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Lobbying and regulation in a political economy: Evidence from the U.S. cellular industry *

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Abstract. In this paper we empirically test the simultaneity between the effects and the determinants of price regulation in the U.S. mobile telecommunications industry. We find that the regulatory regime is endogenous to firms pricing strategies. Because of lobbying successfulness, firms avoided regulation in those markets where it would have been more effective. Therefore, regulation did not significantly reduce cellular tariffs in regulated markets but it would have decreased them if adopted in non-regulated ones. Also, we provide evidence that the choice of the regulatory regime strongly depends on the political as well as regulatory environments.

1. Introduction

Over the last decades, economic regulation has attracted great attention among economists and policymakers, becoming one of the main issues on the political agenda. Since the seminal contribution by Stigler (1971), and following the tradition initiated by the so called "*Chicago School*" (Pelzman, 1976; Posner, 1974; Becker, 1983), much theoretical literature has assumed that the political process and the competition among differently organized interest groups drive regulatory decisions. In particular, as Stigler suggested, regulated industries (firms) might be willing to collaborate in their own regulation, in order to create or to protect their private interests.

From the empirical point of view, though, there has been little attempt to analyze these questions in such a broad framework. The large body of existing empirical literature has focused on the effects of regulation on market outcome, putting less weight on the process which determines the observed regulatory regime. However, if firms can influence the regulatory regime

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under which they operate, a two way causality between the effects and the determinants of regulatory decisions has to be accounted for. Studies that neglected this simultaneity can be seriously biased in their empirical findings.

This paper develops a political economy model of regulation as a first attempt to empirically study this set of questions. We shall present a reduced form simultaneous model for firms pricing behavior and price regulatory choice, which encompasses economic as well as political factors to explain the role of market regulation. The main point we will make is that the endogeneity of regulatory choice, motivated by political economy reasons, has to be explicitly considered in order to empirically model the impact of regulation on prices.[1] Moreover, taking this consideration into account, we want to determine the (unbiased) impact of price regulation on cellular tariffs using U.S. data for the second half of the 1980's. Finally, we are also interested in identifying the main determinants of regulatory choice.

The U.S. cellular telephone industry is an ideal environment for our study. The existence of many and geographically defined duopolistic markets and the heterogeneity in the price regulatory schemes among states provide a exceptional "natural experiment" for a study on the regulation's impact on prices as well as on the determinants of the choice of a particular regulatory regime.

There are some other contributions that have empirically analyzed the impact of regulation on price levels in the U.S. cellular industry. They tested whether *exogenous* regulatory variables have a significant impact on prices using a reduced form approach.[2] The results they obtained are contradictory. Ruiz (1995) found that the regulatory variables did not significantly explain prices. Shew (1994) and Hausman (1995) observed that the regulatory variables were significant and that the sign of the coefficient was positive. This finding suggests that prices rise with regulation. The main explanation has been that regulation led to higher prices because it facilitated collusion. The regulatory body, in fact, could have acted as a cartel board which made firms' pricing strategies common knowledge (Porter, 1983 and Green and Porter, 1984).

Another analysis of the effects of regulation in the U.S. cellular industry is by Parker and Röller (1997). They specified a structural model to estimate whether the duopolistic industry structure led to a competitive outcome. The main findings are that the U.S. cellular industry's conduct was anticompetitive and that multimarket contact, cross-ownership, and regulation played a role in explaining this result.

All the previous empirical studies may be subject to a significant misspecification problem (Baron, 1995). If regulated firms have some control over the regulatory regime under which they operate, then treating regulatory variables as exogenous introduces selection bias (Heckman, 1979).

There exists some empirical literature dealing with the endogeneity of regulatory decisions. The typical approach is to explain the discrete choice among different regulatory plans using political and economic variables. The regulatory policy in the wireline U.S. telecommunications industry has been empirically analyzed, first in a static and then in a dynamic setting, by Donald and Sappington (1995) and (1997). They found evidence that both the political as well as the regulatory history were important determinants of the chosen regulatory regime. Teske (1991a) and (1991b) used a rent-seeking approach to address more clearly the issue about firms' specific "political strategies" to achieve the desired regulatory environment in the wireline U.S. telecommunications market. Yet, all these studies, except partially the last one, neglected the importance of firms' strategic behavior in influencing the regulatory game.

Empirically, our paper bridges between these two different approaches, accounting for the simultaneity between firms' pricing behavior and regulatory decisions. The econometric tool that is appropriate to achieve this goal is an endogenous switching regression model (Lee, 1978 and 1979), which is a simultaneous equations model with a binary qualitative variable (regulatory status) and limited dependent variables (regulated and non-regulated tariffs).

The paper proceeds as follows. In Section 2, we give a description of the market analyzing some preliminary statistics. In Section 3, we derive a theoretical framework that will be the starting point for the empirical analysis. Section 4 deals with the empirical specification and the econometric analysis. We present our main results in Section 5 and close the paper in Section 6 with some concluding remarks.

2. A description of the market and data

The regulatory environment in the U.S. cellular market is quite unique. The Federal Communication Commission (FCC) divided the country into non-overlapping geographical markets corresponding to the 306 Standard Metropolitan and 428 Rural Statistical Areas (SMSAs and SRSAs respectively). The first regulatory decision in the late 1970's was to split entry and price regulations: the Federal Government (FCC) kept the right to regulate entry through its authority to assign radio spectrum to cellular services providers, while the individual states were awarded discretion over tariff regulation.

Despite the fact that the magnitude of economies of scale could have been substantial and after a long debate, the decision of the FCC in 1981 was to allow entry of two cellular services providers in each area. The first ("wireline") license was typically awarded to a regional Bell operating company (the RBOC), which was operating in the same area, and the second ("non-wireline" license) was assigned mainly to independent companies. At the beginning of the 1990's in almost all of the SMSAs two operators were able to offer their services.

Concerning the second regulatory dimension – price regulation – only a few states strictly regulated cellular tariffs, whereas few others regulated them only loosely, and almost the half of the states did not regulate prices at all. A number of states even adopted some form of a regulatory ban, either at the legislative level or at the Public Utility Commission's (PUC) level. In our study, we want to test whether regulation had any effect on firms pricing behavior compared to a non-regulation situation and to investigate what determines the choice for a regulatory ban. Therefore, we will not consider the different forms of regulation.

