

Analysing the Portuguese Mobile Market

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Abstract: In this paper we use the methodology developed by Banker, Chang and Majumdar (1993) in order to examine and evaluate dimensions of performance for the three Portuguese mobile operators in the period between 1991-2001. Performance is measured using a multi-period ratio analysis model, which enables decomposition of profitability into 4 components: productivity, price recovery, product mix and capacity utilisation. The results have shown an imitation pattern between the three firms. The findings have also shown that the increase in competition following liberalization, induced a shift in the operators' strategies from differentiation to low cost.

JEL Classification: L96

Key words: telecommunications, performance analysis, competition, low-cost strategy, differentiation strategy

Introduction

The Dupont ROI (Return On Investment) formula has long been used as a traditional performance measure. It can be decomposed in two other measures, Return On Sales (a profitability measure) and Asset Turnover. But this aggregate measure is likely not to reveal the dynamics of the performance impacts of industry liberalisation.

The American Productivity Center (APC) extended and decomposed it into other two measures of firm performance: productivity and price recovery. Meanwhile Banker, Chang and Majumdar (1993) recognised that the APC productivity and price recovery ratios 'are confounded by changes in product mix and capacity utilisation'.

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For this reason they proposed a set of four ratios, which we believe can better capture and disentangle the sources of changes in a firm's profitability.

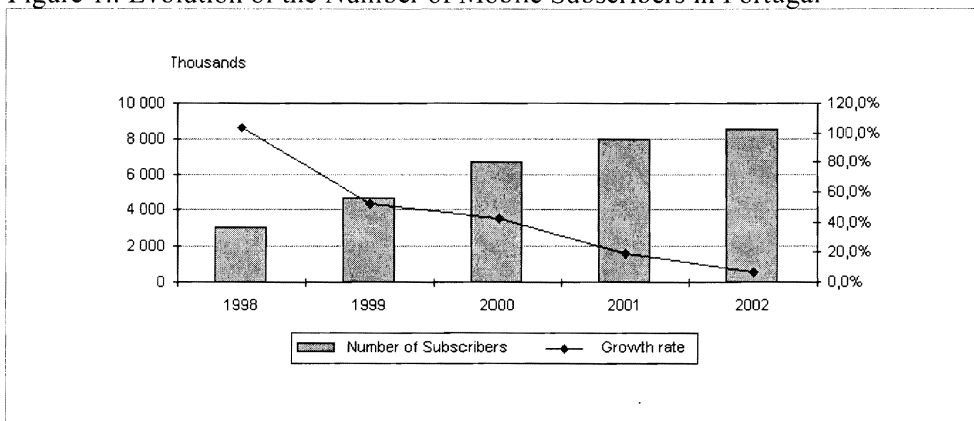
Using the later model we analyse the performance of the Portuguese mobile operators, in a period in which some major institutional and technological changes have taken place. Meanwhile, we also try to relate the measures with Porter's low cost and differentiation strategies (1980, 1985).

The Context

A call for tenders for a GSM license in Portugal was issued at the beginning of 1991. Seven valid bids were submitted, with twelve foreign companies¹ forming consortia with Portuguese companies (ex: British Telecom, Cable and Wireless, amongst others). Telecel², a consortium formed by two large Portuguese economic groups and ex Pacific Telesis (now Vodafone Airtouch), got the award for the license. Some of the bidders argued the award was not entirely fair, because it was based on subjective factors, such as the bigger prediction of growth for cellular market made by Telecel. (230 000 subscribers by the end of 2000, against a maximum of 90 000, predicted by the others).³

Almost at the same time, in 1991, TMN-Telecomunicações Móveis Nacionais was created (belonging to three companies-CTT, TLP and CPRM-Companhia Portuguesa Radio Marconi, in equal proportions), to exploit the analogical technology C450, already supplied by Siemens at a national level. But TMN soon realized that, in order to compete with Telecel, it had to operate a network of the same technology-it started experimentally in May 1992.

Figure 1.: Evolution of the Number of Mobile Subscribers in Portugal



Source: ANACOM, 2003

By 1995, Telecel had already 177.360 subscribers against 152.105 for TMN. Since that time, the cellular market has grown explosively. And this is, according to Donegan (2000), the more prominent feature of Portugal's telecom landscape.

