Revisiting the « Waterbed Effects » across Europe's mobile markets

E. Baranes, L. Benzoni and C.H. Vuong

Novembre 2008

TERA Consultants
32, rue des Jeûneurs
75002 PARIS
Tél. + 33 (0) 1 55 04 87 10
Fax. +33 (0) 1 53 40 85 15

S.A.S. au capital de 200 000 €
RCS Paris B 394 948 731

Revisiting the "Waterbed Effects" across Europe's mobile markets

Edmond Baranes[1] Laurent Benzoni[2] Cuong Hung Vuong[3]

November 2008

The aim of this paper is to present contrasting evidence to an interesting issue concerning the existence of the "waterbed effect" in Europe's mobile telephony. This issue arises when reducing mobile termination rates (MTRs) generally increases the level of retail prices for mobile subscribers. This is a key issue in Europe because the MTRs have been regulated to lower levels and oriented to costs of providing interconnection services with the so-called "glide path" regulation while there is apparently a lack of proper analysis on the "waterbed effect" in practice. The main finding of this study is that the "waterbed effect" is not natural in Europe especially in the presence of several MNOs with asymmetric sizes in each market. In precision, this study demonstrates that when the MTRs were regulated to lower levels, later entrants generally cut retail prices to gain more market share since overall profits should depend more on the retail markets. There was consequently no "waterbed effect" at country level and "glide path" regulation played a positive role in improving the competitiveness of Europe's mobile markets.

JEL Codes: L13, L51, L96

[1]Corresponding author: Edmond Baranes, edmond.baranes@univ-montp1.fr. LASER, University Montpellier 1.

[2] ERMES, University of Pantheon-Assas, Paris.

[3] ERMES, University of Pantheon-Assas, Paris.

Key words: Waterbed effect, network asymmetries, mobile termination charges

Summary

1 Introduction

The aim of this paper is to present contrasting evidences to an interesting issue concerning the existence of the waterbed effect in Europe's mobile telephony sector. The "waterbed effect", which can be seen as a natural effect for multi-product firms, arises when lowering regulated mobile termination rates (MTRs) increases the level of retail prices for mobile subscribers. This is an interesting issue for two reasons. First, the optimal level and the risks of high MTRs in competition between Mobile Network Operators (MNOs) have been discussed extensively in telecommunication economics. Furthermore, from the viewpoint of regulatory authorities, particularly New Zealand's Competition Commission, the waterbed effect is unlikely to occur because the dynamics of a competitive market prevents significant changes to mobile service and handset prices[4]. Second, in principle, European regulation requires MNOs to lower MTRs oriented to costs of providing interconnection services with the so-called glide path" regulation. Indeed, in its draft recommendation on termination rates, the European Commission (2008) asserts that "setting a common approach based on an efficient cost standard and the application of symmetrical termination rates would benefit end-users in terms of lower retail prices". To this end, European Regulatory Group (2008) also proposed to fix MTRs at a symmetric rate calculated by the NRAs. As a result, an important issue for European regulators is to provide proper analysis on whether such glide path" regulation might lead to the "waterbed effect" across the Europe's mobile markets.

A well documented literature exists on network competition and termination charges. The seminal papers by Amstrong (1998) and Laffont, Rey and Tirole (1998a, b) provide a general framework to study competition between interconnected networks. In this literature, the principal question is whether networks may use termination charges as a collusive tool to soften competition in the downstream market. These papers started the debate by pointing to the fact that high termination rates increase retail prices when

[4]Paragraph 12 in the Draft Report on whether mobile termination should become a designated or specified service, New Zealand's Competition Commission, 18th October 2004,

http://www.comcom.govt.nz/IndustryRegulation/Telecommunications/Investigations/

MobileTerminationRates/reportsandsubmissions.aspx#227 operators compete only in usage prices. This conclusion is reversed when operators compete with more sophisticated pricing strategies by using for example two-part tariffs or on-net and off-net price discrimination. Following these seminal papers, a broad literature has been developed by relaxing different modelling assumptions and leads to the general conclusion that operators coordinate low termination rates whether networks are not too asymmetric (see the survey by Armstrong and Sappington (2007) and Armstrong and Wright (2007) for instance). This has a crucial policy implication since this conclusion suggests that low termination rates serve as a collusive device and indicates that a prerequisite for a waterbed effect is that operators use non linear pricing (Gans and King, 2001). In other words, in the mobile market, waterbed effect reflects the fact that high termination rates should be associated with low retail prices for mobile customers.

While there has been an extensive theoretical literature of the waterbed effect[5], empirical works have not been the object of sufficient attention. For this reason, Genakos & Valletti (2008) provide a useful empirical study concerning the existence of the waterbed effect in the mobile market by testing the impact of lower MTRs on service prices of the two largest MNOs in each OECD country. Their main finding is that there is strong evidence of a waterbed effect, i.e a decrease in MTRs necessarily raises MNO tariffs. Additionally, the change in MTRs slightly impacts MNO profitability, suggesting that the "waterbed effect" is not complete[6]. Their results however are based on the first two operators in each country and which often have large market shares with similar characteristics and commercial strategies. This leads to a bias in estimating the waterbed effect, especially when data excludes important factors such as market pressures from the other operators and market responses to price offers.