Our data come from different sources and cover the time spanning from December 1984 to July 1988.[3] The original data set contains information about service prices, input factor prices, demand variables, and industry structure variables. The sample contains information about 122 MSAs. We then enlarged the original data set to encompass information about the political and regulatory environment using data from the *Statistical Abstract of the United States*, the *Book of the States*, and information from the states' regulatory commissions. In Table 1 we provide a short description of the relevant variables and Table 2 presents the summary statistics. The first column refers to the full sample, whereas the second and the third refer to the subsamples of non-regulated and regulated markets respectively.[4]

We observe that prices in regulated markets are, on average, slightly higher than in non-regulated markets.[5] In particular the price p_1, referring to "low usage" (monthly usage of 5 minutes), is on the average about 7% higher in regulated markets, whereas p_2 (monthly usage of 500 minutes) is around 2% and p_3 (monthly usage of 3000 minutes) 0.5% higher in regulated markets. However, given the high standard deviation, all price differences are not statistically significant.

We do not have firm specific measures for costs, but we can relay on market specific data. Large differences among regulated and non-regulated markets cannot be observed, even though in the former most cost drivers take slightly higher values. Only the cost of energy (ENERGY: average monthly cost per square foot) and the prime landing rate (PRIME) are on the average higher in non-regulated markets. Instead, significant differences can be observed with regard to the population (POP: market Population in millions),

Table 1. Variables definition

Variables	Definition	Vector	Source
p_1, p_2, p_3	Monthly bill calculated for different monthly usage times (5, 500, 3000 minutes)		Parker-Röller [1997]
ENERGY	Average monthly cost per square foot ($ per kilowatt hour)	CD	
PRIME (lagged)	One period lagged prime lending rate		
RENT	Average monthly rent per square foot of office space		
WAGE	Average weekly salary per employee for the cellular industry		
OPERATE	Average monthly general overhead and operating expenses per square foot		
POP	Market Population in millions	DD	
BUSINESS	Number of high potential business establishments (divided by 100)		
T	Time trend in months		
ENTRY	Dummy=1 after the second carrier enters into the market	MSV	
CROSSOWN	Dummy=1 when the two competitors in one market are partner in any other market		
MULTIMKT	Total number of markets where the two competitors face each other		
LEAD	Length of the monopoly period in months		
BELLBELL	Dummy=1 if both wireline and nonwireline competitors are RBOCs		
BELLIND	Dummy=1 if the wireline is a BELL and the non-wireline is an independent carrier		
INDBELL	Dummy=1 if wireline is an independent carrier and the non-wireline is a BELL		
INDIND	Dummy=1 if both wireline and nonwireline competitors are an independent firm		
Firm Dummies	Us West Cellular, Bell South Mobility, Ameritech Mobile, Nynex Mobile, South West Bell Mobile,Gte Mobilenet, Contel Cellular, Mccaw, Century Cellular, Rest	Firms_i	
REG	Dummy=1 if no regulatory ban was imposed in the market		Shew [1994]

Table 1. Continued

Variables	Definition	Vector	Source
DEM84, DEM88	Dummy=1 if the State's Governor was from the democratic party in 1984 and 1988 respectively	PV	US Statistical abstract
REP84, REP88	Dummy=1 if the State's Governor was from the republican party in 1984 and 1988 respectively		
GOVSTAB	Dummy=1 if in both elections in the sample period the Governor came from the same party		
ELECT	Dummy=1 if the regulator was elected	RSC	The Book of States
STAFF	Number of full-time employees in the State Public Utility Commission in 1984	RC	
ΔSTAFF	Change in the number of full-time employees in the State Public Utility Commission (86-84)		

Table 2. Summary statistics

Variables	Full sample		Sub-sample regulation		Sub-sample No regulation	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
p_1	17.223	10.600	16.908	11.927	17.543	9.061
p_2	196.126	39.418	197.787	40.596	194.434	38.182
p_3	1025.402	233.428	1029.426	220.473	1021.304	246.274
ENERGY	1.778	0.438	1.783	0.528	1.773	0.322
PRIME (lagged)	9.518	1.069	9.456	1.087	9.582	1.050
RENT	16.062	5.032	16.901	6.252	15.206	3.153
WAGE	519.598	119.172	521.617	101.292	517.534	135.197
OPERATE	6.724	1.724	6.825	2.181	6.622	1.072
POP	0.193	0.278	0.225	0.365	0.161	0.135
BUSINESS	2253.494	406.391	2227.075	457.181	2280.407	345.901
T	21.463	11.842	21.763	11.925	21.158	11.771
ENTRY	0.727	0.446	0.783	0.413	0.670	0.471
CROSSOWN	0.341	0.475	0.239	0.427	0.446	0.498
MULTIMKT	3.571	2.805	2.960	1.809	4.195	3.437
LEAD	10.696	8.047	9.798	7.310	11.611	8.653
BELLBELL	0.120	0.325	0.093	0.291	0.146	0.354
BELLIND	0.615	0.487	0.652	0.477	0.578	0.495
INDBELL	0.047	0.211	0.014	0.117	0.080	0.272
INDIND	0.218	0.413	0.241	0.429	0.195	0.397
REG	0.505	0.500	1.000	0.000	0.000	0.000
DEM84	0.733	0.443	0.658	0.475	0.809	0.394
DEM88	0.583	0.494	0.636	0.482	0.528	0.500
REP84	0.267	0.443	0.342	0.475	0.191	0.394
REP88	0.417	0.494	0.363	0.482	0.472	0.500
GOVSTAB	0.579	0.494	0.721	0.450	0.434	0.497
ELECT	0.200	0.401	0.154	0.362	0.247	0.432
STAFF	271.308	227.115	322.320	268.281	219.341	160.085
ΔSTAFF	–27.410	161.857	–73.092	212.731	19.127	50.729
Obs.	539		272		267	

Table 3. Regulatory status by state

Regulatory status	States
Regulatory ban	AL, CO, DE, FL, GA, IA, IL, KS, MI, MN, MO, MT, NE, NJ, OR, PA,TN, TX,WA, WI
Tariff regulation	AZ, CA, CT, HI, IN, KY, LA, MA, MS, NV, NM, NY, OH, OK, RI, SC, VA
Not in the sample	AK, ID, ME, ND, SD, VT, WV, WY

which in regulated markets is on the average much higher (40%) than in non-regulated ones.

