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An HHI-based analysis of the H3G-Wind merger

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Abstract. Mergers typically represent a cause of concern for possible consequences on the level of competition and the number of choices available to customers. The recently approved merger between Wind and H3G, Italian subsidiaries respectively of Vimpelcom and Hutchison Whampoa, makes no exception. In this paper an analysis of the possible consequences of that merger is reported, by employing the Herfindahl-Hirschman Index as a measure of concentration. It is shown that the Italian mobile telecommunications market would be further pushed into a high concentration situation by the merger, and the entry of Iliad, proposed by the would-be merging companies as a remedy measure, would bring the HHI back to its pre-merger value just if Iliad would take a market share larger than 9.46%.

Keywords: Concentration indices; Competition; Herfindahl-Hirschman Index (HHI); Mergers; Mobile Telecommunications.

1 Introduction

Wind and H3G are the Italian subsidiaries of Vimpelcom and Hutchison Whampoa respectively. Both operate in the Italian mobile telecommunications market, being respectively the third and the fourth largest company in a market made of just 4 licensed operators plus some virtual operators (MVNOs). In February 2016 the European Commission received a notification of a proposed merger between them [6] and proceeded to open an investigation to assess whether the proposed joint venture was in line with the EU Merger Regulation [5]. The merger was approved in September 2016¹, subject to some conditions related to the entry of a new operator, namely Iliad.

Mergers may always represent a problem, since they reduce the number of companies, hence the choices left to customers and the level of competition. That between Wind and H3G, being a horizontal one (both delivering the same service), is not an exception. Though conditionally approved by the European Commission, it is anyway a case to study, especially in the light of its possible future developments, i.e., the actual entry of Iliad.

Examples of ex-post analyses of mobile telecom mergers are those concerning cases in Austria and the Netherlands [2] and Korea [10]. A historical review of a number of mergers in the telecom sector occurred in the EU and the US can be read in [18]; a similar analysis for India is instead reported in [7].

Since long, mergers have been examined by comparing the levels of market concentration before and after the merger, through the Herfindahl-Hirschman Index (HHI) [4]. The use of that index also received an institutional endorsement by the U.S. Department of Justice [21] and the European Commission [20], though a number of different issues should be examined to arrive at a full and informed view of a merger [11].

In this paper we adopt the HHI to perform a preliminary analysis of the just approved merger between Wind and H3G. We find that the merger, acting on an already highly concentrated market, carries along a further significant increase in the level of concentration. Though the entry of Iliad is put forward as a remedy measure, we show that the return to pre-merger values of the HHI would require Iliad to gain a market share roughly in the 9-10% range.

The paper is organized as follows. We report a brief review of the HHI and other concentration indices in Section 2. We then examine the pre-merger characteristics of the Italian mobile network market in Section 3, and the merger details in Section 4. The consequences of the merger and the impact of Iliad’s entry are examined in Section 5.

2 Concentration indices

Concentration indices measure how much a specified quantity is concentrated in the hands of a few holders. In industrial economics, they provide a single-number indication about the structure of a market, and help assess the presence of a quasi-monopoly, a duopoly, an oligopoly, or a fragmentation among many suppliers/producers. They are therefore the right tool to examine whether concerns for the creation of a dominant position exist in the case of mergers and acquisitions. Two major indices are the Herfindahl-Hirschman Index and the \( \text{CR}_4 \) (Competition Ratio) index. In this section, we focus on the HHI and provide its definition and main characteristics. The section is extracted from [16] and is reported here just for the reader’s convenience.

The Herfindahl-Hirschman Index owes its name to the two economists who developed it, though independently. Albert O. Hirschman proposed the index in 1945 in [9], while Orris C. Herfindahl presented it in 1950 in his unpublished doctoral dissertation at Columbia University, ”Concentration in the U.S. Steel Industry”. Hirschman himself had to somewhat untangle the paternity dispute, since his index had been attributed to Gini [8]. Actually, though Herfindahl proposal appeared five years later than Hirschman’s, the form of the index as used today is actually that proposed by Herfindahl (which leads to an index that is the square of the original proposal).

