

Hawthorne, Ryan

## Conference Paper

Do call termination rate interventions affect developing countries (with smaller fixed line networks) differently? Testing for the 'waterbed effect' for non-linear tariffs in South Africa

27th European Regional Conference of the International Telecommunications Society (ITS): "The Evolution of the North-South Telecommunications Divide: The Role for Europe", Cambridge, United Kingdom, 7th-9th September, 2016

### Provided in Cooperation with:

International Telecommunications Society (ITS)

*Suggested Citation:* Hawthorne, Ryan (2016) : Do call termination rate interventions affect developing countries (with smaller fixed line networks) differently? Testing for the 'waterbed effect' for non-linear tariffs in South Africa, 27th European Regional Conference of the International Telecommunications Society (ITS): "The Evolution of the North-South Telecommunications Divide: The Role for Europe", Cambridge, United Kingdom, 7th-9th September, 2016, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/148673>

#### Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

#### Terms of use:

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# Do call termination rate interventions affect developing countries (with smaller fixed line networks) differently?

Testing for the ‘waterbed effect’ for non-linear tariffs in South Africa

Draft

Ryan Hawthorne \*

September 6, 2016

## Abstract

The Independent Communications Authority of South Africa (ICASA) has over the last six years, in line with other regulators in many jurisdictions, reduced call termination rates (the price one operator charges another to complete a call between two networks) by more than 80%. A key question is what impact this has had on retail prices. Theoretical work suggests that reducing call termination rates could result in a ‘waterbed effect’, where retail prices for mobile services increase after a call termination rate reduction, since profits from fixed to mobile calls declines and this reduces the profitability of attracting customers, and operators accordingly ‘soften’ retail price competition. On the other hand, operators might choose a high mobile to mobile termination rate in order to exclude rivals. The extent of this ‘waterbed effect’ therefore depends on the extent to which fixed to mobile calls matter and the extent of market symmetry. South Africa has a relatively small, and declining fixed line network and significant asymmetries between mobile operators (there are two entrants and two incumbents). Measuring retail prices over time in South Africa presents us with an opportunity to test whether, in circumstances where fixed to mobile calls don’t matter as much, operators are asymmetric, call termination rates do indeed facilitate entry and cause a reduction in retail prices. A key problem with retail mobile prices in South Africa is that each of the mobile operators offer a wide variety of packages. In order to overcome this challenge, a hedonic regression approach will be used to develop an index of quality adjusted prices, and estimate the impact of call termination rate reductions on quality adjusted prices. The preliminary results of this analysis show that ‘waterbed effects’ do indeed exist in respect of postpaid prices in South Africa, and this result is robust to using quality adjusted prices or mean prices. This means that operators would choose low call termination rates in order to soften competition, absent an exclusionary strategy. The choice of high call termination rates by incumbent operators prior to Cell C’s entry in 2001, and pressure on resistance to regulatory steps to reduce termination rates when Telkom Mobile entered in 2010, are therefore consistent with an exclusionary strategy on the part of MTN and Vodacom.

---

\*PhD candidate, University of Cape Town; Senior research fellow, CCRED, University of Johannesburg; Economist, Acacia Economics. I am grateful to my supervisors Lawrence Edwards, Lukasz Grzybowski and Simon Roberts for their guidance. All remaining errors are my own.

# 1 Introduction

The Independent Communications Authority of South Africa (ICASA) has recently, in line with other regulators in many jurisdictions, reduced call termination rates (the price one operator charges another to complete a call between two networks) by more than 80%. The rationale for this reduction is, at least in part, to facilitate the expansion of new entrant networks. We would expect, therefore, lower retail prices to result from lower call termination rates. By contrast Armstrong (1998) and Laffont, Rey & Tirole's (1998b) show that operators competing in non-linear tariffs (typically postpaid tariffs) choose low (zero) call termination rates (or even less than zero, in Gans & King's (2001) model) in order to 'soften' competition, since high call termination rates intensifies competition for subscribers. The implication of this is that where regulators intervene to reduce call termination rates, retail prices in fact rise. This was later referred as the 'waterbed effect' (Genakos & Valletti, 2007). Later models showed that operators do indeed have an incentive to set high termination rates in order to exploit their monopoly over fixed to mobile calls (Armstrong & Wright, 2009), or in order to exclude rivals or expand the market. Nonetheless, regulators should not be overly cautious when assessing termination rates, since operators balance their incentive to set high termination rates with their incentive to choose a low enough rate to ensure that competition between them is not too intense.

In South Africa, network coverage is close to ubiquitous, and fixed line penetration is significantly lower than in developing countries. This means that fixed to mobile calls are small enough to be ruled out as outweighing operators' incentives to set low termination rates in order to 'soften' competition, and there is no 'market expansion' rationale for high termination rates. The only remaining rationale for high termination rates is exclusion. The first contribution of this paper will be to test for the existence of 'waterbed effects' in non-linear (often referred to as 'postpaid' or 'contract') tariffs paid by customers in South Africa, in order to test this 'exclusionary' theory of harm. If lower termination rates result in higher postpaid prices, this means that choosing a high termination rate was not in MTN and Vodacom's best interests, absent an exclusionary rationale.