Market structure variables show differences between the two subsamples. Cross-ownership (CROSSOWN: takes value 1 when the two competitors in one market are partners in any other market) and multimarket contacts (MULTIMKT: measures the number of other markets in which two competitors meet) assume higher values in non-regulated markets.[6] The dummy variable ENTRY (equals 1 when the second operator enters into the market) takes slightly higher values in regulated markets, meaning that the incumbent's lead over the second operator was shorter (LEAD: length of the monopoly period in months). Four dummy variables represents the status of the wireline-nonwireline pair: BELLBELL (equals 1 if both firms are baby bells), BELLIND (equals 1 if the incumbent is a baby bell and the entrant is an independent firm), INDBELL (equals 1 if the incumbent is an independent firm and the entrant is a baby bell), and INDIND (equals 1 if both firms are independent companies). The mean values for these dummies slightly vary between subsamples. The pairs BELLBELL and INDBELL are more frequent in non-regulated markets (14.6% vs. 9.3% and 8% vs. 1.4% respectively) whereas the pairs BELLIND and INDIND are more frequent in the regulated subsample (65.2% vs. 57.8% and 24.1% vs. 19.5% respectively).

Turning to institutional variables, we observe that, in the sample period, the state's governor was principally from the Democratic Party (DEM84 and DEM88 are dummies equal to 1 if the governor was a democrat in 1984 and 1988, respectively). However, between 1984 and 1988, the Republicans gained back many states. Unexpectedly, the Democrats were more present in non-regulated markets (81%) than in regulated markets (66%) at the beginning of the sample period, but they lost more states in the regulated subsample (from 81% to 53%) than in the non-regulated one (from 66% to 64%). Around 58% of the States were politically stable during the sample period and did not experience a gubernatorial change (GOVSTAB: equals 1 if in both elections in the sample period the Governor came from the same party). In this case, the differences between regulated and non-regulated markets are consistent: 72% of the States that adopted regulation did not experience a change in political majority during the sample period, while only 43% in the non-regulated markets subsample did face such a change.

We observe less elected (ELECTED: equals 1, if the regulator was elected by citizens) than appointed regulators in all subsamples. However, the percentage of elected regulators is lower in regulated markets than in non-regulated markets.[7] The number of full-time state PUC employees in 1984 (STAFF84) was much larger in states that adopted price regulation. Finally we also observe that in regulated markets, during the sample period, the size of the commission has been significantly reduced (ΔSTAFF: change in the number of full-time employees in the state Public Utility Commission (86-84)), whereas it has increased in non-regulated markets. Notice, however, that the variability was much higher in the former than in the latter case.

3. A theoretical framework

In this Section, we will present a theoretical background on which we will base our empirical analysis, and from which we will derive testable hypotheses. We first derive the regulator's behavior and then move to firms pricing strategies.

3.1. *The regulatory choice*

As a starting point, we assume that the regulatory agency uses a simple rule to determine whether a market should be regulated or not on the basis of the regulation's effects on prices. If regulation is thought to decrease prices "enough", then it is adopted. We can think of this rule as representing the optimality condition for a regulator that maximizes a sum of total welfare and of private interests.[8] At the optimum the regulator weights marginal benefits of regulation to its marginal costs. Hence, a reduced form equation, which constitutes the decisional criterion for the regulator, is:

$$\mathrm{R}^*_{\mathrm{ts}} = \alpha_0 + \alpha_1 \left[\log\left(\mathrm{p}^1_{\mathrm{ts}}\right) - \log\left(\mathrm{p}^0_{\mathrm{ts}}\right)\right] + \alpha_2 \mathrm{RSC}_{\mathrm{ts}} + \alpha_3 \mathrm{PV}_{\mathrm{ts}} + \alpha_4 \mathrm{RC}_{\mathrm{ts}} + \epsilon_{\mathrm{ts}}, \quad (1)$$

where $\left[\log\left(\mathrm{p}^1_{\mathrm{ts}}\right) - \log\left(\mathrm{p}^0_{\mathrm{ts}}\right)\right]$ is the difference between regulated ($\mathrm{p}^1_{\mathrm{ts}}$) and non-regulated ($\mathrm{p}^0_{\mathrm{ts}}$) prices, RSC is a vector of characteristics specific to the regulator, PV is a vector of political variables, and RC is a measure of the cost of regulation.[9] We do not observe the variable $\mathrm{R}^*_{\mathrm{ts}}$, which is latent, but rather a binary variable that indicates whether a market is regulated ($\mathrm{R}_{\mathrm{ts}} = 1$)

or not ($R_{ts} = 0$). Thus, equation (1) can be interpreted as a probit model: Market s will be regulated in time t (and thus we observe $R_{ts} = 1$) if and only if $R^*_{ts} > 0$ and will not be regulated otherwise. The main problem with the presented approach is that, for each observation, we have either the regulated price or the non-regulated one, while in (1) we need to compare both prices for each observation. In each regime we need a measure for the price which is not observed, i.e. the price that firms would have chosen if the other regime had prevailed. As we will see in Section 4, our empirical specification will help us to overcome this question. Once the censoring problem is solved – and thus we can measure the regulated as well as the non-regulated prices in both subsamples – the analysis of α_1 plays a crucial role, since the sign of this coefficient allows us to identify the role of firms' lobbying activities vs. consumer protection. Assuming a benevolent regulator, which principally cares for the consumer surplus (that is the welfare standard adopted in the U.S. antitrust policy), we would expect to observe a significant and positive value for the coefficient α_1: regulation is more probable when its implied benefits in terms of lower prices are larger.

On the other hand, it can be that the regulatory agency is not benevolent but rather self-interested, and that interest groups, as well as individual firms, achieve to influence his decisions through their lobbying activities. High prices are in the firms' interest. Therefore, if firms' rent seeking activities are successful, we should expect a negative coefficient α_1: the probability of regulation should be lower when regulation puts much downward pressure on prices, since lobby intensity against a regulated environment would be higher.[10] The price difference's coefficient should thus measure the relative weight that the regulator assigns to firms' lobbying and to consumers' protection. In our model we do not exactly specify what *lobbying* is; we assume that it is any action taken by the interest group (e.g. the firm) to influence the regulator's decision.[11]

The only measures for regulator's specific characteristics that we use is whether the regulator was appointed by the state's governor, or directly elected. Besley and Coate (2000) gives a theoretical rationale for the importance of this issue by theoretically showing that an elected regulator should be more "pro-consumer". This would mean that, whenever regulation does not increase prices, we should observe a positive relationship between the probability of regulation and the fact of being elected, rather than appointed by politicians.