One of the most important justifications for the success, and 'a major catalyst for growth' (Donegan, 2000) were the prepaid mobile services – a concept created and pioneered by TMN, with a prepaid service called MIMO (in September 1995).

The launching was an immediate success: TMN's subscribers doubled after three months⁴. One of the features of the prepaid services is that they are open to every kind of user-even low-income users-thus contributing for the success.

Optimus (a consortia formed by Sonae, France Telecom, Maxitel and EDP), the third cellular operator (licensed in 97), started aggressively - in September 1998 - with a low price strategy campaign to attract new subscribers. But the other two competitors followed it almost immediately.

The outcome of extra competition was beneficial to consumers: there was a substantial decrease in prices, apparently with the same quality. We'll give an illustrative example: in January 1998, the average price per minute on weekends and at night was 0.125 euro, after the entry of Optimus into the market it decreased to 0.025 euro. In our opinion, this was only possible due to the strong financial support of the companies' partners.

Research Setting and Method

As was previously mentioned, we start with a traditional performance measure, Return On Investment, and decompose it in two other measures, Return On Sales (ROS) and Investment Turnover, as follows:

$$ROI = ROS * Investment\ Turnover \quad (1)$$

where: Investment Turnover = Revenues/Investment and ROS= Income/ Revenues

The later measure can be expressed as :

$$ROS = \frac{Revenues - Expenses}{Revenues} = 1 - \frac{1}{\pi} \quad (2)$$

Let us define:

y'_m quantity of output m in period t , $m=1, \dots, M$

p'_m the price of output m in period t , $m=1, \dots, M$

x'_v the quantity of the variable input V in period t , $v=1, \dots, V$

w'_v the price of the variable input V in period t , $v=1, \dots, V$

- x_{ff}^t the quantity of the fixed input F in period t, $f=1, \dots, F$
 w_{ff}^t the price of the fixed input F in period t, $f=1, \dots, F$
 z_v^t standard quantity of variable input v in period t, $v=1, \dots, V$
 z_{ff}^t standard quantity of fixed input f, at actual output capacity level, $f=1, \dots, F$
 q_{ff}^t standard quantity of fixed input f, based on standard capacity utilization rate

Where $\pi = \text{Revenues/Expenses}$ is the profitability ratio, that can be more formally described in the following way

$$\Pi^t = \frac{\sum_{m=1}^M p_m^t y_m^t}{\sum_{v=1}^V w_v^t x_v^t + \sum_{f=1}^F w_{ff}^t x_{ff}^t} \quad (3)$$

and its variation between t and e_{t_0} is given by :

$$\text{RCCR}^5 = \Pi^t / \Pi^0 = \frac{\frac{\sum_{m=1}^M p_m^t y_m^t}{\sum_{v=1}^V w_v^t x_v^t + \sum_{f=1}^F w_{ff}^t x_{ff}^t}}{\frac{\sum_{m=1}^M p_m^0 y_m^0}{\sum_{v=1}^V w_v^0 x_v^0 + \sum_{f=1}^F w_{ff}^0 x_{ff}^0}} \quad (4)$$

We are now going to specify the set of four ratios previously referred. To operationalize the ratios, we need to define in one hand, standard quantities of inputs, and, on the other hand, base-level prices and base-level quantities of inputs and outputs. The base-level prices and base-level quantities are weighted averages over all periods and firms in the sample being analyzed.

By establishing a base-level, we are able to compare different firms, because we define an index of relative performance. Fraquelli and Vannoni (2000) reported that ‘the benchmark (period $T=0$) in principle could be a firm with some particular characteristics or simply a hypothetical firm with outputs, inputs and prices corresponding to the average values of firms under examination. The relative position of each firm with respect to the average firm and the evolution over time of its performance can then be analysed’

a. *Productivity change*: this ratio compares the cost of the actual input usage to the cost of the standard level of input required for the production of actual outputs (at the

same actual input prices). This ratio helps to evaluate whether a firm is more or less efficient in its operations.