An important corollary of this is that while reducing call termination rates facilitates competition for prepaid customers (which account for 80% of customers) by reducing scope for on-net and off-net differentials (see Hoernig, 2007), the same outcome does not follow in respect of more lucrative postpaid subscribers (which account for 50% of operator revenues). Effectively, entry continues to be forestalled, presumably by some other mechanism, such as a lack of network access regulation (roaming, site access etc.), switching costs (including customer inertia) etc.

While 'waterbed effects' have been tested for using 'baskets' of mobile services (such as by Genakos & Valletti, 2015), such 'baskets' do not take into account changes in the quality of packages over time. The second contribution of this paper is to test for waterbed effects using quality adjusted prices, rather than notional 'basket of use' based prices.

## 2 Literature review

### 2.1 Wholesale call termination rates, retail voice prices and network effects

The theoretical impact of call termination rate reductions is ambiguous. Laffont, Rey and Tirole (1998a, 1998b) model competition between networks and suggest that the call termination rate that operators would choose collusively and the optimal rate that a regulator should set depends on the competitive setting and regulatory context. The key insight from their model is that operators competing on linear retail voice usage prices choose a high call termination rate in order to limit competition by making retail price reductions costly, since lower retail prices would lead to more outgoing calls and higher interconnection costs (Laffont *et al* 1998a).

Laffont *et al* (1998a) find that operators competing in linear tariffs with no on-net / off-net price discrimination, and with symmetric termination rates, and fixed costs of acquiring subscribers ( $f$ ), set a call termination rate (access charge,  $a^M$ ) above costs ( $c_0$ ) when colluding on access charges and retail prices ( $p^M$ ):

$$\frac{a^M - c_0}{2} = \frac{2\theta p^M \pi^M}{\eta} \quad (1)$$

where:

$$\pi^M = (p^M - c)q(p^M) - f \quad (2)$$

Operators will likely choose a relatively benign, low call termination rate where they compete using fixed monthly rental fees (two-part tariffs) rather than usage prices.<sup>1</sup> This is because reducing fixed fees does not encourage more outbound calls, which means that operators cannot use the call termination rate to limit retail price competition. In the (Laffont *et al* 1998a) model with two operators in the non-linear tariff setting, the profits of both operators are independent of the access charge selected (the call termination rate), and rather are determined by the Hotelling parameter ( $\sigma$ ).<sup>2</sup>

Laffont *et al* (1998b) also evaluate the call termination rate that an incumbent operator would set in the face of new entry where competition is in linear prices, by an entrant that builds a network that is less than full coverage. They conclude that incumbent operators would choose a high call termination rate and offer low on-net voice usage prices (if this was allowed) in order to make it attractive to belong to a large network (i.e. generate network effects) and thus exclude the new entrant.

Armstrong (1998) arrives at similar conclusions, although his model focuses on linear tariffs. In particular, operators have an incentive to collude by setting high call termination rates, provided that demand is not perfectly inelastic and that networks are sufficiently differentiated.

Gans & King (2001), this time analysing competition in non-linear tariffs, extend Laffont, Rey & Tirole's (1998b) paper by evaluating the call termination rate that operators would set co-operatively in order to soften competition. While Laffont, Rey & Tirole (1998b) stop at Equation 3, showing that the the Hotelling profit  $\pi^H$  is reached when the mark-up over costs for call termination rates is zero ( $m = 0$ ), Gans & King (2001) explicitly solve for the profit maximising mark-up chosen co-operatively by the operators, exceeding the Hotelling profit. They find that the profit maximising mark-up is always less than 0. They show that:

$$\frac{\partial \pi_i}{\partial m} = -\frac{1}{4}cq((1+m)c) + \frac{1}{4}mc^2q'((1+m)c) \quad (4)$$

When  $m \geq 0$ , Equation 4 is less than zero (i.e. profits grow when the call termination rate mark-up declines), and so operators co-operatively setting the mark-up will always choose  $m < 0$ .

The explanation for this result is that consumers prefer to belong to smaller networks where off-net calls are cheaper than on-net calls. This is the case where the call termination rate is negative: off-net calls are cheaper than on-net calls, since usage charges are always charged at marginal cost. This in turn means that operators have less of an incentive to lower fixed subscription fees in order to grow their market share, where competition takes place in non-linear prices.

Calzada & Valetti (2008) show that incumbent operators can use high call termination rates to exclude rivals in certain circumstances. Hoernig (2007) extends the literature by taking into account call externalities, the benefits that a call recipient gains when receiving a call. Hoernig (2007) finds that incumbent operators, even absent an incentive to exclude new entrants, have an incentive to set high termination rates. This result holds for linear prices and for two-part tariffs. However, the method employed by incumbents varies depending on the tariff type: with linear tariffs, a low on-net price is chosen, while with non-linear tariffs a high off-net charge is employed, together with a low fixed fee.

