Estimating demand elasticities of fixed telephony in Brazil

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Abstract

This paper provides estimates of the elasticities of demand for the Brazilian basic plan of local fixed telephony using a cointegration model. We find a long-run price elasticity of –0.24, and an income elasticity of 0.18. These figures are line with other countries' estimates.

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1. Introduction

Until recently Brazilian telecommunications were stated-owned. By the mid-1990s the state companies were in bad shape thanks in part to the problems caused by foreign debt and the artificial prices set in accordance with macroeconomic policies to curb inflation. Privatization followed together with an effort to boost competition. Prices were no longer set by the government but on the basis of a basket of services (price cap system). Telecoms thrived, as a result. (Mattos 2002, and Facanha and Resende 2003 show details.)

Knowledge of the telecoms industry is critical for Brazil if regulation is to succeed. Here estimating the demand elasticities can play a key role. This short note thus provides an estimate of them for the Brazilian basic plan of fixed telephony using a cointegration approach. (The basic plan is that universally offered by the concessionary of fixed telephony in a public regime of strong regulation and quality duties.)

Section 2 presents a theoretical model that we find appropriate for the Brazilian experience, and further shows methodology and data. Section 3 presents analysis. Section 4 concludes.

2. Model, methodology, and data

To estimate local calls demand elasticities, we employ Waverman's (1974) model. We find this one appropriate for the Brazilian experience in terms of data that are available. Besides, the variables in Waverman's model are quite standard in theoretical literature (e.g. Taylor 1994).

There are two equations, namely

$$\ln\left(\frac{Q}{T}\right)_t = b_0 + b_1 \ln\left(\frac{Q}{T}\right)_{t-1} + b_2 \ln X_t + b_3 \ln P_t + \mu_t \tag{1}$$

where Q is quantity of local pulses, T is quantity of phone set terminals, X is gross domestic product per household in real terms, P is marginal price per pulse, and μ is a random term. And

$$\ln Q_t = b_0 + b_1 \ln Q_{t-1} + b_2 \ln X_t + b_3 \ln P_t + b_4 \ln T_t + \mu_t . \tag{2}$$

While in the first equation elasticities are measured in per head terms, these are shown in aggregative terms in the second one.

Here we will depart from equation (2) and take real GDP rather than real GDP per household. This is because the latter series is not available on a monthly frequency. Thanks to lack of data availability, too, we will take pulses and prices for the Brazilian member-state of Sao Paulo, rather than those for the entire country. We will also discard variable Q's lags because this clashes with our cointegration methodology for estimating short and long run equations.

Indeed, unlike in Waverman's we employ a modern cointegration approach (Enders 2003) to get short and long run elasticities. A cointegration test assesses whether the model variables present a common stochastic trend. Cointegration means a linear combination of nonstationary variables that are integrated at the same order so that the variables have a long run equilibrium relationship. Under such circumstances, the variables can share a same stochastic trend at a smaller integration order ($I(0)$ in here), in which case they cointegrate.

So we replace equation (2) with

$$\ln Q_t = b_0 + b_1 \ln P_t + b_2 \ln Y_t + b_3 \ln T_t + \varepsilon_t \tag{3}$$

where Q_t is the quantity of total local pulses tracked at the set terminals of the basic plan's sector A in month *t*, P_t is the maximum local price of sector A in *t* (net of taxes) that is set by the regulation agency (Anatel). The values are deflated using the consumer price index of FIPE (a think tank), Y_t is GDP in current million *reais* deflated by the consumer price index of FIPE (real GDP), and T_t is the quantity of phone set terminals in the basic plan of sector A. Data on Q_t and T_t were semi-confidentially given to us by Anatel. The series have 72 data points each, spanning from June 1999 to May 2005.

3. Analysis

Since the model above is set in logs, its estimated coefficients will provide the elasticities of Q_t relative to the dependent variables. To start with, we checked for stationarity using the augmented Dickey-Fuller (ADF) test.

