

## **Evolving competition and strategic performance in telecommunications: the Portuguese mobile operators**

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### **Abstract:**

*Policymakers call for some yardstick by which to evaluate the success or failure of their policies. In this sense, finding useful and relevant components of performance is a real need and significant area of research.*

*We evaluate dimensions of performance for the three Portuguese mobile operators, using the methodology by Banker / Chang / Majumdar (1993), as an extension of the APC framework, in the period 1991-2001, when major changes occurred. We apply a multi-period ratio analysis model enabling decomposition of profitability into 4 components: productivity, price recovery, product mix and capacity utilization. The time-paths of the performance indicators revealed a reproduction pattern: a decline in the price recovery ability of firms and an improvement of their operating efficiencies.*

*A second analysis was conducted using the relationship between the products of price recovery and product mix, which should capture the effects of differentiation strategy, and productivity and capacity utilization, which should capture the effects of low-cost strategy. There was a conviction that the introduction of prepaid services could, somehow, be responsible for a change in strategies followed by the operators: surprisingly this shift took place the year immediately after these services were introduced.*

*The framework used 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<sup>1</sup>. By*

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<sup>1</sup> We decided to take in consideration the advice by Banker, R. D. / Chang, H. / Majumdar, S.K. ((1993), p. 35): "A richer study, then, will involve a continuous study of all years in, say, a ten year period 1981 to 1990, to truly understand the temporal dynamics of how telecommunications firms have behaved in what has been a very turbulent decade for them. Thereby, the foundations can be laid for a rich stream of empirical performance analysis, applicable to many contexts resulting from market-liberalization measures being taken in various places around the world".

*disaggregating the profitability measure we were able to identify the underlying factors of performance change that could otherwise be masked.*

**Keywords:** performance measurement, competition, telecommunications, low-cost strategy, differentiation strategy

**JEL:** L96, M40

## **1. Introduction**

Saying that the last decades have been a period of unparalleled technological and regulatory change in the telecommunications environment is not new. The truth is the tendency towards deregulation and the introduction of competition is now visible in most *OECD* countries. Inevitably, extra competition has effects on firm profitability. In this sense, we feel it is important to capture the “*underlying behavioural predilections of firms*”<sup>2</sup> and to observe their responses, in order to better guide policymakers. As we know, many policies are characterized by ambiguous policy preferences, incomplete understanding of causal relationships, distributed knowledge and limited time for action. Policymakers lack the necessary information to make certain decisions, and even though the information may be available, computational or cognitive limitations may prevent them from pursuing their objectives. That’s why it is important to find relevant information in order to fill this gap.

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 liberalization. The *American Productivity Centre*<sup>3</sup> (APC) extended and decomposed it into other two measures of firm performance: *productivity* and *price recovery*. Meanwhile *Banker / Chang / Majumdar* ((1993), p.26) recognized that the APC *productivity* and *price recovery* ratios may be “*confounded by changes in product mix and capacity utilization*”. 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.

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<sup>2</sup> Banker, R.D. / Chang, H. / Majumdar, S.K. (1995), p.37

<sup>3</sup> Now American Productivity and Quality Centre.

Using the later model we trace, explore and compare the performance of the Portuguese mobile operators, in a period where major institutional and technological changes have taken place.

Meanwhile, and because it was believed that the introduction of prepaid services after 1996 induced a change of operators' strategies, we relate the measures with Porter's low cost and differentiation strategies (1980, 1985), by conducting a cross product analysis of the previous indicators. Although, as pointed by *Johnston / Banker* ((2000), p.6), the *Banker / Chang / Majumdar* (1993) models constitute extensions to profit-linked performance measurement models, rather than explicit attempts to develop measures to capture the dimensions in *Porter's* (1980, 1985) framework, the measures capture dimensions of performance which can be linked to low cost and differentiation strategies in systematic ways. Therefore they can be useful in conjunction with other information regarding a business' unit strategies and tactics, in face of additional competition.