Armstrong & Wright (2009) bring together two areas of the literature, the first concerning competition between two mobile networks (MTM), and the second concerning fixed to mobile (FTM) rates. The models concerning competition between two mobile networks result in low call termination rates, since this softens

<sup>1</sup>Networks will also tend to choose a lower call termination rate where their fixed costs are high, which makes attracting new customers expensive, and where the substitutability between networks is low, which means that lowering retail voice usage prices does not result in more customers.

<sup>2</sup>Profits are maximised where:

$$\pi^* = \pi^H = \frac{1}{4\sigma} \quad (3)$$

competition between mobile operators, which otherwise compete with each other vigorously to win customers to earn the mark-ups over costs on call termination. The second area of the literature concerns fixed to mobile rates, which results in very high call termination rates since each operator has a monopoly over inbound call termination, and operators do not compete with fixed line networks. While these rents are competed away Armstrong & Wright (2009) conclude that where there are both fixed to mobile calls, and competition between mobile operators, mobile operators will set a single call termination rate somewhere between these two outcomes. While a case remains for the regulation of mobile termination rates, this is weaker than where the FTM case is analysed by itself. Other explanations for high call termination rates are ‘market-expanding effects’, in which the network effects due to marginal customers joining a network through additional network investments are internalised to some extent through high call termination rates subsidising incremental network investments.

Harbord & Hoernig (2015) evaluate a calibrated model simulating the effects of pure LRIC call termination rates, bill and keep (zero call termination rate), and symmetrical fixed and mobile termination rates (reducing the mobile termination rate to the fixed rate). An important feature of their analysis is that they take into account call externalities for the recipients of calls. The authors find that the optimal call termination rate is in fact zero under most calibrations of their model, since mark-ups over costs result in inefficiently low volumes of off-net calls (and therefore inefficiently low consumer surplus for recipients of calls).

In summary, the theoretical literature suggests that where operators are able to discriminate between fixed to mobile (FTM) and mobile to mobile (MTM) calls, operators will set the FTM rate at close to monopoly levels, while the MTM rate will likely be set by symmetrically sized operators below cost, in order to soften competition. This was in fact the case in South Africa in the 1990s when the operators first established their networks. The fixed to mobile rate was set at approximately  $R1$  (approximately \$0.10), while the mobile to mobile (MTM) rate was set at approximately  $R0.20$ . When Cell C (the third mobile licensee) entered in 2001, the incumbent MNOs hiked the MTR to be equivalent to the FTM rate.

Operators competing in linear tariffs, allowed to discriminate between on-net and off-net prices, will choose a high MTM rate and low on-net rate in the face of new entry. In the absence of new entry and in the presence of on-net and off-net discounts, symmetrically sized operators competing in linear prices prefer low MTM termination rates.<sup>3</sup> Symmetrical networks will choose a low MTM rate where competition is in non-linear prices between symmetrical networks, also in order to soften competition.

Given the very small number of fixed line connections relative to the number of mobile connections in South Africa, it is reasonable to expect that the incentives that mobile operators face favour low mobile to mobile termination rates to soften competition, absent new entry. Since there are two new mobile entrants, there is an exclusionary rationale for high call termination rates. We can test which of the two competing theories is correct, that operators favour low termination rates in order to soften competition, or that operators favour high termination rates in order to exclude new entrants, by observing retail price outcomes when termination rates decline. Higher prices observed together with termination rate reductions imply that absent an exclusionary incentive, operators would have chosen a lower termination rate. That they did not implies that they used termination rates to exclude new entrants.

## 2.2 Empirical evidence on the effects of call termination rate reductions

Bohlin and Kongaut (2012) provide a summary of the empirical research into the impact of mobile call termination rates on retail prices and access to services largely in developed countries, which do not produce consistent results (see Table 1). For example, Genakos and Valletti (2011) found that call termination rate reductions increased retail prices as a result of a ‘waterbed effect’. The same authors more recently found that this ‘waterbed effect’ had disappeared over time (Genakos & Valetti, 2015). Bohlin and Kongaut (2012) themselves find that call termination rate reductions have led to decreases in retail prices. Pensendorfer and Veronese (2009) found no relationship between MTR reductions and retail prices.

Grzybowski (2008) finds that reductions in call termination rates for fixed line services were indeed passed through to retail prices by incumbent operators in the EU between 1998 and 2002, resulting in retail

---

<sup>3</sup>Absent price discrimination between on-net and off-net calls, Laffont, Rey and Tirole (1998a) show that operators have an incentive to set a high call termination rates, since this softens retail price competition because operators want to avoid an access charge deficit.