We insert the political variables to account for different effects. First, in many states the regulatory ban was imposed at the legislative level, therefore the governor's political orientation should account for his specific regulatory policy preferences. Second, the political orientation of the party in power can be seen, according to Donald and Sappington (1995) and (1997), as a measure of the political costs of choosing a regulated regime for the mobile industry. Third, one may want to control for political variables because the political environment shapes firms' rent seeking strategy, as shown by Teske (1991a).

We also control for regulation's costs as proxied by the number of full time PUC employees. The main idea is that large PUCs should bare a smaller opportunity cost for setting up a regulatory regime in a new industry than smaller ones, since their resources are less scarce. Our expectation is thus to observe a higher probability of regulation in states with larger PUCs. Finally, we also use the change in the PUC's composition as a regressor, since it should be more difficult to capture a regulator when the PUC's composition varies, because of the lack of long standing relationships.

3.2. *Firms pricing behavior*

Since prices are endogenously chosen by firms, we need to model firms' pricing behavior and determine a reduced form price equation. Because of the oligopolistic structure of the considered markets, we assume that the cellular price in market s at time t ($\mathrm{p_{ts}}$) is a mark up (μ_{ts}) over marginal costs ($\mathrm{MC_{ts}}$): $\mathrm{p_{ts}} = \mathrm{MC_{ts}} \cdot \mu_{\mathrm{ts}}$. Taking logarithms of both sides we obtain a linear relation:

$$\log \mathrm{p_{ts}} = \log \mathrm{MC_{ts}} + \log \mu_{\mathrm{ts}}. \tag{2}$$

Since we cannot directly observe marginal costs and mark-up, we need to model them through an equation. We assume that the marginal cost is a function of cost drivers ($\mathrm{CD_{ts}}$) and of firms specific dummies ($\mathrm{firm_{its}}$) which should capture the possible heterogeneity in firms' technology:

$$\log(\mathrm{MC_{ts}}) = \mathrm{f}\left(\mathrm{CD_{ts}}, \mathrm{firm_{its}}\right). \tag{3}$$

Similarly, we assume that the mark-up depends on the level of demand ($\mathrm{Q_{ts}}$) and on vector of market structure variables ($\mathrm{MSV_{ts}}$), which should influence firms' ability to coordinate:

$$\log(\mu_{\mathrm{ts}}) = \mathrm{g}\left(\mathrm{Q_{ts}}, \mathrm{MSV_{ts}}\right). \tag{4}$$

Since demand is endogenous, we also need an equation which explains the demanded quantity:

$$\mathrm{Q_{ts}} = \mathrm{Q_{ts}}\left(\mathrm{p_{ts}}, \mathrm{DD_{ts}}\right), \tag{5}$$

where $\mathrm{DD_{ts}}$ are demand drivers. Assuming linearity, substituting equations (3), (4), and (5) into equation (2) and adding an error term $\mathrm{u_{ts}}$, we obtain a reduced form price equation as follows:

$$\log \mathrm{p_{ts}} = \beta_0 + \beta_1 \mathrm{CD_{ts}} + \beta_2 \mathrm{DD_{ts}} + \beta_3 \mathrm{MSV_{ts}} + \beta_4 \mathrm{firm_{its}} + \mathrm{u_{ts}}. \tag{6}$$

We also expect that regulation might have an impact on firms' pricing behavior, since different regulatory regimes should provide cellular operators with different incentives. To account for the fact that the independent variables should have a different impact on prices, depending on which regime prevails, we specify one reduced form price equation for each regime and allow coefficients to differ in the two regimes. Furthermore, the adopted econometric model also involves the use of a correction term in the price equations, which accounts for the selectivity bias that arises from the fact of being in one particular regime.

4. Specification and empirical implementation

As we mentioned before, regulated firms often have influence over the regulatory regimes under which they operate. We take this issue into account in our empirical analysis by estimating a model of endogenous switching (Maddala and Nelson, 1975 and Lee, 1978). The empirical implementation of the theoretical framework analyzed in the previous Section implies the specification of equation (1), and of two price equations like (6), one for each of the two subsamples:

$$R^*_{ts} = \alpha_0 + \alpha_1 \left(\log p^0_{ts} - \log p^1_{ts}\right) + \alpha_2 Z_{ts} + \epsilon_{ts} \tag{7}$$

$$R_{ts} = 1 \qquad \text{if } R^*_{ts} > 0 \quad \text{and} \quad R_{ts} = 0 \quad \text{otherwise}$$

$$\log p^1_{ts} = \beta^1_0 + \beta^1_1 X^1_{ts} + u_{1ts} \qquad \text{if } R_{ts} = 1 \tag{8}$$

$$\log p^0_{ts} = \beta^0_0 + \beta^0_1 X^0_{ts} + u_{0ts} \qquad \text{if } R_{ts} = 0 \tag{9}$$

Where $R_{ts} = 1$ when the market is regulated, X^R_{ts}, $R = 0, 1$ contains cost drivers CD_{ts} (OPERATE, ENERGY, WAGE, RENT, and PRIME), demand drivers DD_{ts} (POP and BUSINESS), and a time trend (T) to control for market growth. Furthermore, we insert several variables to control for market structure (MSV_{ts}): a dummy equal to one if the second carrier has already entered market s in time t (ENTRY), variables related to cross-ownership and multimarket contacts (CROSSOWN and MULTIMKT), a variable controlling for the monopolist's lead over the second entrant (LEAD), firm specific dummies ($FIRM_i$) for the major carriers, and dummy variables to control for the duopolistic market's composition (BELLBELL, INDBELL, and INDIND).[12]

The vector Z_{ts} contains regulator specific variables RCV_{ts} (ELECT/APPOINT), political variables PV_{ts} (GOVCHANGE and DEM), as well as two proxies for the cost of regulation CR_{ts} (STAFF and Δ STAFF). As already mentioned we assume that the independent variables' coefficients in (8) and (9) are different, allowing complete interaction in the price equations. This assumption, which should capture the different incentives faced by firms in the different regimes, will be tested in the next Section. We assume that the error terms are jointly normally distributed, with a variance-covariance matrix given by (10):[13]

$$\mathrm{Cov}\left(u_{1ts}, u_{0ts}, \epsilon_{ts}\right) = \begin{bmatrix} \sigma_1^2 & \rho_{10}\sigma_1\sigma_0 & \rho_1\sigma_1 \\ & \sigma_0^2 & \rho_0\sigma_0 \\ & & 1 \end{bmatrix}. \tag{10}$$

