 the mobile telecommunications industry experienced firm exit and growing consolidation. For example, Telefónica and Sonera exited the German market in 2002 after having invested €8.6bn in a UMTS license. Likewise, OniWay exited the Portuguese market in 2002 after having spent €100mn in a UMTS license. Further, in 2005, France's Orange acquired Spain's Amena in a cross-border merger, whereas T-Mobile acquired Tele.ring in a within-border merger in Austria. In the latter instance, the number of operators in Austria fell from 5 to 4 and the Herfindahl-Hirschman Index (HHI) rose from 2880 to 3430, based on pre-merger market shares. Moreover, in the United States, two mergers in 2004 (Verizon acquired AT&T) and 2005 (Sprint acquired Nextel) reduced the number of operators with national coverage from 6 to 4. According to Cooper (2004), the U.S. CR6 increased from 55% in 1997 to 85% in 2004, and Fox (2005) argued that the U.S. mobile telecommunications industry was more concentrated in 2005 (HHI of 6000 based on radio-spectrum licenses) than in 1998, when the industry was characterized by a duopoly.

From the outset of the mobile telecommunications, regulators promoted competition as a means to improve industry performance. The rapid industry growth experienced in the 1990s and early 2000s, in a sense, vindicated the regulatory approach and resulted in a growing preference for allowing market forces to determine outcomes and in a less prominent role for regulation in the sector, particularly regarding the retail market. On the one hand, the regulators attempted to create conditions that facilitated new entry, namely through wholesale market regulation, and, on the other hand, they accepted reductions in the number of competitors, even when these led to large increases of the HHI (seen as problematic by the standards of earlier decades).

In this context, the December 2006 decision by Portugal's Competition Authority (hereafter PCA) to authorize the €10.5bn (later revised to €1.6bn) merger offer of Sonaecom

for Portugal Telecom (PT), despite creating a duopoly in the mobile market, was but an additional step in the recent international trend towards further industry consolidation.¹

The merger proposal was considered hostile by the targeted group, PT, owner of TMN. However, after a one-year long merger process, the PT shareholders rejected a motion to change the bylaws regarding voting restrictions and, as a result, the merger failed.

Nonetheless, the PCA decision raises at least three important issues from an economic perspective, which we seek to explore in this paper, by focusing on the impact that the Optimus-TMN merger would have had on the Portuguese mobile-voice communications market.² First, we try to evaluate the effects of the Optimus-TMN merger on consumer's surplus and deadweight welfare loss. Second, we attempt to quantify the effect of the Optimus-TMN merger on industry efficiency, industry surplus, and social welfare. Finally, given the prior results, we discuss the regulatory decision regarding the standalone Optimus-TMN merger.

To do so, we use a two-part methodology with some similarities to that of Stewart and Kim (1993).³ First, we estimate the effect of increasing market concentration on prices and price-cost margins, using the empirical approach of the Structure-Conduct-Performance Paradigm (SCPP) and an international dataset of mobile operators with roughly 1700 observations. The results of the estimation are used to predict the post-merger average industry price and marginal cost if the merger had indeed occurred. In the second part, we use both an isoelastic demand specification and estimates of the price elasticity of demand for mobile-voice calls in Portugal by Pereira and Ribeiro (2007), in order to infer what would have been the change in the industry output associated with the change in the average market price. Finally, using the data determined in the prior steps, and assuming no income effects and no shift of the demand curve, we calculate the Marshallian consumer's surplus change, the deadweight welfare loss, the producer's surplus change, and the overall welfare effect of

the merger.

Our results suggest that the merger would have increased both industry efficiency and industry market power, i.e., growing industry consolidation would have resulted, in the long-term, in lower average marginal costs but also in higher average equilibrium price. Moreover, the consumer-surplus loss, a consequence of the higher average price, constitutes more than one third of the estimated producer's surplus change and nearly two thirds of the overall welfare improvement.

2. Merger impact on industry price and price-cost margin

The aim of the econometric analysis of this section is to obtain an estimate of the impact the merger would have had on average price and price-cost margin. In order to do so, we use two SCPP-type reduced-form models that establish the relationship between firm market share and firm price and price-cost margin:

$$(1) \quad \ln P_{icyq} = \alpha_0 + \alpha_1 \text{MSHARE}_{icyq-1} + \alpha_2 \text{CHURN}_{icyq-1} + \alpha_3 \text{MPP}_{icyq} + \alpha_c + \alpha_y + \alpha_q + \xi_{icyq}$$