<b>Authors</b>	<b>Outcomes of research</b>
Genakos and Valletti (2011, 2015)	The authors estimated the impact of MTRs on retail prices and operator profits, initially (in their 2011 paper) over a shorter time period than their more recent (2014) paper. Their initial results showed that reducing MTRs by approximately 10% results in increases of approximately 5% in retail prices. They found that the ‘waterbed effect’ was strongest in markets with high levels of competition and mobile penetration. More recently in their 2014 paper, with more data over a longer period, the authors found that the ‘waterbed effect’ had disappeared, due to the greater role that mobile to mobile calls play in the market in more recent years compared to fixed to mobile calls . The authors found that regulation did not reduce the mobile operators’ profits and investments.
Andersson and Hansen (2009)	The authors used a multi-firm competition model to estimate the impact of MTRs on operator profits. Their results showed that call termination rates do not necessarily have an impact on firm profitability, and concluded that MTRs therefore do not necessarily benefit consumers in mature markets.
Pensendorfer and Veronese (2009)	The authors found that lower MTRs result in lower uptake of mobile services (measured by SIM penetration) and found some evidence of greater usage for higher MTRs but did not find strong evidence of a relationship between lower call termination rates and retail prices. The authors highlighted several data limitations in the available data, and were also concerned about endogeneity between usage and the MTR, since the latter might be set according to usage patterns.
Alexander, Cunningham, and Candeub (2010)	The authors found that higher MTRs lead to greater subscriptions per person.
Growitsch, Marcus and Wernick (2010)	The authors find a strong relationship between reductions in MTRs and lower retail prices for services, and they also find a strong relationship between reductions in MTRs and greater usage (in terms of minutes of use).
Dewenter and Kruse (2010)	The authors find no relationship between either receiving party pays (RPP, i.e. MTRs are set at R0 per minute) or calling party pays regimes (CPP, where MTRs are more than R0 per minute) and mobile diffusion rates, and recommend the use of RPP due to the lower regulatory costs involved.

**Table 1: Summary of studies on impact of mobile call termination rate reductions (Bohlin and Kongaut (2012))**

prices that were 8.2% lower over the period. However, incumbents passed through only a limited proportion of the reduction in call termination rates: a 1% reduction in termination charges on the incumbent network resulted in a 0.17% reduction in the price of a basket of calls, while a 1% decrease in transit charges (for calls between cities, for example) resulted in a reduction of only 0.31% in incumbent peak prices. This suggests that incumbent fixed line operators continue to enjoy some measure of market power in the EU.

An important empirical challenge is selecting prices for telecommunications services. Many of the papers cited above develop prices using a ‘basket’ of services that consumers use, in order to develop a ‘bill’ that is comparable between operators and over time (see, for example, Genakos & Valletti (2015)). This runs the risk of developing an incorrect monthly bill, and fails to capture consumer heterogeneity. The alternative approach to this problem is to use Hedonic price regressions, which regress prices on quantifiable changes in product characteristics. This is particularly relevant for postpaid telecommunications services, which offer a whole range of features. Hedonic price regressions are used by national statistics agencies to adjust price indices for changes in quality, a technique popularised by Griliches (1961).

For example, Grzybowski & Karamti (2010) estimate hedonic price regressions for the three mobile operators in France, in order to test whether the method could be used to assist the statistics office to adjust for quality and to test for whether the operators colluded (the antitrust authority found they colluded in 2005). The authors take into account vertical differentiation (product quality) and horizontal differentiation (product features) in their analysis. Karamti & Grzybowski (2010), estimating the following equation:

$$\log p_i^t = \alpha_i + \sum_{j=1}^k \beta_j z_{ji}^t + \sum_{t=2}^T \delta^t D_i^t + \epsilon_i^t \quad (5)$$

where the price of product variant  $i$  in time  $t$  is regressed on product characteristics  $z$  for product variant  $i$  supplied by operator  $j$ . Consistent with Genakos & Valletti (2015), there is a time dummy variable  $D_i^t$ . Grzybowski and Karamti deal with multicollinearity between the various product characteristics (packages with more voice minutes often come with more megabytes of data, for example) by grouping similar product features together. The authors found that the introduction of a third operator in the market caused prices to decline significantly, horizontal differentiation to increase, and quality improved significantly. While the quality adjusted price index for prepaid prices decreased significantly, quality adjusted postpaid price reductions were more muted.

Schoni & Seger (2014) compare hedonic price indices for individual mobile operators in Switzerland, using a dataset on actual monthly bills of students and employees of the University of Fribourg. The authors overcame the multicollinearity problem by assuming that consumers make their choices not on product characteristics but rather on the subsidised handset, and also group variables together. They compare OLS and generalised additive model (GAM) results in order to test the robustness of their model. They find that there are indeed linear relationships between prices and product characteristics, that are well-estimated by OLS.

Forenbacher, Perakovic & Husnjak (2016) also estimate quality adjusted postpaid telecommunications prices for Croatia using hedonic regression analysis, following a similar approach to that adopted by Grzybowski & Karamati (2010). Multicollinearity was not as significant a problem in their pricing dataset (variable inflation factors, a measure of the extent of multicollinearity, were  $< 10$ ). They too find that quality adjusted prices for mobile services fell between 2009 and 2013. This was linked to changing market conditions in Croatia, including recessionary economic conditions arising from the financial crisis in Europe, and the elimination of taxes on telecommunications services. The quality adjusted price index developed was close to that developed by the Croatian Bureau of Statistics.