The present paper explores the existence of the "waterbed effect" in the European mobile markets by investigating the impacts of glide path regulation on final market outcomes represented by average country prices and penetration rates of the late entry operators. The framework is essentially composed of two main empirical tests. A first test analyses linkage between MTR regulation and penetration rates of the late entry European MNOs. If there is a waterbed effect (if it exists at all), it can be expected that MTR reduction would have enhanced their service prices, and hence negatively impact late entrant penetration rates, or at least, the impact is insignificant. The second test is to more explicitly investigate the waterbed effect in Europe's mobile markets at country level which is, by definition, the negative relationship between glide path regulation and the average market retail price of voice services.

---

[5]See, for example, Schiff (2007) for a more general framework showing how waterbed effect depends on the degree of product substitutability.

[6]Anderson & Hansen (2007) with the data on the European mobile telephony also find that firm EBITDA were insignificantly affected by the MTR regulation.

The main finding is that, during 2002-2006, average mobile service prices included higher MTRs, that is by lowering MTRs by one percent, average mobile service prices could decrease as much as 0,27 percent depending on the model specifications. This is because one important characteristic of Europe's mobile markets is the presence of several MNOs in each country with asymmetry in size and commercial targets. Smaller MNOs are usually the last market entrants, with strong incentives to increase their customer bases. To compensate for their late market entrance, asymmetric regulation[7] was also applied in wholesale markets, allowing later entrants to charge higher MTRs than earlier entrants. With this in mind, when the MTRs were regulated to lower levels, it was more likely for the later entrants to undercut retail prices to gain more market shares. Moreover, lower MTRs strengthen incentives to increase client bases since their profits are more dependent on the retail markets, hence increasing with their penetration rates. Consequently, they competed more aggressively to gain new subscribers, intensifying the competitiveness of the European mobile markets.

The rest of the paper is laid out as follows: section 2 describes variables and data across Europe's mobile telephony. Section 3 is devoted to the empirical test for the relationship between glide path regulation on the entrant's penetration rates. Section 4 is dedicated to an explicit analysis of the waterbed effect in the context of European mobile markets. Section 5 presents concluding remarks. All tables and figures are relegated in the appendix.

2 Data and econometric variable descriptions

With limited data and to ensure consistency among data, annual data is collected from thirteen countries in Western Europe with similar economic and regulatory environments (Germany, Netherlands, Austria, Belgium, Spain, Finland, France, Greece, Ireland, Italy, Portugal, Sweden, UK) (country level) and from twenty five late MNOs (operator level). The late entrant MNOs is defined as the main infrastructure MNOs using GSM technology in Europe with small market shares, excluding historic incumbents and early entrants with high market shares during the considered period. Their names are listed in the appendix.

National average prices of mobile services (P). Due to the complexity of mobile tariffs offered in Europe's mobile markets, it is obviously impossible to collect all data, especially information on non-linear tariffs, which are mainly composed of subscription fees and per minute call price, and the levels of handset subsidies. Fortunately, data on

[7]See Peitz (2005 a, b) for a theoretical analysis of asymmetric regulation and Peitz (2003) for the discussion about the nessesity of asymmetric regulation in Europe

average price for one minute of mobile outgoing traffic in each country can be obtained from QUANTIFICA[8] for the period 2002-2006, which is calculated as follows:

$$P_{c,t} = \frac{Voice\_revenues_{c,t}}{Voice\_traffics_{c,t}}$$

where: $Voice\_revenues_{c,t}$ is the total mobile revenues from outgoing voice services in country c in the year t

and $Voice\_traffics_{c,t}$ is total mobile outgoing traffics generated within the correspondent year

Therefore, $P_{c,t}$ is a good proxy for competitiveness in Europe's mobile market since it takes into account the impacts of all main infrastructure MNOs and real market demands in each country without studying individual nonlinear tariff packages. Moreover, this indicator is more general than the one chosen by Genakos & Valletti (2008), who obtain the lowest tariff information offered by the two largest operators in each country. In Europe, however, the first two mobile operators often have the same characteristics and commercial strategies leading to a strong bias of the data and their conclusions.

Mobile termination rates ($MTRs$**).** The reports on European regulatory implementation packages gives data about average MTRs for each operator in the EU from 2002 to 2007. To calculate average MTR for each country, it can be weighed with corresponding operator market shares[9].

In general, average MTRs in country i can be formulated as:

[8]QUANTIFICA provides data on demand at www.quantifica.fr

[9]In France, the Bill and Keep regime between mobile operators was used until 2004, so the French average MTRs in this study are, in fact, fixed-to-mobile termination rates.