$$(2) \quad \text{EBITDA}_{icyq} = \beta_0 + \beta_1 \text{MSHARE}_{icyq-1} + \beta_2 \text{CHURN}_{icyq-1} + \beta_c + \beta_y + \beta_q + \zeta_{icyq}$$

where $\ln P_{icyq}$ is the logarithm of the price, measured as the average revenue per minute (ARPM) of the firm i in the country c during the quarter q of the year y ; MSHARE_{icyq-1} is the lagged market share (the ratio of the number of subscribers for the firm i to the total number of subscribers in the country c); CHURN_{icyq-1} is the lagged churn rate (the percentage of subscribers that cancel their contract in a given quarter), which is thought to be a significant cost factor in the mobile-voice industry; MPP_{icyq} is a dummy variable that controls for countries where the regulatory framework is based on mobile party pays, and voice traffic is

defined differently; $EBITDA_{icyq}$ is the EBITDA margin (hereafter just EBITDA), a proxy for the price-cost margin, defined as earnings before interest, taxes, depreciation, and amortization divided by total operational revenues; α_c , α_y , α_q , β_c , β_y and β_q are vectors containing country (c), year (y) and quarter effects (q); and finally ξ_{icyq} and ζ_{icyq} are random disturbances.

We include market shares and churn rates with lags in our models because it is reasonable to think that, in practice, firms devise current-period pricing and mark-up plans on the basis of market data from earlier periods.⁴

Our dataset is extracted from the Merrill Lynch's (hereafter ML) Global Wireless Matrix 2Q04 report and contains quarterly data on 177 firms across 45 countries, from the first quarter of 1999 to the second quarter of 2004. Summary sample statistics are reported in Appendix.

The estimation results, based on ordinary least squares, are presented in Table 1 and 2. To summarize, we find that a one percentage-point increase in the average market share results in a 0.7 percentage-points increase in the average market margin and in a 0.2% increase in the average market price. If we consider the Eurozone sub-sample (or an OECD sub-sample), the effects are even larger. Specifically, a one percentage-point increase in the average market share results in a 1.1 (0.7) percentage-points increase in the average margin and a 0.5% (0.4%) increase in the average price.⁵

Our approach is as follows. If the number of firms in the Portuguese market falls from 3 to 2 because of a merger, then the average market share increases by 16.7 percentage points. Multiplying this change by our market-share coefficient estimates obtained from (1) and (2), we obtain an estimate of the expected change in both average price and average margin, respectively, when the average market share increases. In practice, the approach, like prior

literature (Salant *et al.*, 1983), compares two static long-run equilibria: the basis scenario of the pre-merger three-firm oligopoly (Optimus, TMN and Vodafone Portugal) with the duopoly structure that would have resulted, had the merger been successful. The empirical results suggest that, if the average market share were to increase from 33% to 50%, the average price would have increased by 3.8% and the average margin would have increased by 11.6 percentage points. For comparison, Grzybowski and Pereira (2008), using Portuguese mobile telecommunications data, estimate that the proposed Optimus-TMN merger would have increased the average price by 6 to 7%.

The use of the average in the appraisal of the merger effects is novel, to the best of our knowledge, and is a way of dealing with at least three issues. First, as pointed out by Salant *et al.* (1983), Perry and Porter (1985), as well as by Farrell and Shapiro (1990), following a merger, the merged parties reduce the output, while the parties that are external to the merger increase the output, even when the resulting oligopoly is strongly asymmetric. Thus, the combined pre-merger market share is not a good predictor for the post-merger market share of the merging firms. Likewise, the post-merger market share of the non-merging firms is likely to increase. Hence, estimating the impact of the merger on prices, margins, and welfare using pre-merger market shares is inappropriate.

Second, data on output by operator are neither public nor available to us. Nevertheless, by using total industry output in combination with average prices and margins, it is possible to obtain estimates of the merger impact on welfare, consumer, and producer's surplus (see Section 3 below). Specifically, the industry's output and average price can be derived from the average firm's output and price.

Finally, since the proposed merger would have resulted in a duopoly with an above-average and a below-average firm, it is still possible to make general inferences on the performance (prices and margins) of these firms relative to a hypothetical average firm.

On the other hand, we are aware that the average conveys little information about the performance of each firm, nor does it indicate how the estimated producer's surplus is going to be split by the resulting duopoly.

3. Merger impact on industry output

To infer the output variation consistent with the change in the average price, we use an isoelastic demand curve (Hausman, 1997) and estimates of the price elasticity of demand for minutes of mobile telephony calls in Portugal due to Pereira and Ribeiro (2007).