## **2. Competition in Telecommunications and possible impact on firms**

### **2.1. Theoretical background**

Following *Penrose* (1959), there is recognition that firms are relatively idiosyncratic bundles of resources and capabilities and react differently to economic signals. Firm rivalry may then be responsible for an increase of the intensity of these signals (*Hayek*, (1945)) and, as a result, greater possibilities of *economic experimentation* may occur. In a somewhat broader context, namely that of political philosophy, openness to experiments in rules, organization, lifestyles, etc. has been one of the traditional arguments in favour of the liberal society at least since the writings of *Stuart Mill*. And a number of authors have argued that "... *the freedom to undertake... experiments has been the essential element accounting for the fact that industrialization has been, uniquely, a historical product of capitalist societies*" (*Rosenberg* (1992), p. 181). *Kor / Mahoney* (2000) suggest a list of key ideas that are derived from *Penrose* (1959), one of them consisting precisely on the thought that "*an important component of the competitive process is experimentation*".

Nonetheless, not all firms' routines may be similar to each other (*Nelson / Winter 1982*) and divergence in behaviour is likely to occur as competitiveness increases. Such divergences are, according to *Banker / Chang / Majumdar ((1995), p.39)*, likely to result in increasing firm-level variations in different performance parameters.

Following seminal work by *Chamberlin (1933)*, a relatively large numbers of authors have tried to explain the impact of competition on the performance of firms.

In telecommunications there are several contributions<sup>4</sup>, one of them being *Banker / Chang / Majumdar (1995)*, who analyzed performance of firms in the US local operating sector from 1988-1991, extending prior evidence generated for years 1981, 1984 and 1987. The main goal was to look for the effects of “*increasing pervasiveness of competition*” on the components of firms' profits. Their results showing continuing significant drops in price recovery ability of firms, and increased operating efficiencies.

*Fraquelli / Vannoni (2000)* have used the same methodology to investigate the dynamics of the different components of performance for the major European telecommunications operators in the period 1989–1993. The results presented a general improvement in productivity levels and a reduction in the ratio between output and input prices. According to authors, these findings were consistent with the view that incentive regulation is useful to enhance efficiency but the introduction and the promotion of competition seems to be more effective in reducing the price levels.

## **2.2. The Portuguese 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 companies<sup>5</sup> forming consortia with Portuguese companies (ex: *British Telecom, Cable and Wireless*, amongst others). **Telecel**<sup>6</sup>, 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

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<sup>4</sup> It is not our goal to list them here.

<sup>5</sup> No more than a 25% share of foreign ownership was allowed.

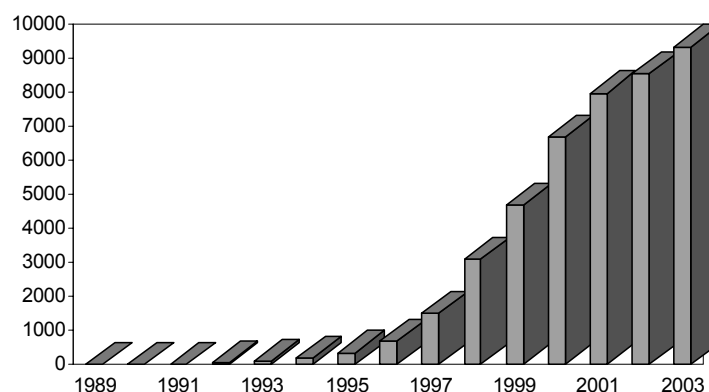
<sup>6</sup> Now 50,9% owned by Vodafone Europe B.V. In 1999, *Telecel's* name changed to *Vodafone-Telecel*. We will use the two, meaning the same company.

subscribers by the end of 2000, against a maximum of 90 000, predicted by the others). 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).

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.

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.

**Fig. 1: Evolution of the number of mobile subscribers in Portugal**



Source: ANACOM, 2004

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 months<sup>7</sup>. One of the features of the prepaid services is that they are open to every kind of user-even low-income

<sup>7</sup> 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. Also the Brazilian operators have adopted similar policies.

users-thus contributing for the success. At the moment most users of mobile networks have prepaid plans (see Table 1):

**Table 1: Distribution of Mobile Subscribers**

	2002	2003
<b>Post-paid</b>	22%	21%
<b>Prepaid</b>	78%	79%

Source: Anacom, 2004

*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€, after the entry of *Optimus* into the market it decreased to 0.025€. In our opinion, this was only possible due to the strong financial support of the companies' partners.