### 2.3 Gaps in the literature addressed in this paper

The research on theoretical outcomes of fixed to mobile and mobile to mobile termination rates largely considers a developed country setting where fixed line networks are close to ubiquitous (i.e. where fixed to mobile calls matter to a considerable extent). In this setting, together with new entry (asymmetrical networks) it is hard to distinguish between an exclusionary rationale for high call termination rates, and operators merely setting high call termination rates in order to capture rents for fixed to mobile calls.

**Table 2: Observations - monthly subscriptions (2010 - 2016)**

<b>operator</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>Total</b>
1. Cell C	12	32	31	17	22	178	28	320
2. MTN	11	19	20	55	75	123	55	358
3. Telkom(M)	5	10	11	57	41	139	21	284
4. Virgin	16	13	11	13	22	33	7	115
5. Vodacom	34	48	38	47	60	119	69	415
<b>Total</b>	<b>78</b>	<b>122</b>	<b>111</b>	<b>189</b>	<b>220</b>	<b>592</b>	<b>180</b>	<b>1,492</b>

South Africa is quite different, since the role of the fixed line network is more limited. We can therefore rule out operators setting high call termination rates due to this effect overwhelming the operators' incentives to set low termination rates in order to 'soften' price competition. If operators do choose a high call termination rate, then this means that they must have had an exclusionary rationale to do so.<sup>4</sup> We can test for this proposition by assessing what happens to postpaid prices in South Africa when call termination rates decline. If price competition becomes less intense, we can be sure that the only rationale for maintaining high rates was exclusion, since the operators had an incentive in fact to keep termination rates low, at least in respect of postpaid subscribers.<sup>5</sup> Testing whether lower call termination rates indeed had this 'waterbed effect' is the first contribution of this paper.

The key difficulty with testing this proposition is that there are a plethora of postpaid packages. The second contribution of this paper is the use of an Hedonic price procedure to decompose the product features.

### 3 Data on prices, call termination rates and profits

#### 3.1 Data sources

Postpaid prices were collected from a variety of sources, from archive.org's 'wayback machine', and from Tarifica, an organisation that collates mobile prices, and from other industry analysts.<sup>6</sup>

Call termination rates are published in government gazettes. There are fixed line and mobile call termination rates, and within those two categories, there are rates for large operators and small operators (4 separate rates for a 12 month period).

#### 3.2 Descriptive statistics

The key relationships to be tested in this research are between postpaid telecommunications prices, their determinants, and call termination rates in South Africa. There are 1,492 subscription observations (see Table 2), which vary significantly between operators and over the years (see Table 3, prices are in Rands per month).

A key determinant of monthly subscription prices is number of included minutes (see Figure 1). As set out in the methodology section below, other important determinants of monthly subscriptions are operator and year.

The key variable to be tested against is the termination rate, which declined significantly between 2010 and 2016 (see Table 4). Termination costs, per operator, will be calculated using each operator's market share, which also varied considerably over the period (see Table 5).

<sup>4</sup>Absent any arguments about 'market expanding' effects. We can rule this out in South Africa, at least for MTN and Vodacom, whose networks reached more than 90% population coverage some time ago (and prior to 2010, when call termination rates were reduced by the regulator) and where more than 80% of consumers have a cellphone (this has also been the case for some time).

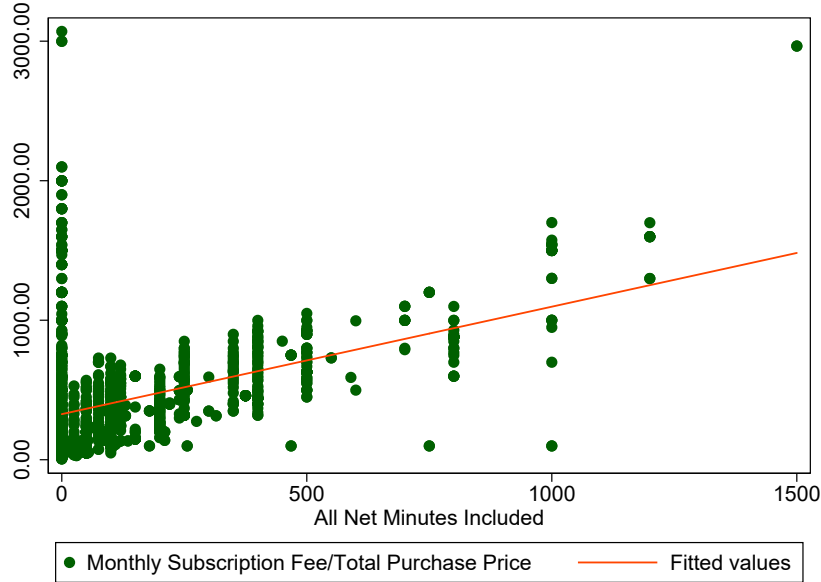
<sup>5</sup>A question arises as to what incentives operators have when considering termination rates and their effect on linear tariffs (prepaid). While off-net prices have declined in South Africa, it is not clear what has happened overall to retail tariffs since on-net discounts might not be as deep. This is difficult to test for given the 'dynamic discounts' offered by MTN and Vodacom in South Africa, depending on the time of day and on geographic location. Overall, it appears as though retail voice prices have declined, using at least MTN and Vodacom's annual reports.