Specifically, we assume that the demand curve is given by:

$$(3) \quad Q = AP^{-\varepsilon}$$

where A is a demand shifter, Q is the industry output measured as minutes of voice traffic, P is the average price per minute of voice call, and ε is the price elasticity of demand.

Pereira and Ribeiro (2007) estimate the own-price elasticity of demand for TMN, Vodafone, and Optimus, at 1.3, 2.2, and 3.3, respectively. Thus, we use the non-weighted average of Pereira and Ribeiro's own-price elasticities of demand, 2.3, as our measure of the Portuguese market's price elasticity of demand ε . Section 5 discusses the sensitivity of our welfare analysis (Section 4) to changes in the price elasticity of demand.

We solve equation (3) to determine the parameter A for Portugal, using 2004 pre-merger industry data on output and price. Note that we resort to 2004 data as they are the latest data available in our dataset. Particularly, first half of 2004 price data from the ML dataset indicate that the average (non-weighted) nominal average price per minute (P) in Portugal is €0.197 per minute. The total industry output (Q) in 2004 is 14487 million minutes, according to Portugal's Telecommunications Regulator, ICP-ANACOM (2005a).⁶ Therefore,

we evaluate the pre-merger parameter A at $345.3 = 11487 (0.197)^{2.3}$.

In order to estimate the change in the industry output associated with the change in average price, we assume, like prior theoretical and empirical literature (Salant *et al.*, 1983; Farrell and Shapiro, 1990; Levin, 1990; Stewart and Kim, 1993), that the demand curve does not shift as a result of the merger, i.e., the parameter A does not change because of the merger.

As argued in the previous Section, the average market price would have risen by 3.8% to €0.205 per minute. Therefore, equation (3) suggests that the total industry output would have diminished by 8.2% (or 1191 million minutes) to 13296 million minutes. This is roughly 119 fewer minutes per subscriber per year.

4. Merger welfare analysis

The estimation of consumer's surplus and welfare changes has been an important tool in guiding merger analysis in the last decades (Harberger, 1971; Willig, 1976; Motta, 2004; Brito and Catalão-Lopes, 2006), despite criticisms about the concept of consumer's surplus (Harberger, 1971; Hausman, 1981).

Generally, mergers are regarded as detrimental to society if they result in large deadweight welfare losses or alternatively in large transfers of consumer's surplus to producers. They are regarded as beneficial, if they result in large producer efficiency gains with limited impact on prices, and thus on consumer's surplus. In this section, we use the results of the prior two sections to infer the impact of the merger on consumer's surplus, producer's surplus, and welfare.

We use Marshallian rather than Hicksian measures of consumer's welfare change. In using the former approach, we also follow the theoretical merger literature assumption of no income effects (Salant *et al.*, 1983; Farrell and Shapiro, 1990; Levin, 1990), consistent with

Marshallian applied welfare analysis.

While Hicks' compensating and equivalent variations are the correct theoretical measures of the impact on consumer's welfare from a change in a single good's price, most analyses have estimated consumer's welfare change using the Marshallian demand function and consumer's surplus concept.⁷ Moreover, prior literature (Willig, 1976) has shown that, if the income effects are small relative to overall income, then the Marshallian consumer's surplus approach provides a sufficiently accurate estimate of the correct compensating and equivalent variations. Hausman (1981), however, points out that the Marshallian approach, despite providing an accurate estimate of the change in consumer's welfare, may result in significant differences in the estimate of the deadweight welfare loss.

Since the total consumer's surplus change, as we will argue below, represents less than 0.1% of Portugal's GDP, income effects can be considered as being very small relative to overall consumer's income. Thus, the income effects associated with a rise in the average price can be neglected. Moreover, as we shall show below, the deadweight welfare losses are quite small relative to the overall merger impact and to the consumer's surplus change. Thus, the Marshallian consumer's surplus approach used in this paper provides a sufficiently accurate estimate of the impact that the merger would have had on consumer welfare.

- Figure 1 about here -

Figure 1 represents the welfare impact of the merger, where D is the Marshallian market demand curve, Q is the industry output, total industry voice traffic in minutes, P is the average market price of a minute of voice traffic, c is the industry average marginal cost per minute of voice traffic, and the subscript 0 (1) is for the industry output, price, and marginal cost before (after) the merger.

The impact of the merger on consumer's surplus ΔCS , producer's surplus ΔPS , and welfare ΔW is defined and estimated below.