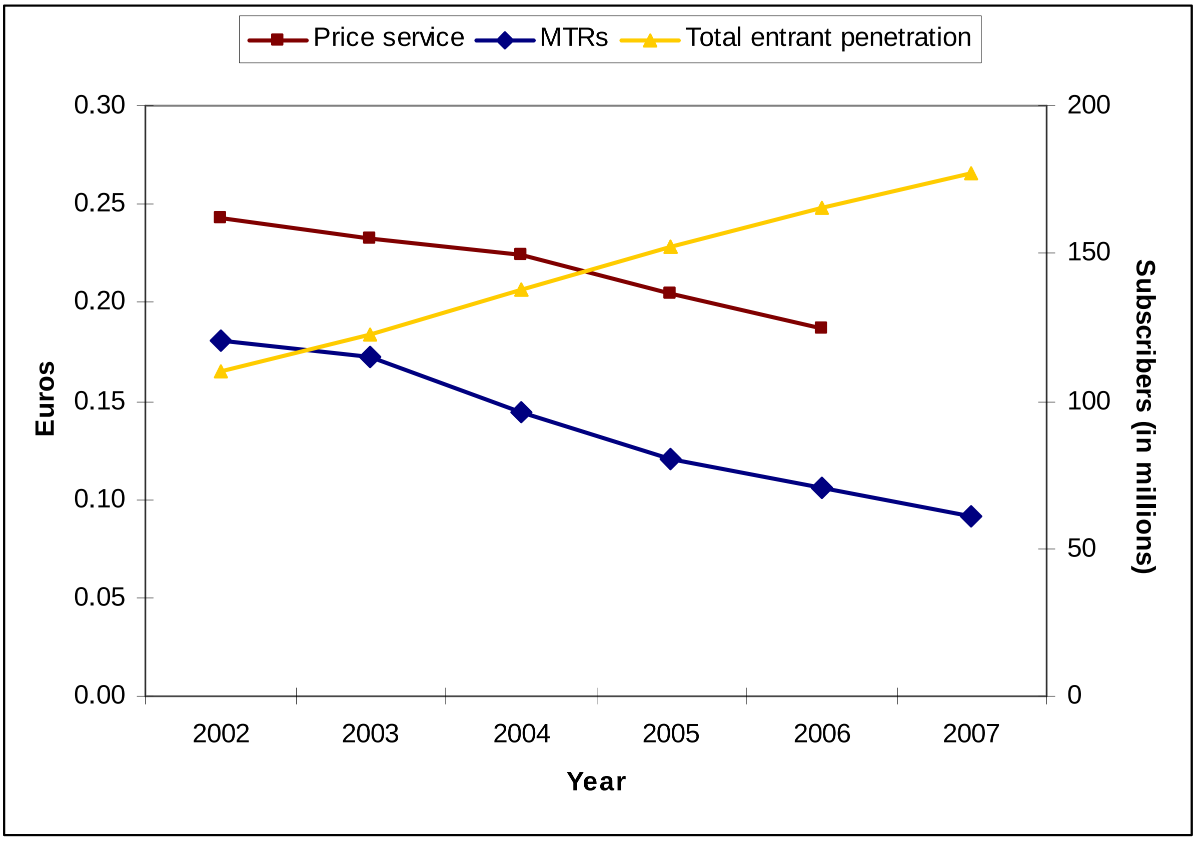
$$Average\_MTR = \sum_{j} \alpha_{ij} MTR_{ij}$$

where, MTR_{ij} denotes the termination rate for operator j in country i and α_{ij} the market share of operator j in country i.

Figure 1 shows that, from 2002 to 2006, average service prices and MTRs decreased together. Precisely, during the considered period, average service prices dropped from twenty four to eighteen euro centimes while average MTRs reduced by seven centimes to eleven euro centimes in 2006. Therefore, it seems that the existence of the waterbed effect at country level in the European mobile industry is questionable.

Penetration rates of the late entrants. Penetration rates of late entrants are also obtained from QUANTIFICA for the period 2002-2007. Figure 1 shows that the total penetration rates steadily surged from 110 million in 2002 to almost 180 million in 2007. This raises the question if the late entrant retail prices actually increased during this period as a result of lower MTRs?

Figure 1 : The average service prices, the average MTRs and the total subscribers of the late entry operators. (Source: QUANTIFICA and the European Commission)



Market concentration (HHI). The HHI index is widely used in economics research and in European competition analysis. The HHI index is proportional to the total sum of the square of market shares of all market players in an identical market. Mathematically, HHI_c in country c with J operators is calculated as:

$$HHI_c = \sum_{j=1}^{J} (\alpha_j^2) \times 10000$$

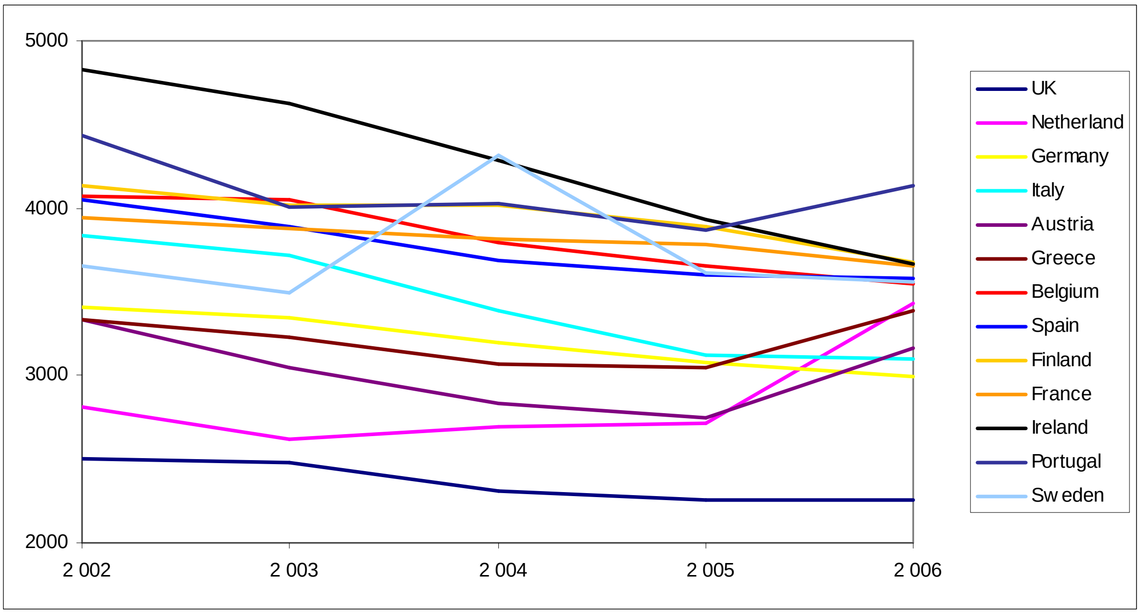
Where, α_j is the market share of operator j in country c.