<sup>6</sup>The compiler of the 'broadband bible' was particularly helpful in this regard.



**Table 3: Average monthly subscription charges (2010 - 2016)**

operator	2010	2011	2012	2013	2014	2015	2016	Total
1. Cell C	218	238	196	238	239	280	305	262
2. MTN	250	237	213	169	206	348	300	267
3. Telkom(M)	200	307	501	215	226	300	280	277
4. Virgin	226	243	226	224	294	269	336	260
5. Vodacom	287	185	348	390	426	470	258	360



**Figure 1: Monthly subscriptions and included minutes, 2010-2016**

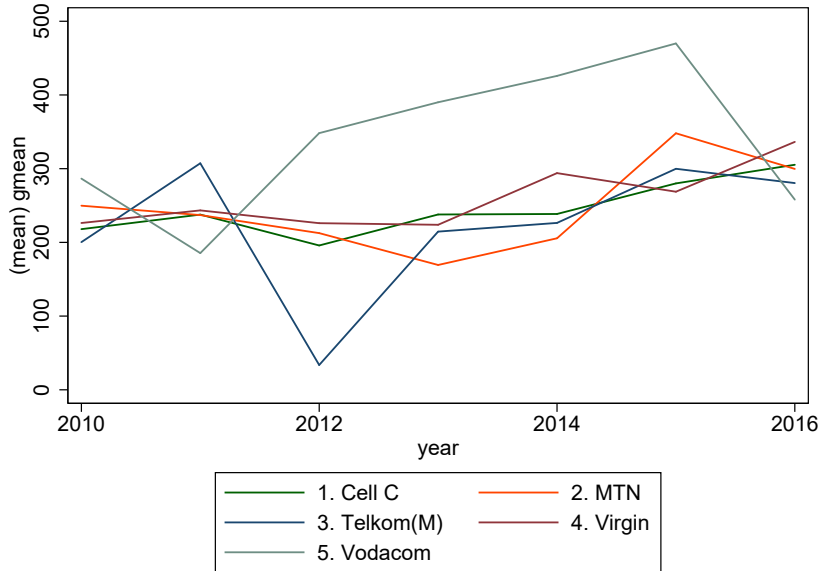
*Source: Analysis of postpaid pricing dataset on postpaid prices.*

**Table 4: Termination rates (2010 - 2016)**

operator	2010	2011	2012	2013	2014	2015	2016	Total
1. Cell C	0.89	0.73	0.56	0.40	0.44	0.31	0.24	0.41
2. MTN	0.89	0.65	0.52	0.40	0.20	0.20	0.16	0.29
3. Telkom(M)	0.89	0.73	0.56	0.40	0.44	0.31	0.24	0.38
4. Virgin	0.89	0.73	0.56	0.40	0.44	0.31	0.24	0.49
5. Vodacom	0.89	0.65	0.52	0.40	0.20	0.20	0.16	0.35

**Table 5: Market shares (2010 - 2016)**

operator	2010	2011	2012	2013	2014	2015	2016	Total
1. Cell C	0.16	0.16	0.15	0.19	0.24	0.25	0.26	0.22
2. MTN	0.37	0.39	0.38	0.36	0.34	0.34	0.33	0.35
3. Telkom(M)	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
4. Virgin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Vodacom	0.45	0.43	0.45	0.42	0.40	0.38	0.38	0.41



**Figure 2: Average monthly subscription charges, 2010-2016**

Average postpaid subscription prices have increased over time.

## 4 Methodology

The main idea is to test for a ‘waterbed effect’, which is that higher retail prices result from call termination rate reductions. This effect suggests that a customer’s bill is positively related to operator costs and differentiation (Hotelling parameter), negatively related to rents from call termination (higher call termination rates mean more rents that are competed away through lower bills) and positively related to the impact of call termination rates on the extent of competition between operators (higher call termination rates mean less competition, and higher bills), as follows (Genakos & Valetti, 2015):

$$\text{Bill} = \text{cost} + \text{Hotelling parameter} - \text{rent from inbound calls} + \text{effect of operator competition}$$

These ‘waterbed effects’ are tested for by estimating the impact of changes in call termination rates ( $TR$ ) on customers’ bills (Equation 6), as follows:

$$\log P_{ujt} = \alpha + \beta_1 \log(TR)_{jt} + \epsilon_{ujt} \quad (6)$$

where  $u$  in equation 6 corresponds to a category of use (and in the approach adopted below, this refers to package), for operator  $j$  in time period  $t$ .