As Heckman (1979) and others pointed out, there exists a selectivity bias problem that leads to inconsistent parameter estimates when estimating the price equations separately by OLS, for $\mathrm{E}\left[u_{its} \,|R_{ts} = i\right] \neq 0$ $(i = 0, 1)$. To overcome this problem, we need to correct for the endogeneity of regulation. Following Lee (1978), we construct two selectivity bias terms as follows:

$$\begin{aligned} \mathrm{E}\left[u_{1ts}\,\middle|R_{ts}^* > 0\right] &= \rho_1\sigma_1\left[\phi\left(\alpha' z_{ts}\right)/\Phi\left(\alpha' z_{ts}\right)\right] \text{ and} \\ \mathrm{E}\left[u_{0ts}\,\middle|R_{ts}^* \leq 0\right] &= \rho_0\sigma_0\left[-\phi\left(\alpha' z_{ts}\right)/\left(1-\Phi\left(\alpha' z_{ts}\right)\right)\right] \end{aligned}$$

for the regulated and non-regulated markets subsamples respectively, where $\phi(\cdot)$ and $\Phi(\cdot)$ are respectively the density and the cumulative function of a standard normal distribution.

The estimation procedure is as follows. Equation (7) accounts for the separation criterion and can be consistently estimated by a probit ML method. Because we do not observe both prices for each observation, in the first stage we estimate a reduced form of the probit equation where we substitute (8) and (9) in (7). Once we get consistent estimates of the α's, we compute $\hat{\lambda}_{1ts} = \phi\left(\hat{\alpha}' z_{ts}\right)/\Phi\left(\hat{\alpha}' z_{ts}\right)$ and $\hat{\lambda}_{0ts} = -\phi\left(\hat{\alpha}' z_{ts}\right)/\left(1-\Phi\left(\hat{\alpha}' z_{ts}\right)\right)$, using the estimated instead of the real parameters' values. After inserting the selectivity bias terms as a control in the pricing schedules, we then consistently estimate the β, the ρ_i, and the σ_i terms by simultaneously estimating (7), (8) and (9) by FIML. The last step consists of estimating the structural probit by ML, where we insert the estimated price differences.

The typical test of selectivity bias is to analyze whether the coefficients of λ_{its} $(i = 0, 1)$ are significantly different from zero. But from the sign and size of the coefficient estimates we can learn even more, namely how the selectivity terms influence pricing behavior.

5. Results and interpretation

In this section we start presenting the results of the two pricing relations' FIML estimation. In order to enrich our analysis and to observe whether regulation had different effects on the various cellular tariffs, we will propose different specifications in which we use the three available price measures as the dependent variables. In this way, we also will capture the fact that firms' strategies vary in different market segments.

Table 4 reports the coefficient estimates for the reduced form price equation in the subsample of regulated markets, while Table 5 reports the results relative to the non-regulated markets.

We first analyze the role of the selection bias in both subsamples. The selectivity terms' coefficients are given by the product between ρ_i and σ_i, $i = 0, 1$. In the regulated markets' subsample both ρ_1 and σ_1 are strongly statistically significant in all specifications. In particular, the product of the two coefficients is negative, implying that the fact of being in a regulated market has put some downward pressure on cellular tariffs. Later we will precisely quantify this effect. In non-regulated markets, the selectivity bias correction's coefficient is highly significant as well. Both ρ_0 and σ_0 are statistically significant in the first and third specifications, while only the variance σ_0 is significant in the second one. In this case, we observe a positive estimate for the selection terms' coefficient, which means that a lack of regulation should have increased prices.

The significance of these terms in both subsamples and in all specifications is the first compelling finding from our analysis: the endogeneity of regulatory choice must be accounted for. The price estimate that we would obtain without correcting for the selectivity bias would in fact be inconsistent and biased. Furthermore, our first result seems to go in the opposite direction than previously observed in the literature. Later we shall analyze this point in more detail.

Now we turn to the effects of the other exogenous variables on firms' pricing behavior. We start with the regulated markets' subsample (Table 4). The first interesting point is that there are evident differences in pricing behavior among low usage time tariffs on the one hand, and middle and high usage time tariffs on the other.[14] Particularly compelling is the finding that entry pressure (ENTRY) led to significantly lower usage tariffs in the lower market segment only, whereas it did not affect prices for middle and high usage times. Moreover, the only determinants of regulated prices for higher usage, apart from the selectivity bias term, are some demand drivers and, only partially, market structure variables. Surprisingly, almost none of the cost drivers are statistically significant in all specifications.

Table 4. FIML estimates: Price equation – Regulated markets

Dep. variable	Low usage tariff ($\ln p_1$)		Middle usage tariff ($\ln p_2$)		High usage tariff ($\ln p_3$)	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
CONSTANT	2.700***	1.017	5.192***	0.435	6.665***	.418
OPERATE	0.64E-01	0.41E-01	0.17E-01	0.23E-01	0.16E-01	0.23E-01
ENERGY	–0.110	0.198	–0.65E-01	0.51E-01	–0.80E-01	0.56E-01
WAGE	0.18E-03	0.97E-03	–0.57E-03**	0.25E-03	–0.22E-03	0.27E-03
RENT	–0.75E-03	0.14E-01	0.86E-02	0.58E-02	0.13E-01**	0.59E-02
PRIME (lagged)	–0.76E-01	0.58E-01	0.58E-02	0.21E-01	0.17E-01	0.22E-01
POP	0.278	0.201	0.139*	0.82E-01	0.72E-01	0.90E-01
BUSINESS	0.99E-04	0.13E-03	0.10E-03***	0.37E-04	0.36E-04	0.34E-04
T	–0.951E-04	0.53E-02	–0.55E-02***	0.18E-02	–0.46E-02**	0.21E-02
CROSSOWN	–0.464**	0.205	–0.43E-01	0.73E-01	0.40E-01	0.85E-01
MULTIMKT	0.74E-01*	0.43E-01	–0.18E-01	0.20E-01	–0.21E-01	0.21E-01
LEAD	0.78E-02	0.81E-02	0.55E-02*	0.28E-02	0.41E-02	0.28E-02
ENTRY	–0.476***	0.167	0.28E-01	0.65E-01	0.35E-01	0.69E-01
BELLBELL	–0.685	0.648	0.136	0.174	0.187	0.162
INDBELL	–1.478***	0.370	–0.24E-02	0.111	–0.163	0.137
INDIND	0.13E-01	0.558	–0.19E-01	0.153	–0.97E-01	0.138
Firms dummies	(* 3/9)		(0/9)		* (1/9)	
σ_1	0.620***	0.31E-01	0.142***	0.11E-01	0.220***	0.14E-01
ρ_1	–0.949***	0.41E-01	–0.641***	0.147	–0.932***	0.50E-01
Adj. R^2	0.7913		0.5551		0.5960	
Obs.	272		272		272	