Additional competition accounted also for the fact that mobile penetration surpassed the fixed one in September 1999:

**Table 2: Fixed and Mobile Penetration**

	1997	1998	1999	2000	2001	2002
<b>Fixed Penetration</b>	39,7	40,6	41,6	42,2	43,9	43,1
<b>Mobile Penetration</b>	14,9	30,4	45,9	65,2	81,2	82,3

Source: INE, 2003

Concomitantly, competition had its expected results on market concentration, moving it away from values close to a monopolistic structure, as it is possible to see from Table 3:

**Table 3: Herfindahl-Hirschman Index**

	1995	1996	1997	1998	1999	2000	2001	2002
<b>HHI Index</b>	0,5	0,5	0,5	0,422	0,374	0,36	0,378	0,392

Source: Anacom, 2004

### 3. Methodological Issues

#### 3.1. Detail of performance ratios

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:

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

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

The later measure can be expressed as:

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

Let us define:

$y_m^t$  quantity of output  $m$  in period  $t$ ,  $m=1, \dots, M$

$p_m^t$  the price of output  $m$  in period  $t$ ,  $m=1, \dots, M$

$x_v^t$  the quantity of the variable input  $V$  in period  $t$ ,  $v=1, \dots, V$

$w_v^t$  the price of the variable input  $V$  in period  $t$ ,  $v=1, \dots, V$

$x_f^t$  the quantity of the fixed input  $F$  in period  $t$ ,  $f=1, \dots, F$

$w_f^t$  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  $t$ ,  $v=1, \dots, V$

$z_f^t$  standard quantity of fixed input  $f$ , at actual output capacity level,  $f=1, \dots, F$

$q_f^t$  standard quantity of fixed input  $f$ , based on standard capacity utilization rate

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

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

and its variation between t and e t<sub>0</sub> is given by :

$$(4) \quad \text{RCCR}^8 = \Pi^t / \Pi^0 = \frac{\frac{\sum_{m=1}^M P_m^t y_m^t}{\sum_{v=1}^V w_v^t x_v^t + \sum_{f=1}^F w_f^t x_f^t}}{\frac{\sum_{m=1}^M P_m^0 y_m^0}{\sum_{v=1}^V w_v^0 x_v^0 + \sum_{f=1}^F w_f^0 x_f^0}}$$

Before moving on, 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 analysed.

By establishing a base-level, we are able to compare different firms, because we define an index of relative performance. *Fraquelli / Vannoni* ((2000), p. 35) 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 analyzed*”.

Using this starting point we are now going to specify the set of four ratios previously referred.

Let it be:

**i) Productivity Change:**

$$(5) \quad \text{PRDVT}^t = \frac{\left( \sum_{v=1}^V w_v^t z_v^t + \sum_{f=1}^F w_f^t z_f^t \right)}{\left( \sum_{v=1}^V w_v^t x_v^t + \sum_{f=1}^F w_f^t x_f^t \right)}$$

**ii) Price Recovery Change:**

$$(6) \quad \text{PRCREC}^t = \frac{\sum_{m=1}^M p_m^t y_m^t / \sum_{m=1}^M p_m^0 y_m^0}{\left( \sum_{v=1}^V w_v^t z_v^t + \sum_{f=1}^F w_f^t z_f^t \right) / \left( \sum_{v=1}^V w_v^0 z_v^t + \sum_{f=1}^F w_f^0 z_f^t \right)}$$

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<sup>8</sup> Revenue Cost Change Ratio.