An important departure from Genakos & Valetti (2015) will be the estimation of their model for a single country (South Africa), rather than adopting a cross-country approach. While there are considerably fewer observations, this approach avoids the risk of pooling diverse countries. An extension of their model is that rather than use a basket of prices approach, an hedonic approach to estimating the impact of call termination rates will be used following Karamti & Grzybowski (2010) and Forenbacher, Perakovic & Husnjak (2016). Quality adjusted prices for each operator between 2010 and 2016 are developed (for a total of 35 observations), following the estimation of equation 5.

This is achieved by using the model to predict quality changes by predicting  $\log p_i^t$ , setting the time dummy variables to zero. This ‘quality index’ is then used to adjust observed prices in order to develop a ‘quality-adjusted’ series of prices. These quality-adjusted prices are then regressed on termination rates in order to estimate the impact of reduced call termination rates on postpaid prices in South Africa.

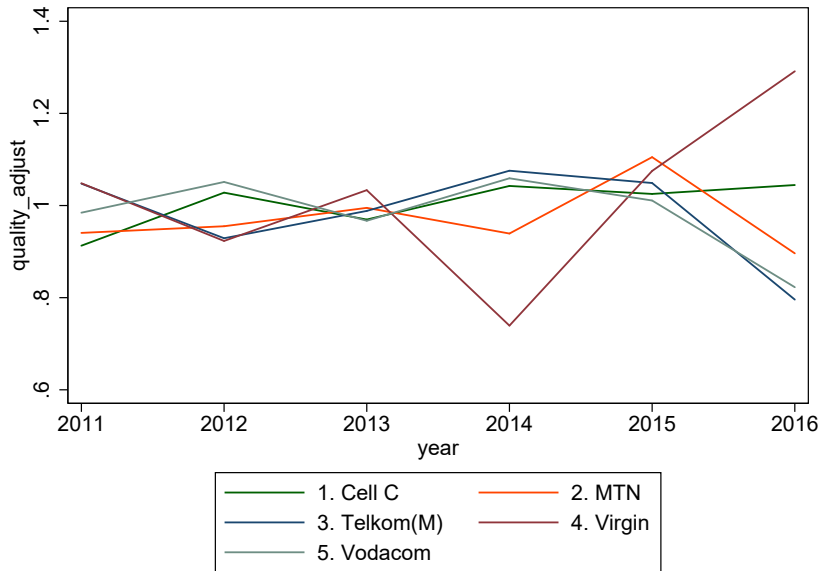


Figure 3: Quality index, 2010-2016

Table 6: Estimation results - Average prices, Quality-adjusted prices

	Average prices	Quality-adjusted prices
Termination costs (log)	-0.326***	-0.291*
Constant	5.138***	5.175***
$R^2$	0.024	0.173
N	1,492	35

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

## 5 Results

Postpaid package subscription charges increased over time, as discussed above (see Figure 2). However, it might have been the case that increased package prices increased due to improvements in quality. For the most part this was not the case, however, since most operators (other than Virgin Mobile) in fact reduced on average the quality of their packages over time (see Figure 3 below). This means that even quality-adjusted prices increased over time (see Figure 4 below).

The preliminary results of formally measuring the relationship between termination rates and postpaid subscription charges show that there is evidence of a ‘waterbed effect’ in relation to postpaid prices in South Africa. A 1% decrease in the call termination rate results in approximately a 0.3% increase in monthly subscription charges. This result is robust as to whether monthly subscriptions are used, or quality adjusted prices.

While one measure of the ‘goodness of fit’,  $R^2$ , shows that the first model explains relatively little variation in the dataset, the second model explains considerably more variation. Further work is needed in order to test the robustness of these results.

These preliminary results suggests that, absent a ‘market expanding’ effect and absent an exclusionary strategy, mobile operators in South Africa have an incentive to set termination rates that are as low as possible.<sup>7</sup> The fact that MTN and Vodacom raised termination rates significantly prior to Cell C’s entry in 2001, and strongly resisted termination rate reductions in 2010 when Telkom Mobile entered, are consistent with MTN and Vodacom using high termination rates as an exclusionary strategy.

<sup>7</sup>This is equally applicable in respect of competition in linear prices, for prepaid customers, since any rents earned from termination rates would encourage vigorous competition through on-net discounts.