***, **, * represent significance at the 1%, 5%, 10% levels, respectively

Demand drivers are more significant, though coefficients' sign, size, and significance vary widely across specifications as well. The population size (POP) had a positive impact on prices, which is however significant only in the first specification. In all specifications we observe a positive coefficient's estimate for BUSINESS, which is significant only for the middle usage segment. As expected, the time trend (T) is negative in all specifications but it is significant only in the middle and high usage specifications. The market growth generated downward pressure on prices only in the business segment, which developed the fastest in the sample period.

Table 5. FIML estimates: Price equation – Non-regulated markets

Dep. variable	Low usage tariff ($\ln p_1$)		Middle usage tariff ($\ln p_2$)		High usage tariff ($\ln p_3$)	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
CONSTANT	4.071***	1.256	4.831***	0.278	6.545***	0.407
OPERATE	–0.89E-01	0.75E-01	–0.14E-01	0.17E-01	–0.20E-02	0.26E-01
ENERGY	–0.80E-01	0.226	0.30E-01	0.53E-01	0.33E-01	0.75E-01
WAGE	0.99E-04	0.18E-03	0.10E-04	0.12E-03	–0.27E-04	0.18E-03
RENT	0.12E-01	0.23E-01	0.17E-02	0.61E-02	–0.22E-02	0.90E-02
PRIME (lagged)	–0.34E-01	0.78E-01	0.52E-01***	0.18E-01	0.49E-01*	0.28E-01
POP	0.502	0.583	0.263*	0.152	0.173	0.215
BUSINESS	0.20E-03	0.23E-03	0.37E-04	0.46E-04	0.45E-04	0.76E-04
T	–0.72E-02	0.78E-02	0.23E-02	0.17E-02	0.35E-02	0.26E-02
CROSSOWN	0.28E-03	0.202	–0.14E-02	0.47E-01	–0.102	0.69E-01
MULTIMKT	0.97E-01**	0.45E-01	0.12E-01	0.84E-02	0.20E-01	0.14E-01
LEAD	–0.95E-02	0.10E-01	–0.29E-03	0.22E-02	–0.83E-03	0.36E-02
ENTRY	–0.392**	0.178	0.11E-01	0.48E-01	0.103	0.69E-01
BELLBELL	–0.793**	0.346	0.375***	0.83E-01	0.235**	0.114
INDBELL	–0.73E-01	0.392	–0.128*	0.87E-01	–0.344**	0.136
INDIND	0.418	0.365	–0.179***	0.72E-01	–0.319***	0.113
Firms dummies	* (3/9)		*** (6/9)		*** (7/9)	
σ_0	0.467***	0.30E-01	0.148***	0.11E-01	0.155***	0.17E-01
ρ_0	0.835***	0.65E-01	0.245	0.485	0.445	0.372
Adj. R^2	0.46127		0.6060		0.6172	
Obs.	267		267		267	

***, **, * represent significance at the 1%, 5%, 10% levels, respectively

Market structure variables are also partially significant in the regulated market subsample. In the middle usage segment the head start advantage of the first license owner (LEAD) led to a small increase in cellular tariffs, whereas it did not affect low usage prices. Instead, low usage tariffs depend significantly on multimarket contact (MULTIMKT) and on cross-ownership (CROSSOWN), but the two effects go in opposite directions. While MULTIMKT seems to have increased tariffs, as expected, cross-ownership seems to have decreased them.

Firm specific terms and firms-pair dummies are not at all significant in the second and third specifications. Only in the low usage segment, the fact that a

RBOC entered a market with a independent incumbent put some downward pressure on tariffs. In regulated markets the kinds of firms operating in the market did not strongly influence the price level.

One possible interpretation for our findings is that regulated prices were not set by the firms but rather by the regulator. This is because the firms specific characteristics do not seem to have influenced regulated prices, while those variables that should explain, at least partially, consumer surplus – like demand drivers, and the selectivity bias correction to account for regulation – are the main significant cellular tariffs' determinants.

We now turn to the non-regulated markets' subsample. Here, we observe some differences among specifications as well, which suggest that firms' pricing strategies vary in the different market's segments. In the second and third specifications, prices are very significantly dependent on firm specific effects. Not only are the firms' dummies significant, but also the wireline/non-wireline variables present highly significant coefficient estimates.[15]

Specifically, when an independent carrier owned the first license, it seems that markets were more competitive in the sense that prices were lower with respect to the reference group, which includes the BELLIND pair. The presence of two baby Bells in the same non-regulated market, on the one hand, increased prices in the middle and high usage segments, meaning that two baby Bells could have been better able to collude. On the other hand, however, this market structure led to more price competition in the low usage segment (BELLBELL's coefficient estimate is negative and significant). Also, multimarket contact (MULTIMKT) has a positive impact on tariffs but is significant only in the first specification.

Competitive pressure imposed by the second firm entering the market did not reduce middle and high usage time tariffs. The negative and significant impact of entry in the low usage segment can be motivated by a more aggressive pricing strategy by entrant firms, in order to enlarge the non-business costumers' base.

Before moving to the direct analysis of price regulation's effects on tariffs, we want to statistically test whether the coefficients' estimates differ among the two subsamples using a Wald test.[16] We reject the hypothesis that the same coefficients apply to the two subgroups for all specifications at any usual confidence level. This means that the explanatory variables in the two subgroups have different effects on the firms' pricing strategy, depending on the fact of being regulated or not: firms' behavior is influenced by price regulation.