Table 1 shows the ADF test with intercept. The second column presents the optimal number of lags selected by the Bayesian information criterion of Schwartz. Whenever the calculated statistic in absolute terms is shorter than the critical value, one cannot reject the null hypothesis (H_0) of existence of unit roots, in which case a series is nonstationary. As can be seen, H_0 cannot be rejected at the 5 percent significance level. The model variables are nonstationary.

Yet it is still possible that the variables cointegrate. We estimated a long run equation, then tested for cointegration, and finally got the short run equation. The long run equation estimated from our model is

$$\begin{aligned} \ln Q_t = {} & 3.1797 - 0.2442 \ln P_t + 0.1772 \ln Y_t + 0.6690 \ln T_t \\ & (5.4812) \quad (-2.4833) \quad (1.8305) \quad (13.5532) \\ R^2 = {} & 0.86, \quad T = 71 \end{aligned} \tag{4}$$

where *t* statistics are in brackets. Apart from Y_t (that is significant at 10 percent), the other variables are significant at the 5 percent level. The variable's signs are all as expected.

We then checked the stationarity of the series of estimated residuals in (4). Table 2 shows that they are stationary, which is indicative of cointegration between the model variables. It is then possible to estimate an error correction model to get the short run elasticities.

To select the optimal quantity of lags, we employed the information criteria of both Akaike-Schwarz and Hannan-Quin. These criteria clashed and then we decided to adopt

Akaike-Schwarz's since this employs a smaller number of lags. The short run equation estimated is

$$\begin{aligned}
\Delta \ln Q_t = &-0.0153 - 0.3238\,\hat{e}_{t-1} - 0.1230\Delta \ln P_t + 0.1663\Delta \ln Y_t + 0.1354\Delta \ln T_t \\
&\;(-2.5908)\;\;(-2.5765)\;\;(-0.9116)\qquad(1.6336)\qquad(0.1814) \\
&-0.1652\Delta \ln Q_{t-1} + 0.0757\Delta \ln P_{t-1} + 0.3510\Delta \ln Y_{t-1} - 0.3049\Delta \ln T_{t-1} \\
&\;(-1.2255)\qquad(0.5783)\qquad(3.4109)\qquad(-0.3051) \\
&-0.2459\Delta \ln Q_{t-2} + 0.1235\Delta \ln P_{t-2} + 0.2124\Delta \ln Y_{t-2} + 1.2857\Delta \ln T_{t-2} \\
&\;(-2.0687)\qquad(0.9661)\qquad(1.8043)\qquad(1.7059)
\end{aligned} \tag{5}$$

The short run elasticities are measured by the sum of the coefficients of the variable's lags. As can be seen, only Y_{t-1}, Y_{t-2}, T_{t-2}, and Q_{t-2} are significant at the 10 percent level, and the signs are not those expected. However the correction error term is significant, and its sign shows convergence toward long run equilibrium. So it makes sense using equation (4) and to interpret the long run price elasticity as that estimated as –0.24. Such a figure is similar to other countries' estimates (Table 3).

The low sensibility to price of the basic plan's local demand can be explained by the fact that it is provided by the fixed telephony concessions. This strongly regulated environment increases the barriers to competition and then lowers elasticity (Baumol and Sidak 1994).

Equation (4) also shows a long run income elasticity of 0.18. This can be explained by the fact that the fixed telephony is already widespread, and also because of mobile telephony and broadband internet access. Equation (4) also shows low response of the local pulses to extra terminal increases (elasticity of 0.67). Since phone sets are commonplace, addition of an extra terminal unit increases less than proportionately local traffic. The latter elasticity can be interpreted as a measure of a net externality since it gauges the benefit of the marginal user. The low elasticity suggests the basic plan to be exhausted.

4. Conclusion

Employing a theoretical model that is quite standard in literature and chosen on the basis of availability of data, this paper provides pioneering estimates of the elasticities of demand for the Brazilian basic plan of local fixed telephony using a cointegration approach. We find a long run price elasticity of –0.24. This is in accordance with the results for most countries. We also find a low income elasticity of 0.18.