Change in consumer's surplus

The change in consumer's surplus would have been brought about by the increase in the post-merger average price. The impact of the merger on Marshallian consumer's surplus is given by:

$$(4) \quad \Delta CS = \int_{P_0}^{P_1} Q(P)dP = \int_{P_0}^{P_1} AP^{-\varepsilon}dP = \left[\frac{AP^{1-\varepsilon}}{1-\varepsilon} \right]_{P_0}^{P_1}$$

and corresponds to the area to the left of the demand curve when the average industry price rises from P_0 to P_1 (see also Figure 1).

Substituting in equation (4) the values of parameter A , price elasticity of demand ε , and pre- and post-merger average prices estimated in Sections 2 and 3, the total change in consumer's surplus is €103.9mn per year, which, using a 5% discount rate and an infinite time horizon, has a present value of €2.1bn. Thus, the merger would have had a large detrimental effect on consumer's surplus.

Most of the loss in consumer's surplus, or €9.5mn per year, would have resulted from the transfer of surplus from consumers to producers (STCP in Figure 1), since consumers would have paid higher prices at the final, lower level of industry output. The remainder, €4.4mn per year, is a loss of consumer's surplus related to the output that is no longer consumed at the higher price, the deadweight welfare loss (DWL in Figure 1). This means the deadweight welfare loss would have been relatively small compared to the transfer of surplus from consumers to producers or when compared to the overall industry size.

Change in producer's surplus

Due to increased market concentration and economies of scale, it is reasonable to expect that the merger would have resulted in an increase in the producer's surplus. The issue is the extent to which the change in the producer's surplus is obtained through increased market power (improved ability to set higher prices) vs. improvements in producer efficiency (reductions in marginal costs).

The estimation of the efficiency gains is made by comparing the price-cost margins before and after the merger, considering that, after the merger, prices would have been 3.8% higher. Specifically, we have a measure of the initial non-weighted average price-cost margin for the Portuguese mobile telecommunications market in 2004 (the average EBITDA of the operators), which is 35.6%. Using the results of regression (2), we estimate that the expected long-run average margin in the Portuguese market would have increased to approximately 47.2% (see Section 2).⁸

Since we know initial and final average prices (P_0 and P_1) and average margins ($EBITDA_0$ and $EBITDA_1$), it is possible to estimate the reduction in the average marginal cost ($c_1 - c_0$) using the following approximations:

$$(5) \quad \frac{P_0 - c_0}{P_0} \approx EBITDA_0 \quad \frac{P_1 - c_1}{P_1} \approx EBITDA_1$$

where the subscript 0 (1) is for the price and marginal cost before (after) the merger (see also Figure 1).

Substituting the prior results in (5), we estimate that the merger would have resulted in an average marginal-cost reduction equal to €0.019 per minute or 14.9% of the pre-merger marginal cost. Thus, the potential efficiency gains might have been large.

Given the large reduction in the average marginal cost, the average market margin would have increased by 32.5%, nearly ten times more than the average price increase. The change in producer's surplus ΔPS is given by (see also Figure 1):

$$(6) \quad \Delta PS = STCP + PEG - LPS$$

where $STCP = (P_1 - P_0)Q_1$, $PEG = (c_0 - c_1)Q_1$ and $LPS = (P_0 - c_0)(Q_0 - Q_1)$. The areas STCP, PEG and LPS are, respectively, the surplus transferred from consumers to producers, the total producer efficiency gain at the final level of industry output, Q_1 , and the loss of producer's surplus from the reduction in the level of industry output from Q_0 to Q_1 .

Equation (6) indicates that the producer's surplus would have increased by a total of €67.2mn per year, of which 37.2% would have been the result of a surplus transfer from consumers to producers. Producers would have captured the entire efficiency gain and some surplus from consumers by raising prices. Using the 5% discount rate, the present value of the total producer's surplus increase is €3.3bn.⁹

Change in welfare

Finally, the change in welfare is given by:

$$(7) \quad \Delta W = \Delta CS + \Delta PS$$

In sum, the merger would have been welfare-improving by €63.3mn per year, with a present value of €3.3bn. This result seems consistent with the recent anecdotal evidence of growing industry consolidation. The market is driving further industry consolidation not only because firms have an incentive to increase their market power, but foremost because there

are substantial efficiency gains to be had.

5. Caveats

There are a number of issues with the analysis, which we briefly discuss in this section. First, there is the issue of extending the results of our 45-country sample to the Portugal case. Our estimates are based on approximately 1700 observations which are used to draw inferences relative to the Portuguese market. We follow this approach since the sample comprehends diverse observations with a variety of market structures. This, in our view, is better than the alternative of using the few available Portuguese market observations to draw inferences about prices and margins under an entirely different post-merger market structure.