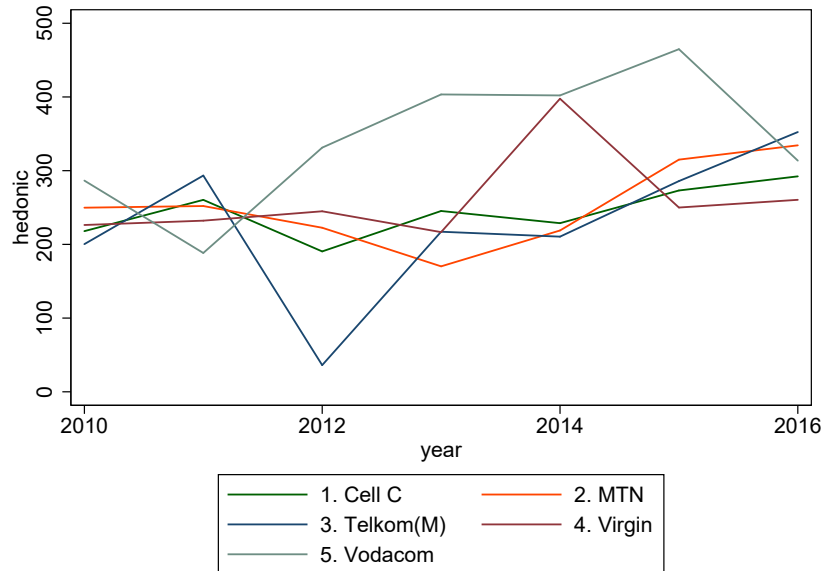


Figure 4: Quality adjusted prices, 2010-2016

## 6 Conclusion

There results presented here suggest that, in respect of postpaid prices, there is some evidence of ‘waterbed effects’ in South Africa. This means that operators would choose low call termination rates in order to soften competition, absent asymmetries between operators (and therefore an incentive to use high termination rates to exclude new entrants). These results are robust to whether average package prices over time are used, or whether quality-adjusted prices are used.

MTN and Vodacom in fact increased termination rates prior to Cell C’s entry in 2001 (when there may have been some support for a ‘market expanding’ effect) and resisted termination rate reductions when Telkom Mobile entered the market in 2010 (when close to full coverage and penetration were already achieved). MTN and Vodacom’s conduct is consistent with an exclusionary strategy to use high call termination rates to exclude Cell C and Telkom Mobile.

The implication of this is that regulators in markets with substantial asymmetries between operators should be cautious about incumbent behaviour when they face entry or expansion by smaller rivals, and regulators should consider pro-competitive measures to assist new entrants.

## References

- Alexander, P., A. Candeub, and B. Cunningham (2010). “Network growth: Theory and evidence from the mobile telephone industry.” In: *Information economics and policy* 22(1).
- Andersson, K. and B. Hansen (2009). “Network competition - Empirical evidence on mobile termination rates and profitability.”
- Armstrong, Mark (1998). “Network Interconnection in Telecommunications.” In: *The Economic Journal* 108.448, pp. 545–564.
- Armstrong, Mark and Julian Wright (2009). “Mobile Call Termination.” In: *The Economic Journal* 119.538, F270–F307.
- Bohlin, E. and C. Kongaut (2012). *Impacts of mobile termination rates (MTRs) on retail prices - The implication for regulators.*
- Calzada, Joan and Tommaso M Valletti (2008). “Network competition and entry deterrence.” In: *The Economic Journal* 118.531, pp. 1223–1244.
- Dewenter, R. and J. Kruse (2010). *Calling party pays or receiving party pays? The diffusion of mobile telephony with endogenous regulation.* Discussion paper.

- Forenbacher, Ivan, Dragan Perakovic, and Sinisa Husnjak (2016). “Hedonic modeling to explore the relationship of cell phone plan price and quality in Croatia.” In: *Telematics and Informatics* 33.4, pp. 1057–1070.
- Gans, Joshua S. and Stephen P. King (2001). “Using ‘bill and keep’ interconnect arrangements to soften network competition.” In: *Economics Letters* 71.3, pp. 413–420.
- Genakos, C. and T. Valletti (2015). “Evaluating a decade of mobile termination rate regulation.” In: *Economic Journal*.
- (2011). “Testing the waterbed effect in mobile telephony.” In: *Journal of the European Economic Association* 9(6).
- Griliches, Zvi (1961). “Hedonic Price Indexes for Automobiles: An Econometric of Quality Change.” In: *The Price Statistics of the Federal Government*. Ed. by Report of the Price Statistics Review Committee. NBER.
- Growitsch, C., J. Marcus, and C. Wernick (2010). “The Effects of Lower Mobile Termination Rates (MTRs) on Retail Price and Demand.” In: *Communications and strategies* 80.
- Harbord, David and Steffen Hoernig (2015). “Welfare Analysis of Regulating Mobile Termination Rates in the U.K.” In: *The Journal of Industrial Economics* 63.4, pp. 673–703.
- Hoernig, Steffen (2007). “On-net and off-net pricing on asymmetric telecommunications networks.” In: *Information Economics and Policy* 19.2, pp. 171–188.
- Karamti, Chiraz and Lukasz Grzybowski (2010). “Hedonic study on mobile telephony market in France: pricing–quality strategies.” In: *NETNOMICS: Economic Research and Electronic Networking* 11.3, pp. 255–289.
- Laffont, J., P. Rey, and J. Tirole (1998a). “Network competition I: Overview and non-discriminatory pricing.” In: *Rand Journal of Economics* 29(1).
- (1998b). “Network competition II: Price discrimination.” In: *Rand Journal of Economics* 29(1).
- Pensendorfer, M. and B. Veronese (2009). “Wholesale termination regime, termination charge levels and mobile industry performance: a study undertaken for Ofcom.”
- Schöni, Olivier and Lukas Seger (2014). *Comparing Mobile Communication Service Prices Among Providers: A Hedonic Approach*. Tech. rep. Université de Fribourg.