Obviously, the more concentrated a mobile market, the higher the difference market shares between MNOs operating in that country. The market with the highest degree of competitiveness is when firms have similar market shares, all else being equal.

The following figure reports the HHI index in thirteen European countries from 2002 to 2007 in the sample. It is apparent here that there was a gradual decreasing trend in the level of market concentration with few exceptions where mergers between mobile operators occurred[10] or where market shares of MNOs were almost stagnant as France.

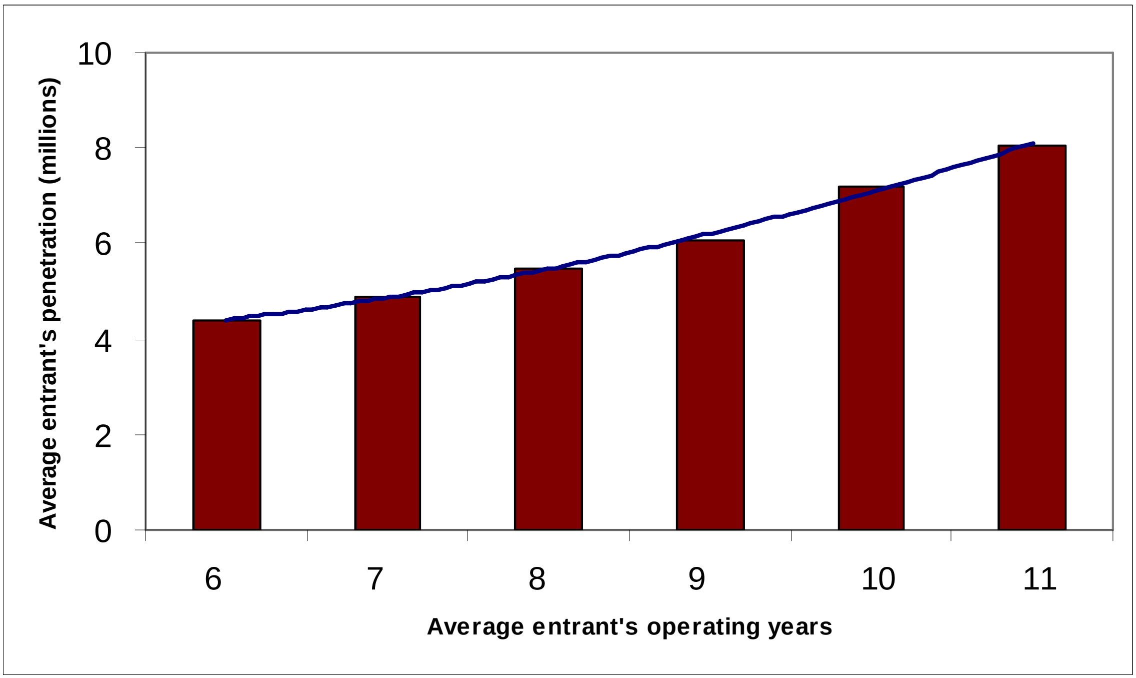
[10]For example, Telfort was bought out by KPN, the Netherland's incumbent operator, at the end of 2005.

Figure 2 : The European mobile market concentration (HHI index) (Source: QUANTIFICA)



Number of operating years. This variable counts the number of years a firm has operated in the market since its first launch of mobile services. Since penetration is typically accumulated overtime, it can be expected that the longer time of market presence, the more likelihood for the MNO to have higher subscribers (Benzoni, 2007). In fact, the data sample illustrates that, the average late entry operator can acquire as many as four million additional mobile subscribers after five years from 2002 to 2007 (Figure 3).

Figure 3 : The relationship between the average entrant.s operating years and the average entrant's penetration (Source: QUANTIFICA)



Asymmetric regulation index (AR **).** As discussed earlier, in the European context, asymmetric regulation in wholesale markets has been implemented, i.e: later entrants can set higher termination rates than the earlier ones. Such regulation is to promote competition in the retail mobile markets as ex-post entry profits are higher and hence financially helping the later entrants to increase their penetration faster. Although this type of regulation has been controversial at theoretical level (Valletti, 2006), asymmetric regulation can be seen as an appropriate regulatory tool to help late entry MNOs established (Benzoni, 2007). To increase the estimation robustness, one needs a variable to represent the effectiveness of European asymmetric regulation in the empirical model. In principle, the indicator should reflect the entrant benefits from the asymmetric regulation. In the simplest form, it can mean differences in MTRs between infrastructure MNOs in the relevant market. Practically, asymmetric regulation benefits should also depend highly on the market positioning of the market players and hence are likely to be proportional with the operator market shares[11].

[11]Under theoretical assumption of balance calling patern, the off-net traffics are greatest when both firms have the same market size, see for example: Laffont *et al.* (1998a, b)

Furthermore, since there are a number of MNOs in each European mobile market, it is pertinent to account for the relative market shares of the market players. Then, the construction of the asymmetric regulation indicator (at operator level) between a late entrant MNO i with its earlier entrant(s) is the total sum of the product of the difference in MTRs between entrant i with the earlier entrant j multiplied by their relative market shares[12].