$$PRDVT^t = \frac{\left(\sum_{v=1}^I w'_v z'_v + \sum_{f=1}^F w'_f z'_f \right)}{\left(\sum_{v=1}^I w'_v x'_v + \sum_{f=1}^F w'_f x'_f \right)} \quad (5)$$

b. *Price Recovery change*: this ratio compares the values of outputs and inputs at current and base-level prices, holding output quantities constant at actual level and input requirements constant at standard level required for actual output. It measures how effective is a firm in maximizing output prices while minimizing the costs of its inputs.

$$PRCREC^t = \frac{\sum_{m=1}^M p'_m y'_m / \sum_{m=1}^M p^0_m y^0_m}{\left(\sum_{v=1}^I w'_v z'_v + \sum_{f=1}^F w'_f z'_f \right) / \left(\sum_{v=1}^I w^0_v z^0_v + \sum_{f=1}^F w^0_f q^0_f \right)} \quad (6)$$

c. *Product mix*: this ratio individualises changes in the product mix. In order to accomplish it, this measure incorporates the same standard inputs for variable inputs as in the other two ratios, but for fixed inputs it uses the standard inputs given actual outputs and standard capacity utilisation.

$$PRDMIX^t = \frac{\sum_{m=1}^M p^0_m y'_m / \sum_{m=1}^M p^0_m y^0_m}{\left(\sum_{v=1}^I w^0_v z'_v + \sum_{f=1}^F w^0_f q'_f \right) / \left(\sum_{v=1}^I w^0_v z^0_v + \sum_{f=1}^F w^0_f q^0_f \right)} \quad (7)$$

d. *Capacity Utilization*: this ratio captures the variation in capacity utilization, by comparing inputs costs for actual outputs at standard capacity utilization levels with those at actual capacity utilization levels, holding input prices constant at base-level.

$$CAPUT^t = \frac{\left(\sum_{v=1}^I w^0_v z'_v + \sum_{f=1}^F w^0_f q'_f \right)}{\left(\sum_{v=1}^I w^0_v z^0_v + \sum_{f=1}^F w^0_f z^0_f \right)} \quad (8)$$

If we multiply the four above mentioned ratios we obtain the revenue-cost change ratio (RCCR):

$$RCCR^t = PRDVT^t \times PRCREC^t \times PRDMIX^t \times CAPUTL^t \quad (9)$$

Measures and Data Sources

Finding good and available data is always, we may say, a not very straightforward task. Most of the data required for computing the above-described ratios is available from or estimated based on public sources, namely the companies' financial reports. However, and as pointed by Banker et al. (1996), 'the reliability of the data employed (especially items such as capacity levels and prices indexes) (...) may be improved if the researcher has access to internal company records'.

We use two physical output measures: the total number of subscribers and the new subscribers for each year. Financial output measures are revenues from service rendered and revenues from sales. The use of revenue to measure output is somewhat controversial, but has been used in several studies. Also it would have been preferable to have the total number of call minutes instead of number of subscribers. But not all the operators have this data available since the beginning of their operations and therefore it will not be used. As pointed by McKenzie and Small (1997), 'The difficulty in obtaining data dictates the output variables used (...). The number of subscribers is readily available and provides a good measure.'

The main physical resources are the number of BTS (Base Transceiver Station) installed – this implies the ability to render the service to the users of the mobile operator network and therefore will be used as a capacity measure.

In what concerns the inputs involved, we have used the classification of Fraquelli and Vannoni (2000) and have considered one variable cost input (which groups Cost of Goods Sold and Material Consumed and External Supplies and Other Services) and two fixed cost inputs, Depreciation and Labour Costs. The number of employees has been used as the physical input for the variable cost and for the fixed cost Labour. The number of BTS has been used as the physical input for Depreciation and as an index of capacity, as mentioned before.

The calculation of capacity was the most demanding. By knowing the number of BTS, configuration, their distribution, the block rate, among others, it was possible to estimate the capacity in terms of subscribers served⁶.

We tried to obtain financial quarterly data, but not all of the 3 mobile operators had it available. Due to this fact, the ratios were calculated on a yearly basis. We have data from the first year of activity⁷ for each firm.

Findings on Firm Performance and Strategies

In what concerns the Revenue-Cost Change Ratio (RCCR), there appears to be a process of convergence, towards stabilisation.