The margin and price regression coefficient estimates for the Eurozone sub-sample and for the OECD sub-sample, both of which include Portugal, are larger than those of the international sample, and the price equation coefficient estimate is approximately twice as large. Moreover, price data for Portugal indicate that, from 1999 to 2004, prices in Portugal fell by less than in other Eurozone countries, suggesting that the level of competition in Portugal was less intense than in other Eurozone countries. Thus, it may be the case that the Portuguese sub-sample distribution bears more close resemblance to the Eurozone and OECD distributions than to the international one. Therefore, the inferences we make on the rise in prices in Portugal and, consequently, on the surplus redistribution effects from consumers to producers may be, if anything, under-estimated. Indeed, the previously cited result of Grzybowski and Pereira (2008), who estimate an average price increase of 6 to 7% following the TMN-Optimus merger, points in the same direction.

Second, our SSCP-type comparative statics model departs from the hypothesis that the market is in a long-run equilibrium. The inferences one can draw are also about the long-run equilibrium, after a transitional period, *ceteris paribus*. While there are a number of issues

with such models, the fact is that they provide a useful benchmark and have been widely used for merger analysis in the past (Salant *et al.*, 1983; Farrell and Shapiro, 1990; Levin, 1990).

Third, as usual in applied work, the analysis faces data constraints. The choice of the price measure is always a difficult issue in telecommunications studies as tariffs are non-linear, with a high degree of price discrimination, and because of large differences across countries. Several studies calculate a price index based on low, average, and high types of consumption bundles. For example, Parker and Röller (1997) use the price of the average consumption bundle, while indicating that they obtain robust results using different consumption bundles. Instead, our dataset's available measure of price is the average revenue per minute. While there is some loss of information by using an average, this measure has an advantage relative to the use of consumption bundles. Specifically, the average revenue per minute reflects what consumers actually pay, rather than what they might have paid for a hypothetical bundle based on menu tariffs.

It may also be the case that our measure of price-cost margins, the EBITDA margin, captures not only price-cost margins but also efficiencies that reduce fixed costs, such as consolidation of duplicated network installations. If this were the case, our inference about the reduction in the average industry marginal cost might be over-estimated.

Our dataset also lacked the most recent data. Hence, we based the analysis on non-weighted 2004 averages from our original data sample, and 2004 industry output data from ICP-ANACOM (2005a), though the merger would have only occurred in 2007, and it would have taken some time to actually merge the operations of the two firms. Not only would prices, margins, and output data have changed somewhat in this period, but the industry as a whole might have also evolved.¹⁰

Furthermore, we define output as minutes of outgoing calls plus off-net incoming calls, consistent with the way the output is defined in our dataset. However, while the

operator revenues derived from outgoing calls are based on retail tariffs, operator revenues for off-net incoming calls (e.g., from fixed networks) are typically based on wholesale tariffs between operators. End consumers pay a higher retail tariff for off-net incoming calls, for which we lack data. Nonetheless, again, we do not expect this issue to affect the order of greatness of the results, nor their implications for policy making. Indeed, if we correct for the difference in off-net incoming call prices,¹¹ the estimated price of outgoing calls would be €0.201 per minute, which is fairly similar to the average price used in our analysis (€0.197). On the other hand, outgoing traffic was approximately 73.5% of total traffic (10653 million minutes).¹² Thus, roughly 73.5% of the estimated change in consumer's surplus results from the expected change in retail outgoing-call prices.

Forth, our analysis is robust to changes in the price elasticity of demand. For example, if the average price elasticity of demand were similar to that estimated by Hausman (1997) for the U.S. mobile telecommunications market (0.4), consumer's surplus would have decreased by €107.7mn annually, rather than by €103.9mn (3.7% higher impact), the deadweight welfare loss would have been 81.7% smaller, at €0.8mn annually, and the producer's surplus change would have been 35.2% larger, at €61.4mn annually. Therefore, the results are roughly the same and the policy implications, discussed further below, do not substantially change.

Moreover, earlier literature has found evidence of collusion in duopoly markets, which may not be well captured by our empirical analysis since our sample contains few duopoly markets. For example, Parker and Röller (1997) find evidence of collusion under a duopoly for U.S. metropolitan areas, with estimated price-cost margins of 35% implying that prices are 23% higher due to collusion. Busse (2000), using the same dataset, estimates that, under duopoly, multimarket contact results in 7% higher prices through collusion. Valetti (1998) as well as Stoetzer and Tewes (1996) argue that the price evolution, before and after the

introduction of additional competition in the United Kingdom and in Germany, suggests that there was collusion under duopoly. Hence, this literature suggests that the negative effects of the TMN-Optimus merger on consumer's surplus might have been even larger than argued so far, if (post-merger) collusive behavior were to occur.

