Cellular demand analysis in South Africa: Urban vs rural patterns of consumption

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Outline

Beyond access

Motivation

- South Africa is still divided upon racial lines, with the so-called "first" and "second" economies.
- Policies aiming at reversing the apartheid social and economic structures and applied to the telecommunications sector have solved the problem of access, what about usage?

Objectives

- Explore whether usage price elasticities are high, and greater than those typically found in developed countries.
- Analyze whether the second economy is integrated within the developed sector in terms of usage. Are price elasticities higher for urban than for rural consumers?

South Africa's telecom policies (I)

Target

- Accessibility to telephony within a walking distance ($\leq$ 500 m)
- Fixed-line or cellular services to every household by 2010
- Internet access to $\geq$ 25% of the population by 2010

Means

- Privatization of fixed-line incumbent Telkom in 1997
- Liberalization of cellular sector: Vodacom (50% Telkom) in 1986/1994/2004, MTN in 1994/2005, CellC in 2001
- Creation of a regulator ICASA in 2000

South Africa's telecom policies (II)

Preliminary results 2004/2005: Access vs usage

- Growth: 38.2% in cellular subscription, 1.8% in fixed-line penetration
- Coverage: 76.8% cellular subscription , 10.7% fixed-line penetration
- BUT for cellular: Banding of two-year contracts to handset sales, high tariffs for voice and SMS, penalization of prepaid subscribers as compared to contract, 500% increase in interconnection tariffs

Price elasticities in developing countries

Approaches to examine price elasticities

- Cross-country studies based on macroeconomic indicators (Sridhar and Sridhar, 2004, GSM Association, 2005, Martins, 2003, Wheatly, 2006).
- Single country studies based on stated preferences (OSIPTEL, 2005, CRT, 2005, Chowdhury et al, 2003).

Some findings

- Demand is more elastic for cellular than for fixed-line, for prepaid than for contracts, in developing than in developed countries (fixed-line). Moreover, access remains an issue!

This work: Price elasticities in South Africa

- Single country analysis based on revealed preferences.

Data

Basics

- Two Vodacom cross-sectional data sets on 6,936 prepaid consumers in South Africa for May 2005 on voice and SMS.
  ↪ Voice and SMS communications originated by Vodacom prepaid consumers
  ↪ Type of prepaid card
  ↪ Day and time
  ↪ Network of correspondent: Vodacom, CellC, MTN, Telkom
  ↪ Location of user: Urban vs rural classification

[↪] **Prepaid market** on 2005: It is the bulk of Vodacom's growth with over 85% of new subscriptions, and 75% of communications in our data set
[↪] **SMS** on 2005: 58.9% for the growth in data revenue is imputable to the 2 million SMS transmitted

Preliminary empirical analysis (I)

Socio-economic features

Table 1
Income by area

Province	Town	Suburb	Zone	Obs.	Income
Mpumalanga	Pilgrim Rest	Open Space	Rural	685	24,668
Kwazulu Natal	Nqutu	Open Space	Rural	1,617	17,473
Limpopo	Thohoyandou	Open Space	Rural	2,598	21,282
Limpopo	Polokwana	New Pietersburg	Urban	822	65,945
Gauteng	Pretoria	Pretoria Ctl	Urban	41	47,781
Gauteng	Vereeniging	Vereeniging Ctl	Urban	390	65,945
North West	Mafikeng	Montshiwa	Urban	470	67,446
Eastern Cape	Queenstown	Top Town	Urban	313	40,845

The data set contains, among other,
the less developed regions in South Africa

Preliminary empirical analysis (II)

Socio-economic features

Table 2

Socio-economic characteristics by province (%)

Province	Population	Young	No educ.	Labor	Water	Light
Mpumalanga	6.9	47.0	27.5	23.0	86.7	68.3
Kwazulu Natal	20.6	46.7	21.9	27.8	73.2	61.8
Limpopo	12.0	52.6	33.4	22.0	78.0	63.8
Gauteng	19.2	32.1	8.4	45.0	97.5	80.8
North West	8.2	41.9	19.9	31.8	85.8	70.5
Eastern Cape	15.0	49.4	22.8	20.4	62.4	49.5

No severe problem of sample selection in the urban and rural sub-samples

Preliminary empirical analysis (III)

Consumer choice

Table 8

Observations for urban and rural sub-samples

Combination of alternatives	Number of observations	
	Urban consumer	Rural consumer
Voice/Vodacom-Telkom/Peak	334	1.673
Voice/Vodacom-Telkom/Off-Peak	692	1.286
Voice/CellC-MTN/Peak	158	864
Voice/CellC-MTN/Off-Peak	401	851
SMS/Vodacom/Peak	63	49
SMS/Vodacom/Off-Peak	211	85
SMS/CellC-MTN/Peak	47	31
SMS/CellC-MTN/Off-Peak	130	61

Differenciated preferences for urban and rural consumers

Preliminary empirical analysis (IV)