As to the Product Mix Ratio, the one with the most uninteresting evolution, we can observe very similar values for the 3 firms, which is not a surprise because the mix does not differ significantly between the 3 operators. In what concerns the Capacity Utilisation Ratio we perceive an upward trend, and a tendency to stabilisation in the last years, which is consistent with growth of network size and with the achievement of a penetration rate that is very close to 90% (ANACOM, 2003). We can also confirm the very analogous behaviour of this ratio for the 3 companies.

The most striking differences between operators are in the Productivity Ratio and Price Recovery Ratio. Although in the early beginnings of network operation, both TMN and Vodafone-Telecel had very equivalent values in productivity, the gap between the 2 companies became larger after 1997. This has probably to do with the fewer number of workers of TMN when compared to Vodafone-Telecel and with Optimus.

The Price Recovery Ratio presents a decreasing pattern for the 3 firms. If we decompose this ratio in two other measures, Output Price Changes and Input Price Changes, it is possible to more clearly understand the effects of a more competitive environment on the price recovery ability of firms. There was, in fact, a drop on output prices that drove this ratio down for all the 3 companies.

Table 1.: Performance Measures for Company TMN

Year	RCCR	Productivity	Price Recovery	Product Mix	Capacity Utilization
1991	0.70	0.75	3.23	0.40	0.72
1992	0.72	0.50	3.56	0.51	0.79
1993	0.74	0.52	3.38	0.54	0.78
1994	0.73	0.47	2.04	0.64	0.75
1995	0.86	0.89	1.51	0.53	0.90
1996	1.00	1.26	0.77	0.55	0.96
1997	1.00	2.45	0.75	0.51	1.03
1998	1.15	2.64	0.67	0.56	1.04
1999	1.09	2.48	0.50	0.65	1.02
2000	1.14	3.03	0.48	0.68	1.02
2001	1.14	3.19	0.48	0.64	1.02

Table 2.: Performance measures for company Optimus

Year	RCCR	Productivity	Price Recovery	Product Mix	Capacity Utilization
1998	0.41	1.90	0.61	0.40	0.87
1999	0.69	1.69	0.90	0.48	0.94
2000	0.79	1.80	0.78	0.59	0.97
2001	0.79	1.53	0.76	0.65	1.05

Table 3.: Performance Measures for Company Vodafone-Telecel

Year	RCCR	Productivity	Price Recovery	Product Mix	Capacity Utilization
1992	0.18	0.37	2.35	0.40	0.53
1993	0.55	0.44	3.46	0.44	0.80
1994	0.75	0.50	3.22	0.52	0.88
1995	0.96	0.63	2.96	0.55	0.95
1996	1.11	0.75	2.67	0.56	0.99
1997	1.12	1.28	1.62	0.52	1.04
1998	1.09	1.42	1.30	0.57	1.05
1999	1.05	1.01	1.40	0.72	1.02
2000	1.03	1.28	1.14	0.69	1.02
2001	1.05	1.09	1.12	0.74	1.16

Table 4.: Mann-Whitney Test

Test Statistics^b

	PRODUTIV	PRECIV	REVEN	REVCHA NG	PRMIX	CAPUTIL
Mann-Whitney U	36,000	46,000	53,000	53,500	51,000	46,500
Wilcoxon W	91,000	112,000	119,000	119,500	117,000	112,500
Z	-1,339	-,634	-,141	-,106	-,282	-,601
Asymp. Sig. (2-tailed)	,180	,526	,888	,916	,778	,548
Exact Sig. [2*(1-tailed Sig.)]	,197 ^a	,557 ^a	,918 ^a	,918 ^a	,809 ^a	,557 ^a

a. Not corrected for tie

b. Grouping Variable: Firm

In order to confirm our prior discussion, and also to examine if the differences between operators were statistically significant, we conducted some statistical tests. The first was a Mann-Whitney test, to compare TMN and Vodafone-Telecel.. At a significance level of 5% we cannot reject the null hypothesis (that TMN and Vodafone-Telecel are similar) for any of the performance measures (see Table 4).

Being so, we cannot say that there are statistically significant differences in performance between the 2 companies, which corroborate what was previously believed.

Meanwhile, we conducted a Spearman Test to investigate about the existence of a statistically significant correlation between profitability and the 4 performance measures. The results in Table 5 are a proof of this.