Finally, we are not able to control for tax policy effects. In fact, since the Sonaecom-PT merger structure was based on a large level of debt financing, it would have resulted in a reduction of taxable income for the acquired firm, and therefore it would have resulted in a large surplus transfer from taxpayers to producers.

6. Discussion

This paper estimates the welfare impacts of the authorized Sonaecom-PT merger on the Portuguese mobile telecommunications market, the largest market impacted by the proposed merger, worth about 33% of the electronic communications market in Portugal. We find that, if the Optimus-TMN merger would have taken place, the average profit margin in the Portuguese mobile telecommunications market would have increased by 11.6 percentage points and the average price would have increased by 3.8%. As a consequence, the average marginal cost would have decreased by 14.9%, and welfare would have increased by €63.3mn per year, a gain entirely captured by the producers. Importantly, the merger would have resulted in a surplus transfer from consumers to producers of €9.5mn per year.

These findings raise important issues for a social decision-maker on the trade-off between consumer's surplus and social welfare maximization. In particular, the results suggest that the standalone Optimus-TMN merger could have been authorized on efficiency and welfare maximization grounds. However, merger remedies would have been required, in order to ameliorate the large detrimental impact of the merger on consumer's surplus.

Specifically, we calculate the present value of the consumer-surplus loss at €1bn.

Consequently, merger remedies should have been designed to address this loss directly. A price-cap remedy, based on the average revenue per minute, would have been an appropriate instrument to achieve this objective. Importantly, a price-cap merger remedy would have been welfare enhancing, compared to a merger without remedies, because total welfare would have increased by $DWL + LPS + APEG$, where $APEG$ represents the additional producer efficiency gain due to the price-cap remedy (see Figure 1).

In fact, in its decision to authorize the Sonaecom-PT merger (Autoridade da Concorrência, 2006b), the PCA did impose a number of remedies for the relevant markets, including a price-cap and seven non-price remedies for the mobile telecommunications market.

The PCA price-cap remedy constrained the merged Optimus-TMN operator to adjust the rate of change of the price for three reference consumption baskets at the lowest of two indicators (Autoridade da Concorrência, 2006b, pp. 734-737): 1) the rate of change of the price for the same three reference consumption baskets sold by a confidential group of European mobile telecommunications operators; or 2) the rate of change of the consumer price index for services (CPI-S). This price-cap remedy would have expired after a confidential period of time. Its strength would have depended on several factors, for which information was confidential. As such, it is not possible for us to assess the effect of the PCA price-cap remedy objectively.

We have some indirect assessment of the strength of the PCA price-cap remedies through ICP-ANACOM. In its October 19th, 2006 expert opinion on the merger, the ICP-ANACOM criticized the PCA price-cap remedies as insufficient and recommended the implementation of stricter retail price caps (Autoridade da Concorrência, 2006b, pp. 547-549). In particular, the ICP-ANACOM claimed the discretionary ability to request adjustments in retail price, as well as a negative offset of the CPI-S in 2). Moreover, ICP-

ANACOM criticized the fact that, in the PCA's decision, the price-cap revisions 1) or 2) would have had to be initiated by the interested party (Sonaecom), rather than by the regulator. Nonetheless, most of the ICP-ANACOM recommendations on price-cap remedies were not adopted by the PCA in its final decision.

All but two of the seven non-price remedies imposed in the PCA decision (Autoridade da Concorrência, 2006a and 2006b), were directioned towards promoting market contestability, by seeking to reduce sunk, fixed, and marginal costs faced by a potential entrant. For example, the remedies a) allowed potential entrants to use Sonaecom base stations (co-location); b) defined favored access tariffs to Sonaecom's networks for potential entrants so as to diminish the network effects of Sonaecom; c) obliged Sonaecom to sign access contracts with virtual network operators (VMNOs) that chose to enter the market. In addition, the PCA required that either Sonaecom or PT's radio spectrum frequency rights and licenses be returned to ICP-ANACOM. Like the price-remedy case, with the available data, we are unable to further elaborate on the efficacy of the PCA's non-price remedies.

In summary, our results can be construed as supporting the PCA decision to allow the Optimus-TMN merger within the context of the authorization of the Sonaecom-PT merger. However, it is not possible to assess whether the PCA decision remedies would have been sufficient to avoid the loss in the consumer's surplus that the Optimus-TMN merger would have induced.

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Table 1. Price equation

Dependent variable: logarithm of average revenue per minute calculated using (1) 2004 nominal exchange rates to the Euro; (2) data in Euros; (3) annual PPPs to the US Dollar.