iii) **Product mix:**

$$(7) \quad PRDMIX^t = \frac{\sum_{m=1}^M p_m^0 y_m^t / \sum_{m=1}^M p_m^0 y_m^0}{\left( \sum_{v=1}^V w_v^0 z_v^t + \sum_{f=1}^F w_f^0 q_f^t \right) / \left( \sum_{v=1}^V w_v^0 z_v^0 + \sum_{f=1}^F w_f^0 q_f^0 \right)}$$

iv) **Capacity Utilization:**

$$(8) \quad CAPUTL^t = \frac{\left( \sum_{v=1}^V w_v^0 z_v^t + \sum_{f=1}^F w_f^0 q_f^t \right)}{\left( \sum_{v=1}^V w_v^0 z_v^t + \sum_{f=1}^F w_f^0 z_f^t \right)}$$

Where:

**Productivity Change** 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;

**Price Recovery Change** 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;

**Product Mix** ratio individualizes 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 utilization;

**Capacity Utilization** 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.

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

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

### 3.2. 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 / Chang / Majumdar*. ((1996), p.698), "*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 / Small* ((1997), p.152), "*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 / Vannoni* ((2000), p.38-39) 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 computation 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 served<sup>9</sup>.

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<sup>9</sup> Please note that when we say number of subscribers served we do not mean simultaneously.

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 activity<sup>10</sup> for each firm.

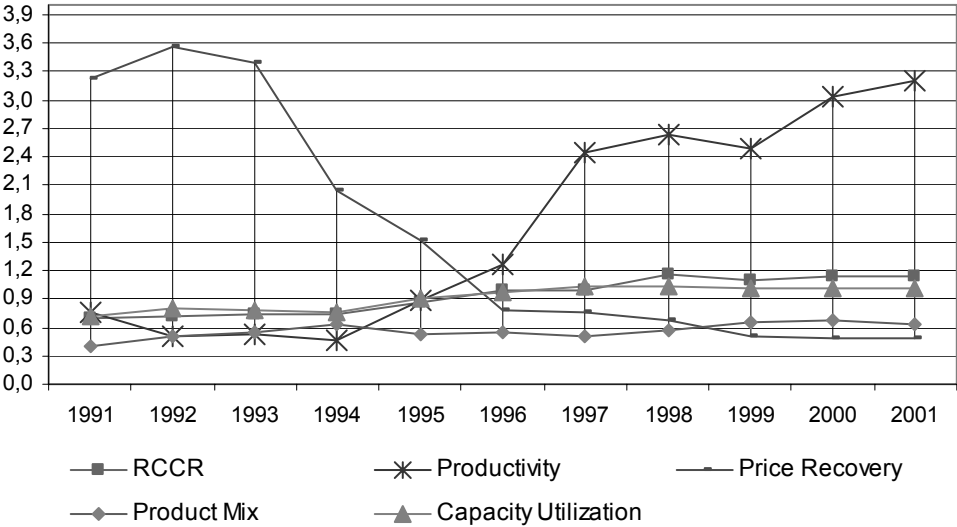
#### 4. Findings on Firm Performance and Strategies

##### 4.1. General Analysis

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

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 revelation because the mix does not differ significantly between the 3 operators. In what concerns the Capacity Utilization ratio we perceive an upward trend, and a tendency to stabilization 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.

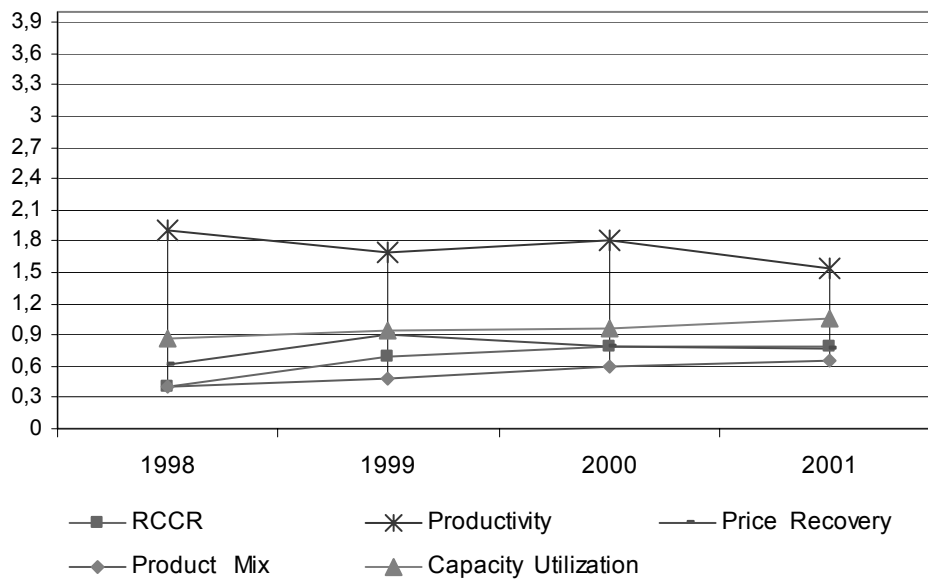
Fig. 2: Performance measures for company TMN