If we consider a market where \( n \) companies are operating, and the market share of the \( i \)-th company is \( s_i \), the HHI is defined as the sum of the squares of
all the market shares

$$\text{HHI} = \sum_{i=1}^{n} s_i^2.$$  \hspace{1cm} (1)

The HHI is obviously a positive figure. If the market shares are expressed as fractions of the whole market (i.e., $0 < s_i \leq 1$, $\forall i$), then we have $0 < \text{HHI} \leq 1$. Instead, if the market shares are expressed as percentages (i.e., $0 < s_i \leq 100$, $\forall i$), then we have $0 < \text{HHI} \leq 10000$. In the following we opt for the first choice, which gives us a naturally normalized value for the HHI.

Actually, not the whole range of values may be taken by the HHI. If we have a monopoly, where a single company takes all the market, we have $n = 1$ and

$$s_1 = 1 \implies \text{HHI} = 1,$$  \hspace{1cm} (2)

but the opposite case, where the market is uniformly distributed between the company (perfect competition) does not lead to $\text{HHI} = 0$. In a market of $n$ companies with perfect competition, we have

$$s_i = \frac{1}{n} \quad i = 1, 2, \ldots, n \implies \text{HHI} = \sum_{i=1}^{n} \left( \frac{1}{n} \right)^2 = \frac{1}{n},$$  \hspace{1cm} (3)

which is then the minimum value attainable by the HHI.

Though the computation of the HHI would require us to know the complete set of market shares, it has been shown that a reliable interval estimate can be obtained even with incomplete information [15].

The HHI has also been compared to concentration indices established among statisticians (namely those due to Gini, Bonferroni, and Amato) and has been shown in [13] to provide the largest sensitivity in the case of the Zipf law, i.e., the largest changes when the Zipf parameter changes (see [17] for an example of application of the Zipf law also in contexts other than the distribution of firms). Several studies have been conducted in the past to examine the relationship between HHI and another popular concentration index, the CR$_4$ index that measures the market share owned by the four largest companies; correlation analyses between the HHI and the CR$_4$ are reported in [19], [3], [12], [22], and [14].

For both the HHI and the CR$_4$, tables have been provided to translate the values of the index into a statement on the level of competition. Though a precise correspondence cannot be drawn between the numerical value of the HHI and the qualitative indication of a level of concentration (or, equivalently, of competition), some guidelines have been provided for that purpose. The U.S. Department of Justice provided its guidelines for horizontal mergers first in 1985 and later revised them several times, till the latest version in 2010, proposing in Section 5.3 of its 2010 version a classification of markets into three types, reported in Table 1 [21]:

The European Commission, rather than stating just the levels of HHI for the same purpose of identifying horizontal competition concerns, has proposed to define both the levels of post-merger HHI and the change $\Delta\text{HHI}$ incurred
Table 1. Levels of competition and the HHI

<table>
<thead>
<tr>
<th>HHI</th>
<th>Competition level</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.15</td>
<td>Unconcentrated Markets</td>
</tr>
<tr>
<td>0.15–0.25</td>
<td>Moderately Concentrated Markets</td>
</tr>
<tr>
<td>&gt;0.25</td>
<td>Highly Concentrated Markets</td>
</tr>
</tbody>
</table>

by the HHI because of the merger to identify the cases of no concern. Namely, it has stated that concerns are unlikely when any of the conditions listed in Table 2 apply [20]. All other cases are therefore likely to raise concerns about competition.

Table 2. Alternative conditions for no competition concerns

<table>
<thead>
<tr>
<th>Post-merger HHI ΔHHI</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.1</td>
<td>Any</td>
</tr>
<tr>
<td>0.1–0.2</td>
<td>&lt;0.025</td>
</tr>
<tr>
<td>&gt;0.2</td>
<td>&lt;0.015</td>
</tr>
</tbody>
</table>

3 The Italian mobile telecommunications market

Before providing the details of the would-be merger, we need to examine the current situation of the Italian mobile network market. The market at the start of October 2016 is made of four licensed operators (Telecom Italia, Vodafone, Wind, and H3G) plus several mobile virtual operators (e.g., PosteMobile, CoopVoce, Fastweb Mobile).

The pertaining market shares at the end of 2015 are reported in Table 3, as certified in [1], where we use the name TIM in the place of Telecom Italia, since it is the new brand name covering both fixed and mobile activities of Telecom Italia.

As can be seen, the market was shared among four large operators, as reported in Table 3, with the very small residual portion taken by mobile virtual network operators (MVNOs).