	(1)	(2)	(3)
	Full sample	Eurozone sample	OECD Sample
Lagged market share	0.229 (0.000)	0.459 (0.000)	0.413 (0.000)
Lagged churn rate	-1.133 (0.203)	0.603 (0.602)	-6.764 (0.000)
Mobile party pay	-0.527 (0.000)		-1.830 (0.000)
Observations	1658	457	1141
R-squared	0.874	0.827	0.792

P-values based on robust standard errors are in parentheses. Regression controls include country, year and quarter effects. Country and year effects are jointly significant at the 1% level. Quarter effects are jointly significant at 1% level in (1) and at 10% level in (2). They are not jointly significant in (3).

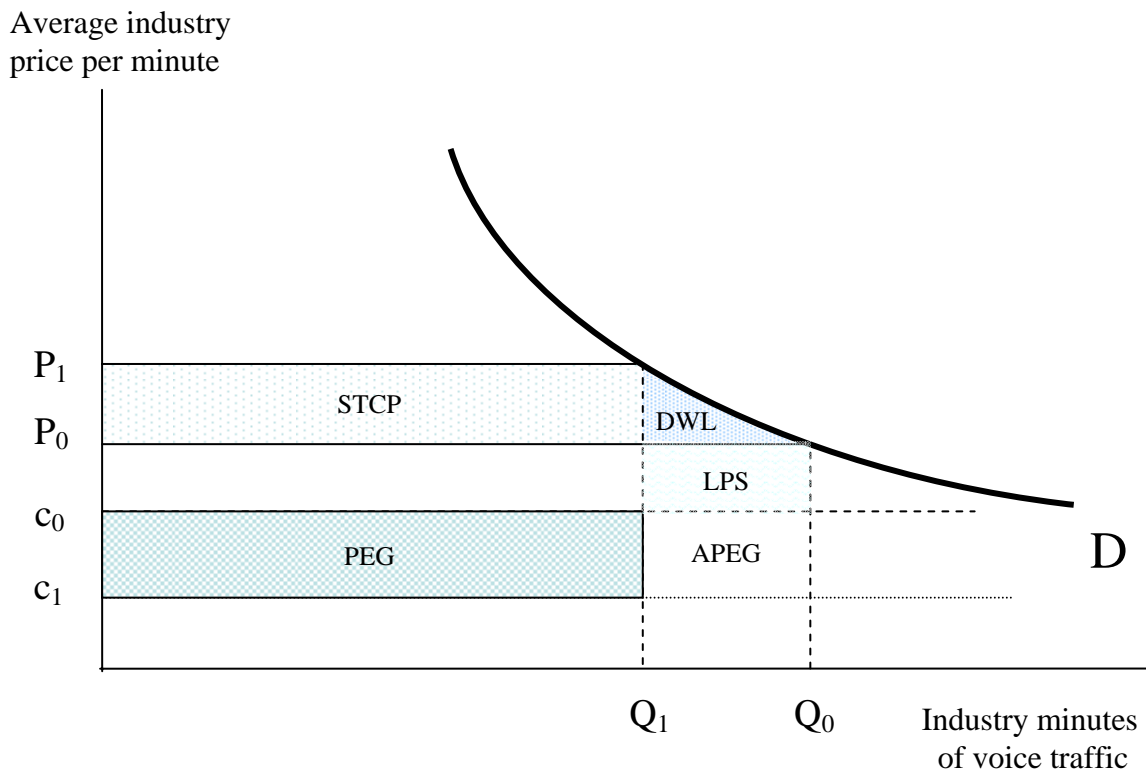
Table 2. Price-cost margin equation

Dependent variable: EBITDA margin

	(1)	(2)	(3)
	Full sample	Eurozone sample	OECD sample
Lagged market share	0.696 (0.000)	1.080 (0.000)	0.742 (0.000)
Lagged churn rate	-0.131 (0.535)	0.430 (0.800)	-0.773 (0.401)
Observations	1846	468	1168
R-squared	0.560	0.667	0.526

P-values based on robust standard errors are in parentheses. Regression controls include country, year and quarter effects. Country and year effects are jointly significant at the 1% level. Quarter effects are not jointly significant.