Source: first author PhD results.

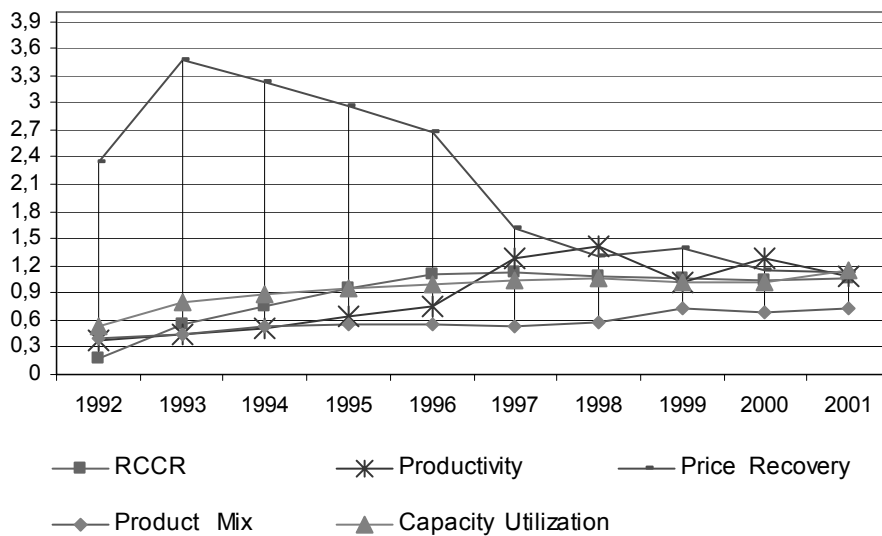
<sup>10</sup> TMN- Financial Reports (1991-2001) Vodafone-Telecel Financial Reports (1992-2001) and Optimus Financial Reports (1998-2001).

**Fig. 3: Performance measures for company *Optimus***



Source: first author PhD results.

**Fig. 4: Performance measures for company *Vodafone-Telecel***



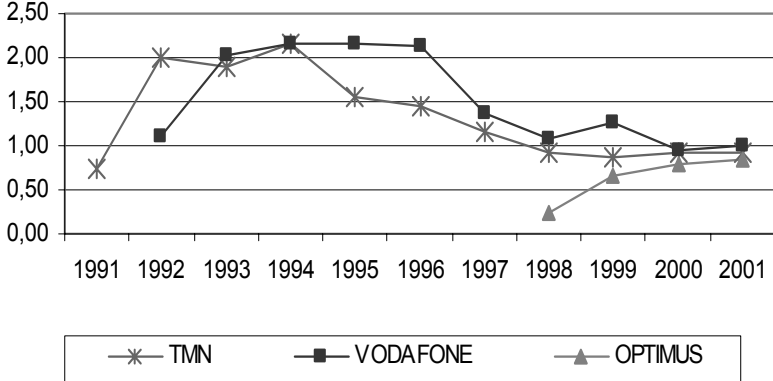
Source: first author PhD results.

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*. One should not forget that *TMN* can sometimes benefit from labour force borrowed from firms belonging to the same group (*PT*).