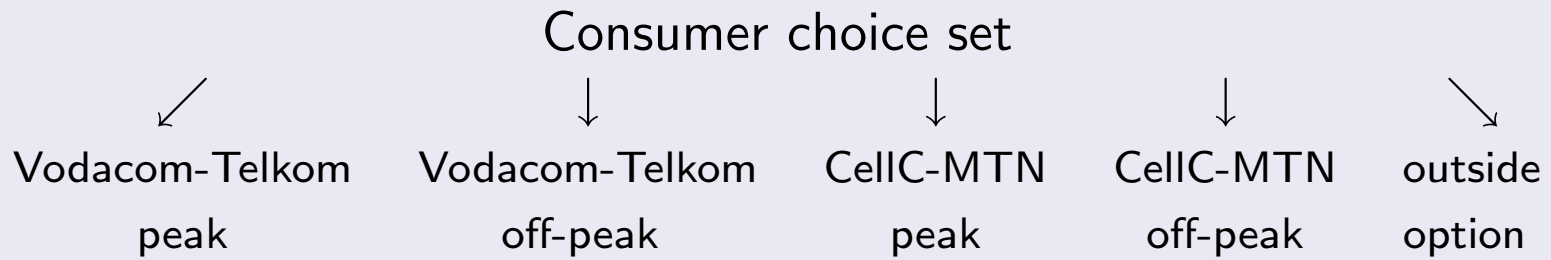
Summary

- Separate analysis for voice and SMS
- Consumer choice for voice and SMS: time, correspondent
- Total sample
  $\hookrightarrow$ with less developed areas
- Urban and rural sub-samples
  $\hookrightarrow$ without problem of sample selection
  $\hookrightarrow$ as proxies for "first" and "second" economies in South Africa

Estimation (I)

Demand

- Discrete choice model on aggregated data based on multinomial logit (Berry, 1994).
- The outside option allows a sensitivity analysis that accounts for the potential market.



$$ln(s_j) - ln(s_0) = \delta_j \equiv \psi_j - \alpha p_j + \xi_j$$

$$CS = \frac{1}{\alpha} \ln(1 + \sum_{j=1}^{J} \exp^{\delta_j}), \quad \eta_{j,j} = -\alpha p_j (1 - s_j), \quad \eta_{j,k} = \alpha p_k s_k$$

Estimation (II)

Supply

- We model a profit maximizing monopoly since we lack data on Vodacom's competitors.

  $\hookrightarrow$ Demand under competition shall be more elastic than under monopoly, since the demand curve faced by a competitive firm is more price sensitive that the demand curve faced by a monopole.

$$\Pi = \sum_{j=1}^{J} (p_j - c_j) q_j(p) - K$$

- Applying the demand setting and solving the J-equation system, we have the following supply equation

$$p_j = c_j + \frac{1}{\alpha(1 - \sum_{k=1}^{J} s_k)} + \omega_j$$

Estimation (III)

Calibration procedure

- We solve the demand and supply system (8 equations, 9 unknowns $\{\alpha,\ c_i,\ \psi_i\}$) through a calibration procedure under some distributional assumptions
  - ↪ We generate K times two vectors of 4 components for $\eta_{j,j} \sim N(0,1)$ and $c_j \sim N(a,b)$ being a the mean, which I define as the minimum price, and b the standard deviation, which I define as the difference between the maximum price and the minimum price.
  - ↪ α is derived through the Non Linear Three Stage Least Squares (N3SLS) joint estimation of the own-price elasticity and supply equations under the constraints

$$p_j \geq cj \ \ \forall j \Rightarrow \alpha \geq 0, \quad cj \geq 0 \ \ \forall j \Rightarrow \alpha \geq \frac{1}{p_j(1 - \Sigma_{\forall k-1} s_k)} \ \ \forall j$$

Results (I)

Main findings

- Demand for cellular services is elastic, with higher prices-elasticities than those typically found in developed countries
- Price-elasticities are higher for urban than for rural consumers during peak hours, the reverse for off-peak hours
  - Rural consumers attach a larger value to peak hours, urban consumers to off-peak hours (relative terms)

$\hookrightarrow$ Rural consumers have a larger preference for working hours, urban consumers for leisure hours (relative terms)

Results (II)

Other findings

- All consumers attach the largest valuation to peak hours but since these hours are highly priced, demand for peak hours is significantly more elastic than for off-peak hours

  $\hookrightarrow$ All consumers value the ability to place communications during working hours presumably of the purpose of economic activity

- Demand for joining CellC/MTN consumers is more elastic than for joining the fixed-line/Vodacom consumers, and well as less valued

  $\hookrightarrow$ This result stems from the higher prices applied to CellC/MTN and from the lower consumer base of these operators

Policy implications (I)

Incentives for investment

- At first sight, price cuts on prepaid services could be rewarding both for consumers and for the firm (peak hours)
- For rural areas networks, close to full capacity, it would be necessary to verify that the increase in revenues would be sufficient to cover incremental investments on base stations

Policy implications (II)

Cost of alternatives

Reducing the gap between the first and second economies, calls for investment in network in rural areas

- Usage appears to support economic activity (high value and relative low elasticity attached to working hours)
- The results are consistent with the mismatch between the areas where the majority of the people live and those where work opportunities and commercial and industrial activity are

  $\hookrightarrow$ The cost of a trip to the city in rural Bangladesh can be two to eight times higher than a single call (CIDA study)

  $\hookrightarrow$ 50 to 70% survey respondents in Tanzania and South Africa claim that their cellular phones led to large savings in travel time and cost (Vodafone study)

Thank you for your attention