Though, in principle, we could not compute the HHI exactly, since we do not know the detailed distribution of the portion taken by MVNOs, we can compute an interval estimation for it, using the formulas derived in [15]. In this case, since the residual portion is lower than the last known share, the lower and
upper bound are given by the following inequality:

\[ 0.257 < \text{HHI} < 0.259. \] (4)

Though by a small quantity, the HHI exceeds the lowest value for the market to be considered as a highly concentrated one (see Table 1). Therefore the Italian mobile network market can be classified as highly concentrated even before the merger takes place.

4 The merger

In March 2016 the European Commission opened an investigation to assess whether the proposed joint venture between the telecommunications activities of Hutchison and VimpelCom in Italy was in line with the EU Merger Regulation\(^2\), under the quite obvious concern that the merger would reduce the number of mobile network operators, thereby increasing the likelihood that MNOs would coordinate their competitive behaviour and raise prices.

The merger was approved in September 2016\(^3\), subject to the entry of a new mobile operator (as suggested by the two companies) and the to-be-merged companies implementing the following remedies:

\begin{itemize}
  \item Divestment to the new mobile network operator of a certain amount of the joint ventures mobile radio spectrum from different frequency bands (900 MHz, 1800 MHz, 2100 MHz and 2600 MHz);
\end{itemize}


– Transferring/colocating the new mobile network operator of several thousand mobile base station sites;
– Providing the new mobile network operator with transitional access to 2G, 3G 4G, and new technologies, until the new mobile network operator has built its own mobile network.

The new mobile operator, as suggested by H3G and Wind, is Iliad, which has released the terms of the agreement it signed with the Hutchison and VimpelCom groups \(^4\), to which H3G and Wind respectively belong. Namely, the agreement involves the following commitments:

– The transfer of a balanced set of 2×35MHz 3G/4G frequencies (2×5MHz at 900MHz, 2×10MHz at 1800MHz, 2×10MHz at 2100MHz and 2×10MHz at 2600MHz) for 450 million, payment of which is to be phased between 2017 and 2019;
– An undertaking to acquire several thousands of macro sites in densely populated areas offered by Wind/H3G or rented from third parties;
– An undertaking either to bring into force a RAN-sharing agreement covering rural areas with Wind/H3G, or to acquire several thousands of macro sites in those areas from Wind/H3G or third parties;
– A 2G, 3G and 4G roaming agreement on the merged network, for a period of five years renewable for one further five-year period at the initiative of Iliad.

These conditions should allow Iliad to take on a significant portion of the market as emerging after the merger.

5 Post-merger concentration

In Section 3 we have computed the concentration index before the merger. In this section we examine what may happen after the merger. Rather than forecasting the future, we consider three paradigmatic cases:

– negligible presence of the new entry (Iliad);
– uniform erosion of incumbents’ market shares by the new entry;
– levelling of incumbents’ market shares.

The extreme case is that where Iliad gets a negligible portion of the market. This is also the situation that will take place at time 0 after the merger, where the only net effect will be the aggregation of H3G and Wind share into a single company. Assuming that all the other positions stay the same, the resulting market composition would be as reported in Table 5 (we use again the shares referring to 2015, as if nothing had changed). As can be seen, we would end up with a market roughly divided into equal shares between the three largest operators, with the usual crumbles left to MVNOs. Using again the interval estimation method derived in [15], we would have

\[ 0.307 < \text{HHI} < 0.308. \]  \hspace{1cm} (5)
The step in the HHI would then be roughly 0.5, large enough to consider the post-merger situation (an already highly concentrated one) as a cause of concern (see Table 2). It is to be noted that the HHI is close to that we would obtain under a perfectly equilibrated triopoly (in fact, we would have HHI = 1/3 = 0.333).

Let’s consider instead a less extreme case, where Iliad takes a share \( x \) of the market, by taking it away equally from the other three incumbent operators. We call this scenario the uniform erosion of incumbents’ market shares. For convenience, we label the shares of the three incumbent operators respectively as \( s_1 \), \( s_2 \), and \( s_3 \) in decreasing order (where \( s_1 \) pertains to Wind+H3G and \( s_3 \) to Vodafone). Indicating by \( c \) the contribution due to the MVNOs (which is anyway very limited), the resulting HHI would be

\[
\text{HHI} = \left(s_1 - \frac{x}{3}\right)^2 + \left(s_2 - \frac{x}{3}\right)^2 + \left(s_3 - \frac{x}{3}\right)^2 + x^2 + c \\
= s_1^2 + s_2^2 + s_3^2 + 3 \left(\frac{x}{3}\right)^2 - 2\frac{x}{3}(s_1 + s_2 + s_3) + x^2 + c \\
= \text{HHI}^* + \frac{4}{3}x^2 - 0.95\frac{2}{3}x,
\]

where \( \text{HHI}^* = s_1^2 + s_2^2 + s_3^2 + c \) is the HHI right after the merger. In Fig. 1 we can see that the emergence of Iliad would progressively reduce the HHI. How large a share should Iliad take to get an HHI as small as the pre-merger situation? The computation is quite easily done through Equation (6), which gives us a quadratic equation, whose solution is that Iliad should take a share \( x = 9.84\% \).