Previous studies suggested that regulation should have increased cellular tariffs, since the regulatory dummies have a positive impact on prices. To more directly asses regulation's impact on cellular tariffs, we ask what

Table 6. Predicted prices with and without regulation: Regulated markets

	Low usage tariff	Middle usage tariff	High usage tariff
$\hat{p}^1$	16.364	196.030	1020.101
	(11.647)	(33.346)	(179.141)
$\hat{p}^{1,0}$	19.022	217.621	1188.160
	(10.658)	(69.706)	(407.524)
$\hat{p}^{1,0} - \hat{p}^1$	2.659	21.5909	168.059
	(17.691)	(66.651)	(404.421)

Standard errors in parenthesis

the prices in regulated markets would have been, had these markets not been regulated. We must then determine $E[\log p^0_{ts} | R_{ts} = 1] = \beta^{0\prime} x^1_{ts} + \rho_0\sigma_0 \left[\phi\left(\alpha' z_{ts}\right) / \Phi\left(\alpha' z_{ts}\right)\right]$.

By using the consistent estimates of β^i, ρ_i, and σ_i, $i = 0, 1$, we calculate the predicted regulated and non-regulated prices for the regulated markets' subsample. Table 6 reports the summary statistics for the predicted prices in regulated markets ($\hat{p}^1$), in regulated markets had they not been regulated ($\hat{p}^{1,0}$), and for the difference between the two. The predicted regulated prices are on average lower than the predicted non-regulated prices in every specification. This would mean that (on average) regulation decreased prices by 14%, 10%, and 14% ca. for low, middle, and high usage tariffs, respectively. This would reverse the results obtained with dummy variables models. However, the standard deviation of the difference between the two prices is very large.[17] Hence, to reach a more precise conclusion, we test the null hypothesis $\hat{p}^1 = \hat{p}^{1,0}$, which cannot be rejected at any usual confidence level for any of the used price measures.

We also do the same exercise for non-regulated markets and ask what the prices in these markets would have been, had they been regulated ($\hat{p}^{0,1}$).[18] In Table 7 we report our results. Predicted prices in non-regulated markets, had regulation occurred, would have been lower than predicted non-regulated prices in all specifications (8.5%, 3%, and 8% for low, middle, and high usage tariffs, respectively). We again perform a simple test of the null hypothesis $\hat{p}^{0,1} = \hat{p}^0$. Now we reject the null hypothesis at the 10% confidence level for middle and high usage tariffs, but not for low usage ones. This means that regulation would have significantly decreased prices for those customers who made extensive use of cellular services in non-regulated markets.

Summarizing, we observed that regulation was not very effective in reducing cellular tariffs in regulated markets. On the other hand, it seems that

Table 7. Predicted prices with and without regulation: Non-regulated markets

	Low usage tariff	Middle usage tariff	High usage tariff
$\hat{p}^0$	21.269	200.979	1086.774
	(10.439)	(34.747)	(205.602)
$\hat{p}^{0,1}$	19.456	194.976	997.696
	(8.761)	(34.202)	(185.043)
$\hat{p}^{0,1} - \hat{p}^0$	–1.813	–6.002*	–89.078*
	(4.862)	(4.276)	(55.988)

Standard errors in parenthesis. * represents significance at the 10% level

cellular tariffs would have fallen significantly – even if not substantially – had regulation been adopted in non-regulated markets, especially for the business sector segment. Where the wrong markets regulated?

To answer this question we estimate the structural probit by maximum likelihood, where we use as regressors the difference between predicted non-regulated and regulated prices as well as other political and regulatory variables, as we derived in Section 3. As we already noted, we simultaneously use the three estimated price differences as regressors to account for different firms' lobbying intensity in different market segments. The coefficient of the difference between the non-regulated and regulated prices should help us to disentangle two effects: effective firms lobbying efforts, which would imply a negative coefficient, and consumers' protection, which would instead imply the coefficient's estimate to be positive.

We present different specifications based on the set of control variables that we used. First, we run the probit regression on the exogenous variables alone. We then propose a specification which controls for firms' fixed effects and one which controls for regional effects to try to capture, at least partially, possible market unobserved heterogeneity.[19] We then insert some interaction terms between the price differences and the other exogenous variables, in order to control for the interaction between firms, politicians, and the regulatory agency.[20] Finally, we try a richer specification where all control variables are used at once. Table 8 reports our results. The main interest here is in the sign and significance of the price difference variables. In all specifications the three price differences are strongly significant. This is a second compelling result of our analysis. However, both consumer protection and firms' lobbying activity seem to have played a role in the regulatory regime's choice. The first and third price differences' parameter estimates present, in fact, a negative sign, while the second has a positive sign.

This would suggest that firms concentrated their rent seeking strategies in those markets where regulation would have hurt more, i.e. those markets where most of the customers were long-time cellular service users, and where competition was expected to be tougher because of the low demand for low usage time. Our findings are also consistent with the fact that the regulator might have concentrated his actions in those markets where final consumers, and not intermediate customers such as business people, were more important, based on the positive sign of the middle usage prices difference.

Turning to the other explanatory variables, almost each is highly significant in every specification. If the state's governor in 1984 came from the Democratic Party, the probability to observe price regulation was lower. This result is unexpected, given that the Democratic Party is supposed to pursue a more consumer-oriented policy.[21] On the other hand, the probability of regulation was higher in states that did not experience a political change during the sample period. This fact might reflect the idea that states in which political changes occurred were more open toward an innovative regulatory policy, such as full price liberalization. The results concerning the political environment are quite robust: both sign and significance level do not vary much across the different specifications.

Regulator specific characteristics and regulation's costs had a significant impact on regulatory choice as well, but these results are less robust among specifications. Looking at the first column, we observe that elected regulators increased the probability of regulation compared to appointed ones, even if not significantly. When we insert firm dummies, this variable turns out to be significant. However, this finding disappears again in the next specifications.[22] The variable STAFF, which should proxy for regulation's costs, presents the expected positive and significant sign in the first, third and last specifications. A regulator with higher resources (larger PUCs) was expected to regulate more often, because his opportunity cost of regulating a new market should be lower. Also, the negative and significant sign of ΔSTAFF means that when the changes in the commission's composition were large the probability of regulation was law. A possible explanation for this fact is that large changes in the commission's personnel could have make it more difficult to capture the regulator, because long standing relationships were lacking. Furthermore, it is worth stressing the role of the different specifications. First, the introduction of the interaction terms, which should more precisely capture the "political game" among firms, politicians, and regulator has a very significant impact on our results. Not only are almost all of these