Precisely, the index for the benefits from asymmetric regulation for each late entry operator i at period t is defined as:

$$AR_{i,t} = \sum_{j} \left(MTR_{i,t} - MTR_{j,t} \right) \frac{\alpha_{i,t}}{\alpha_{j,t}}$$

where, $\alpha_{i,t}$ and $\alpha_{j,t}$ are respectively the market shares of operator i and j, where j enters earlier than i, and $MTR_{i,t}$ the mobile termination rates of operator i at period t.

The asymmetric regulation indicator at operator level has several remarks. First, due to the fact that later entrants frequently set higher MTRs than earlier entrants and by definition, $AR_{i,t}$ are universally non-negative. Second, a late entrant obtains more from the wholesale market when its relative market shares become larger or when the corresponding relative MTRs are higher. Thus, the value of the indicator becomes zero, representing symmetric regulation, when there is no difference in the level of MTRs among MNOs[13]. And finally, overall benefits from asymmetric regulation for a later entrant should comprise all individual asymmetric treatments of the later entrant with each individual earlier entrant.

---

[12]This indicator is therefore different to the one proposed by the European regulatory group in the new regulatory draft as their index is mainly driven by the traffic assumptions (see EU Commission, 2008).

[13]For example, since 2005 symmetric regulation has been applied in the Swedish mobile market.

Asymmetric regulation at country level is defined as the average benefit from differences in termination rates between a later entrant and an earlier entrant. Here, the indicator at country level is defined as the ratio of the sum of the total benefits from asymmetric regulation for all late entrants in a country to the number of infrastructure MNOs in that country. Conceptually, let us denote $AR_{c,t}$ as the asymmetric regulation indicator for country c at period t, then:

$$AR_{c,t} = \frac{\sum_i AR_{i,t}}{n}$$

where, $AR_{i,t}$ is given by (ARit) and n is the number of infrastructure MNOs in country c.

Figure 4 : The constructed index of Asymmetric Regulation in the wholesale market at country level (Data source: QUANTIFICA)

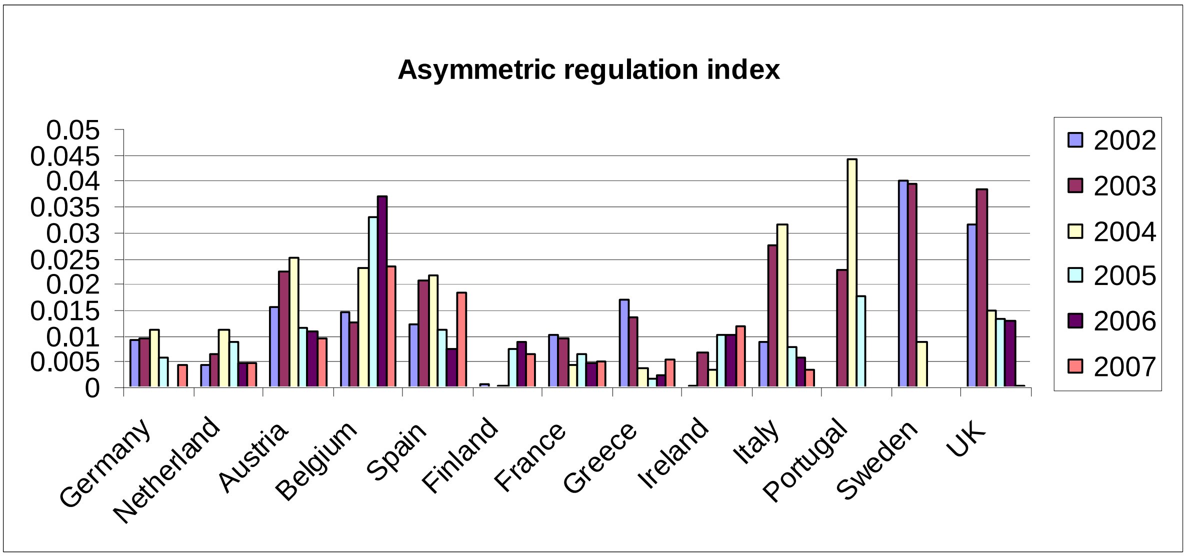


Figure 4 shows that despite a clear decreasing trend of MTRs in Europe, the country asymmetric regulation indicator fluctuates across countries, as well as within each country overtime. This is because, as already discussed, the entrant's benefits from asymmetric regulation depend not only on setting higher MTRs but also on the relative market shares. A precise illustration is the case of England and France in 2002 and 2003. Although in England, the average difference in MTRs in those two years was about 3 Euro centimes between the last two entrants and the two earlier entrants, it was about 4 Euro centimes between the last entrant and the two earlier entrants in

France. As indicated in figure 4, the corresponding asymmetric regulation index is, however, more than three times higher for England than it is for France. This is because in England, the market shares of the two later entrants were high, and almost the same as the earlier entrants while in the France's last entrant had only a 16% market share, and hence a low market position.

3 Econometric specifications and results

As discussed earlier, MNOs may have different strategies in response to the decrease in regulated MTRs and this affects final competition outcomes. The analysis firstly concentrates on empirically studying incentives for late entrants to adjust their retail prices as MTRs were lowered. Because data on retail prices at operator level is hardly observable, the following alternatively studies the penetration rates of the late entrants in the examined period. If the late entrants' retail prices decreased due to lower MTRs, it could be expected to see an increase in penetration rates or vice versa. The test for the impact of lower MTRs on national average service prices in the second subsection is the explicit assessment of the "waterbed effect" across Europe's mobile markets.