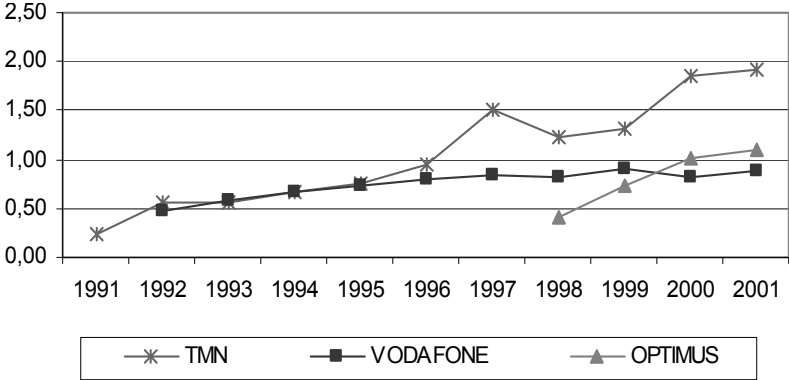
The Price Recovery ratio presents a decreasing pattern for the 3 firms. If we decompose this ratio in two other measures, *Output Price Changes* and *Input Price Changes*, it is possible to more clearly understand the effects of a more competitive environment on the price recovery ability of firms. There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

**Fig. 5: Output Price Changes**



Source: first author PhD results.

**Fig. 6: Input Price Changes**



Source: first author PhD results.

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.

**Table 4: Mann-Whitney Test**

	PRODUCTIV	PRECV	REVEN	REVCHANG	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 <sup>a</sup>	,557 <sup>a</sup>	,918 <sup>a</sup>	,918 <sup>a</sup>	,809 <sup>a</sup>	,557 <sup>a</sup>

a. Not corrected for tie      Grouping Variable: Firm

Source: first author PhD results.

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	Precv	Prmix	CapUtil
TMN	<b>RevenCh</b>	<b>0,888**</b>	<b>-0,870**</b>	<b>0,648*</b>	<b>0,922**</b>
Vodafone	<b>RevenCh</b>	<b>0,787**</b>	<b>-0,462</b>	<b>0,506</b>	<b>0,784**</b>
All firms	<b>RevenCh</b>	<b>0,555**</b>	<b>-0,459*</b>	<b>0,633**</b>	<b>0,816**</b>

\*significant at 0,05      \*\* significant at 0,01

Source: first author PhD results.

#### 4.2. Cross Product Analysis

According to *Johnston / Banker* ((2000), p. 13), the *Banker / Chang / Majumdar* (1993) performance indicators reflect the outcomes of business units' efforts to exploit sources of bargaining power and to reduce threats from new entrants and substitutes.

Emphasis on improvements in productivity and capacity utilization, choices of product mix and volume which move toward products with lower unit costs, and low price recovery are consistent with low cost strategies. Less emphasis on productivity and capacity utilization, choices regarding

product mix and volume which may be more costly but serve less price sensitive consumers, and higher price recovery are consistent with differentiation.

Similarly to *Johnston / Banker* ((2000), p. 19), after having analyzed and compared the time-paths of the performance indicators, we conducted a second analysis using the relationship between the products of Price Recovery and Product Mix, which should capture the effects of differentiation strategy, and Productivity and Capacity Utilization, which should capture the effects of low-cost strategy (see Table 6).

There was a conviction that the introduction of prepaid mobile services could, in some way, be responsible for a change in strategies followed by the operators. But surprisingly this shift took place the year immediately after the prepaid services were introduced - in 1996, for company *TMN*, and 1997, for *Telecel-Vodafone* (see Fig. 7 and Fig. 8). *Optimus*, which started in 1998, followed its predecessors, and started operations with a low cost strategy.