Table 1. ADF Test with Intercept

Variable	Lag	H_0: $\gamma = 0$	Critical Value at 5%
$\ln Q_t$	0	−2.369	−2.903
$\ln P_t$	0	0.134	−2.904
$\ln Y_t$	0	−0.019	−2.903
$\ln T_t$	1	−2.237	−2.904

Table 2. ADF Test for the Residuals in the Long Run Equation

Variable	Lag	H_0: $a_1 = 0$	Critical Value at 5%
$\hat{e}_t$	0	−4.115	−2.904

Study	Country	Type of Market	Elasticity
Abdala , Arrufat, Colomé, and Neder (1996)	ARG	Local	–0.44, –1.73
Davis, Caccapolo, and Chaudry (1973)	USA	Local	–0.21, –0.27
Dobell, Taylor, Waverman, Liu, and Coperland (1972)	CAN	Local	–0.23, –0.70
Doherty (1984)	USA	Local	–0.21, –0.29
Waverman (1974)	SWE	Local	–0.27, –0.38
Pasco-Font, Gallardo, and Fry (1999)	PER	Local	–0.26
Perez-Amaral, Alvarez, and Moreno (1995)	ESP	Local	–0.17, –0.19
Levy (1996)	USA	Local	–0.47, –0.68
Madden, Bloch, and Hensher (1993)	AUS	Local	–0.46
Monkgolporn and Yin (2004)	THA	Local	0.06
Kling and Van Der Ploeg (1990)	USA	Local	–0.17
Trotter (1996)	UK	Local	–0.04
Park, Wetzel, and Mitchell (1983)	USA	Local	–0.08, –0.06, –0.09, –0.11
Manfrim and Da Silva (2006)	**BRA**	**Local**	**–0.24**
Abdala , Arrufat, Colomé, and Neder (1996)	ARG	Long Distance	–0.32, –0.75
Duncan and Perry (1994)	USA	Long Distance	–0.38
Deschamps (1974)	BEL	Long Distance	–0.24
Gatto, Kelejian, and Stephan (1988)	USA	Long Distance	–0.72
Madden, Bloch, and Hensher (1993)	AUS	Long Distance	–0.53, 1.01
Waverman (1974)	SWE	Long Distance	–0.51, –1.08
Train (1993)	USA	Long Distance	–0.42, –0.34, –0.53
Larson, Lehman, and Weisman (1990)	USA	Long Distance	–0.32, –0.76
Martins Filho and Mayo (1993)	USA	Long Distance	–1.51, –1.55
Davis, Caccapolo, and Chaudry (1973)	SWE	Long Distance	–0.88, –1.03
Perez-Amaral, Alvarez, and Moreno (1995)	ESP	Long Distance	–0.10, 0.24
Acton and Vogelsang (1992)	EUA	International	–0.36, –0.49
Appelbe, Snihur, Dineen, Farnes, and Giordano (1988)	CAN	International	–0.43, –0.53
Manenti (2001)	ITA	International	–0.25
Bewley and Fiedbig (1992)	AUS	International	–0.37, –1.54
Perez-Amaral, Alvarez, and Moreno (1995)	ESP	International	–0.30
Perez-Amaral and Muñoz (2000)	ESP	International	–0.81
Bureau of Transports and Communications Economics (1991)	AUS	International	–1.01
Craver and Nekrowitz (1980)	USA	International	–0.67
Perl (1983)	USA	Access Demand	–0.06
Madden, Bloch, and Hensher (1993)	AUS	Access Demand	–0.003
Monkgolporn and Yin (2004)	THA	Access Demand	–1.60
Cain and MacDonald (1991)	USA	Access Demand	–0.05
Solvason (1996)	CAN	Access Demand	–0.68
Taylor and Kridel (1990)	USA	Access Demand	–0.03
Bodnar, Dilworth, and Iacono (1988)	CAN	Access Demand	–0.01

Table 3. Estimates of price elasticities of demand for fixed telephony.

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