3.1 Implicit waterbed effect test: The late entrant penetration rates versus MTRs

This empirical test is motivated as follows. If due to lower MTRs, an MNO had lower wholesale revenue (both from fixed and mobile network operators), the operator had to seek more from retail markets possibly by either setting higher retail prices as predicted by the logic of waterbed effects or lowering retail prices to gain more subscribers and yielding higher profits in subsequent periods. The latter is largely due to the characteristics of the mobile industry with high price cost margins.

The second option is more sustainable for late entrants across Europe's mobile markets. This stems from two main reasons:

1. Late entrants often have small market shares meaning they benefit less from economies of scale, and hence always have strong motivation to increase consumer bases. Furthermore, a large customer base also enhances their reputation, meaning they can gain more subscribers with higher profits in subsequent periods.

2. Secondly, from a theoretical point of view, late entrants benefit from a higher subscriber base under the European asymmetric regulation regime. To clarify this

argument, let us take a very simple example in which each mobile user in the small network (i) makes the same amount of off-net calls as he receives from his friends from other networks, let's say one minute.[14] Under asymmetric regulation favouring network i, operator i would gain net profits from interconnection for each subscriber, and hence its total net interconnection profits would raise the number of mobile users subscribing to its network.

In summary, as already argued, the hypothesis for this part is that late entrant MNOs had strong incentives to boost market penetrations when MTRs were lower. Hence the following basic econometric model is to investigate how the increase in the penetration of the late entrant MNOs is affected by lower MTRs $(Model\ 1A)$:

$$LnPEN_{i,t} = \alpha_1 + \alpha_2 LnPEN_{i,t-1} + \alpha_3 MTR_{i,t} + \varepsilon_{i,t}$$

where LHS is the penetration rate of the late entrant MNO_i at period t in the natural logarithm form, $MTR_{i,t}$ is the average MTRs of operator i in year t, and $LnPEN_{i,t-1}$ is the firm penetration rates lagged order 1 in logarithm form. This proxy is obviously relevant in studying diffusion in the mobile industry (see Govert E. B. *et al.*, 2008).

As discussed above, in Europe, late entrants were treated more favourably than earlier entrants via asymmetric regulation in wholesale markets. Therefore, the indicator of asymmetric regulation at operator-level into the above model $(Model\ 2A)$ is also employed to control this type of regulation in wholesale markets. Finally, the econometric model integrates the number of firm operating years to increase the robustness of the econometric estimation $(Model\ 3A)$.

$$LnPEN_{i,t} = \alpha_1 + \alpha_2 LnPEN_{i,t-1} + \alpha_3 MTR_{i,t} + \alpha_4 AR_{i,t} + \varepsilon_{i,t}$$

---

[14] This can be considered as a variation of the balance calling pattern assumption which can be found in Laffont *et al.*, (1998a,b)

$$LnPEN_{i,t} = \alpha_1 + \alpha_2 LnPEN_{i,t-1} + \alpha_3 MTR_{i,t} + \alpha_4 AR_{i,t} + \alpha_5 LnYOE_{i,t} + \varepsilon_{i,t}$$

where $AR_{i,t}$ is the asymmetric regulation indicator at operator-level, which is constructed in (ARit), and $YOE_{i,t}$ is the number of operating years since the year of the first commercial launch in the markets.

The above models are estimated followed fixed effect model framework and with the weighted least square estimation (WLS) method. Futhermore, the estimation allows White heteroskedasticity covariance of the residuals to overcome heteroskedasticity problems across sections and because of the indirect correlation between penetration rates and MTRs[15].

Since there might be problems associated with endogeneity of variables in the RHS, the model also reports the results from estimating the above models with two-stage-least-square estimation method $(4A, \quad 5A, \quad 6A)$. The common instrumental variable is average MTRs in Europe during the examined period obtained from QUANTIFICA. This indicator appropriately reflects the trend in MTR regulation in the European Union. The other exogenous variables are $MTR_{i,t}$ and $YOE_{i,t}$.

← *Insert Table* 2 →

The result in Table 2 corresponds to the above models. Consistent with all model specifications and estimation methods, the results show that during the examined period, the late entrants' penetration increase rates significantly rose as a result of lower late entrants' MTRs. For instance, in model (LnPenetration 1A), each percent of a decrease in MTRs raises the entrants' penetration rates by 0.36 percent. This rate grows to 0.68 percent after controlling the impact of asymmetric regulation and market competitive pressures in model (LnPenetration 3A) or to 1,74 percent with instrumental

[15] See the descriptive statistics in Table 1.

estimation in model $(5A)$. This is, as already argued, because the late entrants had strong motivation to increase penetration rates. Therefore, when the wholesale revenues, both from rival mobile and fixed operators, were reduced due to lower MTRs, the late entrants were likely to seek more from retail markets by enlarging their customer bases.

Concerning the impacts of asymmetric regulation, it can be seen in Table 2 that penetration rates of the late entry operators increased from 2.05 percent (in model 3A) to 3.24 percent (in model 5A) for each centime difference in asymmetric setting of MTRs between late entry and incumbent MNOs. Furthermore, these results detail the success of asymmetric regulation in increasing the entrant' penetration rates market.