Table 5.: Spearman Correlation Coefficients-Test Results

		Productiv	Prcv	Prmix	CapUtil
TMN	RevenCh	0,888**	-0,870**	0,648*	0,922**
Vodafone	RevenCh	0,787**	-0,462	0,506	0,784**
All firms	RevenCh	0,555**	-0,459*	0,633**	0,816**

* significant at 0,05

** significant at 0,01

Finally, and because it was believed that the introduction of prepaid services after 1996 induced a change in the operators' strategies, from differentiation to low cost (Porter, 1980, 1985), we decided, using a K-S test at a significance level of 5%, to test the validity of this 'assumption'. We tested the values of the performance indicators before and after 1996- a time when both TMN and Vodafone-Telecel had already introduced the pioneering concept⁸. The results (see Table 6) confirmed our suspicion: the prepaid services have had a statistically significant effect on the performance ratios of the two companies.

Table 6.: K-S Test Statistics

		Test Statistics ^a					
		PRODUCTIV	PRECV	REVEN	REVCHANG	PRMIX	CAPUTIL
Most Extreme Differences	Absolute	,909	,929	,623	,552	,552	,786
	Positive	,000	,929	,000	,000	,000	,000
	Negative	-,909	,000	-,623	-,552	-,552	-,786
Kolmogorov-Smirnov Z		2,256	2,305	1,547	1,370	1,370	1,950
Asymp. Sig. (2-tailed)		,000	,000	,017	,047	,047	,001

a. Grouping Variable: antes de 1996 e após 1996-pre pagos

As we have seen, prepaid services were responsible for a move on operators' strategies, observable by means of the evolution patterns of the performance measures and confirmed by the above test.

We can also perceive that both Productivity and Capacity Utilization have increased throughout the years, and at the same time Price Recovery has fallen down. It is also possible to notice that the most noteworthy changes took place in 1996, after the prepaid services were introduced.

In a progressively competitive market, ‘customers who did not have choices of changing their suppliers earlier now do have such choices’ (Banker et al, 1995). This forces the firms to increase productivity and charge lower prices. By doing so, there’s a shift on firms’ strategies: from differentiation to low cost.

Conclusion

The framework used in this paper was useful in understanding the performance’ effects of modifications in the competitive environment and business strategy of the 3 mobile operators, in a 10 year period. By disaggregating the profitability measure we were able to identify the underlying factors of performance change (that could otherwise be masked). The results found have contributed to a deeper understanding of how environmental changes may affect firm’s behaviour

The increase in firms’ rivalry, and the consequent drop on prices that drove down the price recovery ratios of the 3 firms, forced the Portuguese mobile operators (TMN, Vodafone-Telecel and Optimus) to improve their operating efficiencies, as it is visible from the improvement of Productivity ratio over the years. Concomitantly, we could observe an improvement on resource utilization. The only ratio that did not change significantly for neither of firms, during this period, was the Product Mix. This is consistent with the view that in more turbulent periods a low cost strategy provides a more rapid answer, in order not to lose market share.

We believe the effects of liberalization and consequent rivalry, that forced firms to behave differently, have had beneficial impacts on consumers, which is, at the end, one of the major concerns of public policy makers and regulators as well.

NOTES

¹ No more than a 25% share of foreign ownership was allowed

² Now 50.9% owned by Vodafone Europe B.V. In 1999, Telecel’s name changed to Vodafone-Telecel. We will use the two, meaning the same company.

³ In fact, Telecel prediction was wrong, because it was too modest: by the end of 1995 the company had already around 70 % of the total number of subscribers it had predicted for the year 2000, and in 2000 had approximately 10 times the number of subscribers predicted (2.478.800)

⁴ The success of TMN’s prepaid offering was followed by others-Italy was one of them. UK operators Vodafone and One-to-One provide other equally interesting examples.

⁶ Please note that when we say number of subscribers served we do not mean simultaneously.

⁷ *TMN- Financial Reports (1991-2001) Vodafone-Telecel Financial Reports (1992-2001) and Optimus Financial Reports (1998-2001)*

⁸ In fact, the prepaid services were first introduced by TMN in 1995 and in 1996 by Telecel

⁵ *Revenue Cost Change Ratio*

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