Figure 1. Welfare effects



Appendix. Selected sample statistics

Table A1. Variables

Variable	Obs	Mean	Std Dev	Min	Max
EBITDA	2482	0.269	0.375	-9.170	0.770
MSHARE	3390	0.284	0.176	0.010	0.950
MPP	3760	0.163	0.369	0.000	1.000
CHURN	2074	0.022	0.017	0.001	0.400
ARPM	2107	0.184	0.093	0.026	1.065

Table A2. Year effects

Year	Freq	Perc	Cum
1999	656	18.37	18.37
2000	634	17.75	36.11
2001	630	17.64	53.75
2002	653	18.28	72.03
2003	663	18.56	90.59
2004	336	9.41	100.00

Table A3. Quarter effects

Quarter	Freq	Perc	Cum
1	976	27.32	27.32
2	979	27.41	54.73
3	810	22.68	77.41
4	807	22.59	100.00

Table A4. Country effects

Argentina, Australia, Austria, Brazil, Belgium, Canada, Check Republic, Chile, China, Colombia, Denmark, Egypt, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Malaysia, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Russia, Singapore, South Africa, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, United Kingdom, United States, Venezuela.

Endnotes

- ¹ The PCA's decision to authorize the Sonaecom-PT merger was based on the analysis of the effect of the merger on 46 relevant markets, of which only three were associated with mobile networks.
- ² Mobile-voice communications, the subject of our merger analysis, represented approximately 80% of the €3bn mobile telecommunications industry, or approximately 33% of the overall €7.3bn electronic telecommunications industry in Portugal in 2004.
- ³ Stewart and Kim (1993) estimate the effect of exogenous factors and observed merger activity-level on price indices and price-cost margins, for a sample of 117 U.S. three digit manufacturing industries. They use these estimates to calculate the impact of the merger activity-level on consumer's surplus, producer's surplus, and welfare for industries grouped according to concentration levels.
- ⁴ The use of lagged explanatory variables also has the benefit of addressing the endogeneity issue in the econometric estimation.
- ⁵ We obtain similar results if we drop the MPP regressor to obtain symmetric equations.
- ⁶ The average revenue per minute in 2004, based on ICP-ANACOM (2005a), is €0.169 or 14.2% lower than Merrill Lynch's first half of 2004 data. The difference may be explained by falling prices in the second half of 2004, the use of weighted vs. non-weighted estimates, and measurement discrepancies. To maintain consistency in the use of the econometric results, we use Merrill Lynch estimates. Nonetheless, the use of the ICP-ANACOM measure of price does not significantly affect the results of the welfare analysis presented in Section 4 (results based on ICP-ANACOM data are available from the authors upon request).
- ⁷ The Hicksian measure of surplus considers both substitution and income effects when the good's price changes. The Marshallian consumer's surplus is equivalent to only considering the substitution effect.
- ⁸ Interestingly, the Financial Times Lex column of October 3rd, 2006 suggested that the merged firm (Optimus-TMN) could have increased its EBITDA margin to 48%, fairly similar to our own estimate.
- ⁹ Private sector firms calculate the present value of the synergies of a merger based on a shorter time horizon (7 years), and often with no discount rate. Using this methodology, we estimate the private value of the merger at €1.9bn. This compares with an estimate of €2bn provided by the Financial Times Lex column of February 21st, 2007.
- ¹⁰ A seminar participant pointed out that new technologies (e.g. VoIP and Wi-fi) may affect the competitive dynamics in this industry. Nonetheless, the effect of new technologies is likely to remain marginal in the near term. In fact, in mature markets, mobile operators' revenues and output are still growing, even if at lower rates than in the past. Thus, the merger would still have had a large economic impact.
- ¹¹ While retail prices for outgoing calls are not regulated, off-net incoming call wholesale prices between operators are regulated by ICP-ANACOM (2005b). ICP-ANACOM indicates that operators set off-net incoming-call prices at the maximum wholesale price level, which, in 2004, was of €0.185 per minute for fixed-mobile incoming calls and €0.187 per minute for mobile-mobile off-net incoming calls, slightly lower than our estimate of average price. Optimus was allowed to set a higher fixed-mobile termination rate.
- ¹² The merger effect on consumer's surplus could have been lessened if the mobile-to-mobile off-net traffic between TMN and Optimus became on-net traffic as a result of the merger. Since off-net tariffs are higher than on-net tariffs, this might have resulted in a smaller increase of the average price than that predicted by our model. Total mobile-to-mobile off-net traffic between the three pre-merger operators was 2147 million minutes or 14.8% of total traffic. However, it is not clear whether, in a post-merger context, on-net prices would have applied to the part of this traffic between TMN and Optimus. The reason is that the PCA (Autoridade da Concorrência, 2006b) did not impose lower on-net call prices in its decision to allow the merger. Thus, apparently, the merged operator would have had the choice to maintain off-net prices for communications between TMN and Optimus subscribers.