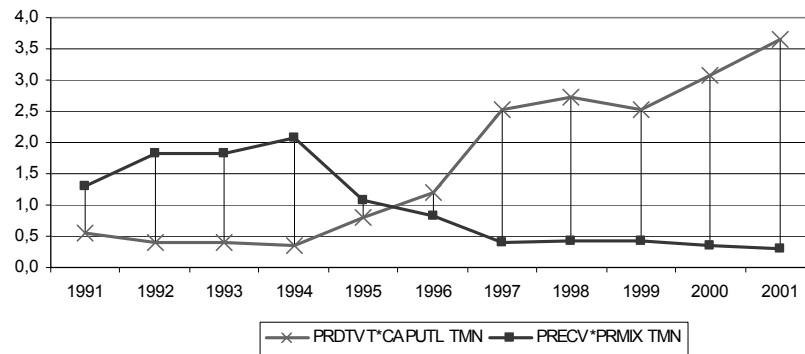
**Table 6: Performance components cross products, by company**

Year	TMN		Telecel-Vodafone		Optimus	
	PRDVT* CAPUTL	PRECV* PRMIX	PRDVT* CAPUTL	PRECV* PRMIX	PRDVT* CAPUTL	PRECV* PRMIX
1991	0,54	1,30	n/a	n/a	n/a	n/a
1992	0,39	1,83	0,19	0,94	n/a	n/a
1993	0,41	1,83	0,36	1,53	n/a	n/a
1994	0,35	2,08	0,45	1,68	n/a	n/a
1995	<b>0,80</b>	<b>1,08</b>	0,59	1,62	n/a	n/a
1996	<b>1,21</b>	<b>0,83</b>	<b>0,74</b>	<b>1,50</b>	n/a	n/a
1997	2,53	0,40	<b>1,32</b>	<b>0,85</b>	n/a	n/a
1998	2,73	0,42	1,48	0,74	1,66	0,24
1999	2,52	0,43	1,03	1,02	1,59	0,44
2000	3,09	0,34	1,30	0,79	1,74	0,46
2001	3,64	0,31	1,26	0,83	1,61	0,49

Source: first author PhD results.

**Fig. 7: Performance components cross products**

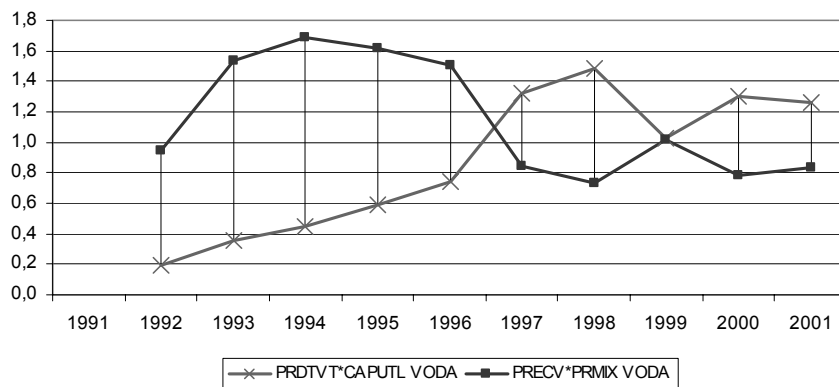
*TMN*



Source: first author PhD results.

**Fig. 8: Performance components cross products**

*Vodafone-Telecel*



Source: first author PhD results.

We decided to test the validity of the previous assumption, by using a K-S test at a significance level of 5%. We examined the values of the performance indicators before and after 1996 - a time when both *TMN* and *Vodafone-Telecel* had already introduced the pioneering concept<sup>11</sup>. The results (see **Table 7**) confirmed our suspicion: the prepaid services have had a *statistically significant* effect on the performance ratios of the two companies.

<sup>11</sup> In fact, the prepaid services were first introduced by *TMN* in 1995 and in 1996 by *Telecel*.



**Table 7: K-S Test Statistics**

		PRODUCTIV	PRECV	REVEN	REVCHA NG	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

Source: first author PhD results

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.

## 5. Concluding Remarks

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 firms' behaviour.

The increase of 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. Declines in price recovery ability of firms suggest that competitive market forces have decreased the possibility of monopoly rent extraction. 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.

The cross product analysis has also illustrated 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 / Chang / Majumdar (1995), p. 43). 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.

The welfare consequences of these results are evidently positive and should be looked at more carefully. We showed how our integrated approach yielded insights into the performance of firms within the industry, of the industry as a whole, and thus enabled us to evaluate the detailed outcomes of public policy decisions such as liberalization and deregulation.

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.

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