However, the uniform distribution of share losses among the three incumbent operator is not the one providing the fastest descent of the HHI. It turns out that the maximum decrease of the HHI is achieved when the operators’ shares are levelled. That means that the share of the largest operator is eroded first, till it equals that of the second largest operator, then both the largest and the second largest operators see their shares eroded equally, till they reach the third largest operator, and so on. We call this scenario the levelling of incumbents’ market shares. We can as well compute the resulting HHI under this scenario. We end up with the computation of HHI being splitted into three different cases, depending on the overall share got by Iliad.

\[\text{https://www.iliad.fr/presse/2016/CP_050716_Eng_.pdf}\]
Fig. 1. HHI in the case of uniform share loss

**Case A:** 0 ≤ x < s₁ - s₂, i.e., 0 ≤ x < 0.5%
This is the case where Iliad is eroding just the company coming out of the merger. The resulting HHI is

\[
\text{HHI} = (s_1 - x)^2 + s_2^2 + s_3^2 + x^2 + c \\
= s_1^2 + s_2^2 + s_3^2 + 2x(s_1 - s_2) + c = \text{HHI}^* + 2x(s_1 - s_2)
\]  

(7)

**Case B:** s₁ - s₂ ≤ x < s₁ + s₂ - 2s₃, i.e., 0.5% ≤ x < 2.9%
Now both Wind+H3G and TIM have been levelled, and their shares are being eroded together. The resulting HHI is, after a few algebraic steps

\[
\text{HHI} = 2 \left[ s_2 - \frac{x - (s_1 - s_2)}{2} \right]^2 + x^2 + s_3^2 + c \\
= s_1^2 + s_2^2 + s_3^2 + \frac{3}{2}x^2 - x(s_1 + s_2) - \frac{(s_1 - s_2)^2}{2} + c \\
= \text{HHI}^* + \frac{3}{2}x^2 - x(s_1 + s_2) - \frac{(s_1 - s_2)^2}{2}.
\]  

(8)

**Case C:** x ≥ s₁ + s₂ - 2s₃, i.e., x ≥ 2.9%
This is the case where all three incumbent operators have been levelled and are now equally eroded by Iliad. With the same notices as before, we have

\[
\text{HHI} = 3 \left[ s_3 - \frac{x - (s_1 + s_2 - 2s_3)}{3} \right]^2 + x^2 + c \\
= \frac{4}{3}x^2 - \frac{2}{3}x(s_1 + s_2 + s_3) + 3s_3^2 + \frac{(s_1 + s_2 - 2s_3)(s_1 + s_2 + 4s_3)}{3} + c
\]  

(9)
If we neglect the contribution by the MVNOs, which would anyway not be larger than $0.041^2 = 0.001681$, we can plot the overall behaviour of the HHI in this case in Fig. 2. Now, the value of Iliad’s market share that would bring the HHI back to its pre-merger value is $x = 9.46\%$, which is actually slightly lower than that obtained under uniform share loss assumption. This value appears therefore as the minimum share taken by Iliad that would restore the pre-merger HHI.

![Fig. 2. HHI in the case of share levelling](image)

6 Conclusions

The merger between H3G and Wind, subsidiaries respectively of Hutchison Whampoa and Vimpelcom, has been analysed by employing the Herfindahl-Hirschman Index as a measure of the level of concentration in the Italian mobile telecommunications market.

The analysis shows that the market exhibited a high level of concentration even before the approval of the merger, but the merger would further reduce significantly the competition, leading to a nearly perfect triopoly.

The entry of Iliad, envisaged as a remedy measure, would have to be significant to restore the level of competition ex-ante. In both cases of uniform erosion of the incumbents’ market shares or their levelling, the market share that Iliad should achieve to bring the HHI back to the value it had before the merger would lie between 9 and 10\%.
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