This result motivates us to suspect the existence of the waterbed effect in the context of Europe's mobile markets. If the waterbed effects logic was true for all European mobile operators, meaning either higher service prices or lower handset subsidies or both, results consequently should have seen a decline (or at least no effect) in the late entrants' penetration rates. The above empirical evidence shows a contradictory outcome, leading us to infer that late entrants might have lowered retail prices to attract more subscribers which is exactly the purpose of the empirical investigation below.

3.2 Explicit waterbed effect test: Retail service prices versus MTRs

The above finding suggests that lower MTRs may cause late entrants to compete more aggressively to gain higher market shares, and hence intensify market competition. To test this hypothesis, the link between retail prices of the late entrants and their MTRs should be investigated. As it is noted above that obtaining individual prices however is not possible. An alternative option is to choose average service prices in European countries provided by QUANTIFICA and investigate the impact of glide path regulation on this price. If lowering MTRs increased entrants' incentives to decrease their retail prices (reinforcing competitive pressures among different market players), it could be expected to observe the positive relationship between average market service prices and glide path regulation.

In precision, the empirical test for the waterbed effect across European markets can be expressed in the following econometrics model:

$$P_{c,t} = \alpha_1 + \alpha_2 P_{c,t-1} + \alpha_3 Average\_MTR_{c,t} + \varepsilon_{c,t}$$

where LHS is the average service price of the country c at time t in the natural logarithm form and, the $Average\_MTR_{i,t}$ is the average MTR in country c at time t in the natural logarithm form[16].

As before, the asymmetric regulation indicator at country level is also employed and the model becomes:

$$P_{c,t} = \alpha_1 + \alpha_2 P_{c,t-1} + \alpha_3 Average\_MTR_{c,t} + \alpha_4 AR_{c,t} + \varepsilon_{c,t}$$

Moreover, the market concentration variable (HHI index) is included in the above model with the expectation that the lower the HHI index decreased average country service prices.

$$P_{c,t} = \alpha_1 + \alpha_2 P_{c,t-1} + \alpha_3 Average\_MTR_{c,t} + \alpha_4 AR_{c,t} + \varepsilon_{c,t} + \alpha_5 Ln(HHI)_{c,t} + \varepsilon_{c,t}$$

With the panel data sample, the fixed effect models are estimated. As the previous subsection, the above models are regressed using IV method to overcome potential problems associated with endogeneity of the variables in the RHS. The models are respectively named (4B), (5B) and (6B). For models 1B, 2B and 3B, the Pool-least-square estimation method is using to account for the hesteroskedasticity of the data. For model (4B), model (5B) and model (6B) the two-stage-least-square estimation method is used with the average MTRs in thirteen countries as the valid instrument while the exogenous variable is $MTR_{c,t}$ and the predetermined variable is $P_{c,t-1}$.

The results in Table 3 indicate that, as expected, the decrease in MTRs resulted in lower service prices in all the model specifications. Furthermore, the results are significant and consistent with various models and estimation methods: lower MTRs decreased the service prices. For example, in model 3B, one percent of reduction in average MTRs led to a decrease of 0,18 percent in average service prices.

←*Insert Table* 3→

Consistent with the finding in the first hypothesis, when NRAs reduced MTR levels, late entrant MNOs responded by reducing their service prices, resulting in lower market average service prices, to gain more subscribers. This is because when MTRs or "wholesale" profits were lowered, operators relied more on retail markets which means that they needed to have large consumer bases. The lower fees of MTRs could therefore be seen as an appropriate instrument to intensify competitiveness across European mobile markets. In other words, the waterbed effect logic is not applicable in the context of Europe's mobile markets, and the aim of NRAs to regulate MTRs oriented to costs is sensible, and encourages competition between European MNOs.

Moreover, as explored in Peitz (2005a, b), asymmetric regulation promotes more aggressive pricing strategy among different sized MNOs and hence stronger market competitiveness. This study empirically shows that the implementation of European asymmetric regulation decreased the average service price by 0,31 percent (model 3B), increasing to 0.82 percent (model 5B). This is perhaps due to the fact that late entrants compete more aggressively in the presence of asymmetric regulation to gain market shares. Correspondingly, incumbents had to lower retail prices to avoid loss in market shares, resulting in lower market retail prices.

Finally, the empirical finding indicates that the market concentration significantly affected the market prices, although at a modest level. Concretely, one percent drop in the HHI index could lower service prices by 0.08 percent (model 6B). This result is not surprising because of the familiar relationship between the degree of market concentration and market competitiveness proxied by service prices in the study.

4 Conclusion

In general, the waterbed effect exists at theoretical level and may be observable with individual cases. In the context of European mobile markets however, the waterbed effect is unlikely to be the case. The study shows that competition for additional market shares was stronger when European NRAs required all MNOs to lower their MTRs. This is because the mobile industry is characterised by high price cost margins and strategic competition between operators. When MNOs derived less revenues from wholesale markets due to lower MTRs, they raised their retail profits by lowering service prices in retail markets to increase their subscriber bases.

Furthermore, a new wave of later entry infrastructure MNOs in Europe with smaller market sizes, but different commercial strategies makes it hard to see evidence of the waterbed effect at country level. This framework has instead witnessed the reserved phenomenon suggesting that competitive pressures in Europe's mobile markets can eliminate the waterbed effect, consistent with the note made by the New Zealand's Competition Commission.

Furthermore, it is intuitive from this study that Europe's current glide path and the implementation of asymmetric regulation have been critical to reduce retail market service prices and to help the late entrants boost their market penetration, and thereby improve performances of Europe's mobile markets.

5 References

Anderson, K and B. Hansen, 2007. Network Competition: Empirical evidence on mobile termination charges and Profitability, Working paper.

Armstrong, M., 1998, Network Interconnection in Telecommunications, Economic Journal, Vol. 108, pp.545-564.

Armstrong, M. and J. Wright, 2007. Mobile Call Termination, MPRA Paper 2344, University Library of Munich, Germany.

Armstrong, M. and D. Sappington, Recent Developments in the Theory of Regulation, Handbook of Industrial Organization, Volume 3, September 2007.

Bezoni, L, 2007, The curse of later entrants: The case of European mobile markets, in A collections of essays in Competition and Regulation with Asymmetries in mobile markets. Available at: www.tera.fr

ERG, 2008, "ERG's Common Position on symmetry of fixed call termination rates and symmetry of mobile call termination rates", ERG (07)83, final 080312, February.

EU Commission, 2008, "Draft Commission Recommendation on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU", Brussels, June.

Gans, J. S. & King S. P., 2001, Using `Bill and Keep' Interconnection Arrangements to Soften Network Competition, Economic Letters, Vol.71, pp. 413-420.

Genakos, C. & Valletti, T., 2008, Testing the Waterbed" Effect in Mobile Telephony, CEIS Tor Vergata, Research Paper Series, Vol. 6, Issue 2, No. 110.

Govert E. B., Maarten C.W. J. & Emiel M., 2008, Early mover advantages: An empirical analysis of European mobile phone markets, Telecommunications Policy, Vol. 32, pp.246-261.

Laffont, J.,-J., Rey P. & Tirole, J., 1998, Network Competition: I. Overview and Nondiscriminatory Pricing, RAND Journal of Economics, Vol. 29, pp. 1-37.

Peitz, M., 2003, On access pricing in telecoms: theory and European practice, Telecommunications Policy, Vol. 27, pp. 729-740.

Peitz, M., 2005a, Asymmetric Access Price Regulation in Telecommunications Markets, European Economic Review, Vol. 49, pp. 341-358.

Peitz, M., 2005b, Asymmetric regulation of access and price discrimination in telecommunications, Journal of Regulatory Economics.

Schiff, A., 2007, The 'Waterbed' Effect and Price Regulation, EFMA 2003 Helsinki Meetings. Available at SSRN: http://ssrn.com/abstract=905172

Valletti, T., 2006, Asymmetric regulation of mobile termination rates. Available at: www.npt.no/iKnowBase/Content/100464/Vedlegg_Telenor.pdf

6 Appendix

Twenty five MNOs with a late market entrance

Mobistar

Base

Elisa

E-plus

O2 Germany

Vodafone Italy

Wind Italy

Vodafone Spain

Amena

Orange UK

TMobile UK

One

TMobile Austria

Telering

Bouygues Telecom

O2 Ireland

Meteor

Wind-Hellas

Orange Netherlands

TMobile Netherlands

Telfort

Optimus

Vodafone Portugal

Tele2 Mobil

Telenor Sweden

Table 1 ✍ Basic Descriptive Statistics

Data	Mean	Maximum	Minimum	Std. Dev.
Competiveness index **HHI**	3 502.52	4 831.72	2 252.70	577.93
Service Prices **P** *(Euros)*	0.22	0.37	0.09	0.06
MTRs **A** *(Euros)*	0.15	0.32	0.06	0.05
Operating years **YOE**	8.30	19.00	1.00	3.46
Penetration **PEN** *(Thousand users)*	5 815.02	29 997.40	95.00	5 951.68

Table 2 ✍ The Relationship between the late entrants❖penetration rates and MTRs

	Fixed effects models with weighted least square estimation			Fixed effects models with Instrumental estimation		
Penetration rates **PEN**	Model 1A	Model 2A	Model 3A	Model 4A	Model 5A	Model 6A
Penetration lagged order 1 **PEN(-1)**	0.76 (0,00)	0.70 (0,00)	0.64 (0,00)	0.76 (0,00)	0.70 (0,00)	0.63 (0,00)
Glidepath regulation **MTR**	-0.36 (0.02)	-1.52 (0,00)	-0.68 (0.03)	-0.35 (0.02)	-1.74 (0,00)	-0.72 (0.02)
Asymmetric regulation **AR**		2.76 (0,00)	2.05 (0,00)		3.24 (0,00)	2.11 (0.00)
Number of operating years **YOE**			0.03 (0,00)			0.03 (0.01)
P-values are reported in the parenthesis signs Software package: EVIEWS						

Table 3 ✍ The "Waterbed effect" in European markets

	Fixed effects models with weighted least square estimation			Fixed effects models with Instrumental estimation		
Service prices **P**	Model 1B	Model 2B	Model 3B	Model 4B	Model 5B	Model 6B
Service prices lagged order 1 **P(-1)**	0.78 (0,00)	0.71 (0,00)	0.71 (0,00)	0.78 (0,00)	0.65 (0,00)	0.67 (0,00)
Glidepath regulation **MTR**	0.14 (0.07)	0.22 (0.01)	0.18 (0.03)	0.14 (0.07)	0.27 (0,00)	0.2 (0,00)
Asymmetric regulation **AR**		-0.39 (0.02)	-0.31 (0.04)		-0.82 (0,00)	-0.74 (0,00)
Market concentration **HHI**			0.04 (0.12)			0.08 (0.01)
P-values are reported in the parenthesis signs Software package: EVIEWS						