Table 8. ML estimates of the structural probit: The probability of regulation

Variables	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
CONSTANT	–0.356 ***	0.164	1.227 ***	0.289	–0.400 ***	0.280	1.989 ***	0.531	5.152 ***	1.959
$\log \frac{p1_{ts}^{0}}{p1_{ts}^{1}}$	–0.350 ***	0.74E-01	–0.250 ***	0.80E-01	–0.846 ***	0.158	–10.417 ***	1.997	–31.501 ***	6.1275
$\log \frac{p2_{ts}^{0}}{p2_{ts}^{1}}$	3.310 ***	0.968	3.337 ***	1.014	2.874 ***	1.485	157.515 ***	30.805	652.4819 ***	111.155
$\log \frac{p3_{ts}^{0}}{p3_{ts}^{1}}$	–2.939 ***	0.764	–4.472 ***	0.859	–4.546 ***	1.139	–113.807 ***	22.865	–4476452 ***	75.9895
DEM84	–0.290 ***	0.130	–0.821***	0.154	–0.489 ***	0.150	–0.305	0.298	–8.418	1.491
GOVSTAB	0.492 ***	0.146	0.461 ***	0.164	0.894 ***	0.196	–1.491***	0.451	–0.945	1.145
ELECT	0.81E-01	0.179	–0.198	0.200	0.656 ***	0.223	–1.237 *	0.686	–0.322	1.069
STAFF84	0.15E-02 ***	0.32E-03	0.42E-03	0.35E-03	0.23E-02***	0.44E-03	–0.86E-03	0.62E-03	0.64E-02 **	0.28E-02
ΔSTAFF	–0.20E-02	0.13E-02	–0.76E-02***	0.15E-02	–0.36E-02***	0.16E-02	0.76E-03	0.35E-02	–0.34E-01***	0.12E-01
Regional effects			YES						YES	
Firm fixed effects					YES				YES	
Interaction terms							YES		YES	
Log likelihood	–320.2546		–286.6652		–257.6257		–183.3153		–52.4511	
Chi squared	102.5729		169.7516		227.8306		376.4513		638.1797	
Obs.	537		537		537		537		537	
Correct predictions	68.16%		70.20%		72.81%		80.63%		97.21%	

The dependent variable is R_{ts} (dummy = 1 if no regulatory ban was imposed in the market). Coefficients' estimates represent the marginal effect with respect to the overall means of the data set. ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively terms highly significant and the overall fit of the model increases, but also some qualitatively new results appear as, for instance, the significance of the regulation's cost proxy or the role of government stability. This is, in our opinion, an important issue that calls for a more precise model of these interactions.

The introduction of firm specific terms has an important impact as well. Almost all firm specific dummies are highly significant in the third and last specifications.[23] This finding reinforces our belief that lobbying for regulation by individual firms matters. Finally, regional variables are also partially significant, which should correct for unobserved market heterogeneity.

6. Conclusions

This paper investigates the political economy of regulation bridging two different approaches of the empirical literature on regulation, and empirically analyzing the simultaneity between price regulatory choice and firms' pricing behavior. We use data from the U.S. mobile telecommunications industry, because of its unique regulatory and market environments. The industry under consideration is quite homogenous for product characteristics, firms' technology and demand, but heterogenous for the adopted price regulatory schemes. Some states adopted strict price regulation, some loose price regulation, and others even banned cellular tariffs' regulation.

The study has different aims. First, we want to prove that the endogeneity of regulation is an important issue to account for because firms do influence the choice of the regime under which they operate. Second, we want to determine the impact of price regulation on cellular tariffs, after correcting for the simultaneity bias. Lastly, we want to identify the main drivers of a regulatory choice. The econometric method we adopt consists of the estimation of an endogenous switching regression model. To enrich the analysis we consider three measures for cellular prices corresponding to different usage times, which allow us to take into account different firms' strategies in the different market segments.

We provide evidence that the regulatory regime has to be regarded as endogenous to firms' pricing strategy. Controlling for the selectivity bias, we show that prices in regulated markets were, on average, lower than the prices firms would have set, had these markets not been regulated. But the impact of regulation is not observed to be statistically significant: price regulation, where applied, has not been very effective. On the other hand, however, we observe that prices in non-regulated markets would have significantly fallen, had regulation been adopted.

Our approach enable us to explain this unexpected result, since we also model the regulatory choice using a probit analysis. We provide some robust evidence that firms' lobbying activities against a regulated environment were successful. Also, we show that, all other things being equal, states were more favorable to some kinds of price regulation when the governor came from the Republican Party, the government was politically stable, the regulator was elected rather than appointed by politicians, and regulation's opportunity cost were low. Finally, we found that the probability of regulation was lower when the changes in the public utility commission's composition were pronounced.

We then conclude that our empirical approach, which allows for the explicit modelling of the political economy of regulation, leads to new results in comparison to those already observed in both streams of the related literature. We do provide evidence that price regulation did not work in the wrong direction, increasing cellular tariffs. Effective regulation, though, did not have a significant impact, because of the firms's lobbying activities to avoid a regulated environment.

Some major caveats apply to our analysis. First, there are still some important facts that have not been considered in the analysis for lack of data. For instance, we do not have more precise regulator's individual characteristics, which might be important determinants of the regulatory choice. Second, we limited our analysis to the dichotomous regulatory choice, not considering that different regulatory schemes were actually adopted, that could have had different effects on prices. In particular, this consideration might help to understand more clearly which kinds of regulatory schemes did not work. Third, regulatory decisions are not only related to the simple choice whether to regulate a market or not; the regulatory commissions, in fact, must also decide on many other issues, which are likely to have an influence on the choice of whether to regulate or not. Finally, in this paper we adopted a reduced form approach to the political economy of regulation as well as to firms' strategic behavior, whereas both issues could be approached in a more structural way. In particular, one should try to provide a rigorous micro foundation for the interaction among regulatory commissions, legislators, and interest groups.

Notes

1. See also Duso and Röller (2003) for an analysis of the determinants of entry regulation and its impact on firms' productivity in the mobile telecommunications industry of OECD countries.
2. Similar analyses, which took the same kind of approach, were performed for the wireline telecommunications industry as well. See among others Mathios and Rogers (1989), Kaestner and Kahn (1989), and also Kriedel, Sappington and Weisman (1996) for a survey.

3. We owe a particular thank to Lars-Hendrik Röller and Phil Parker for providing us with the main data set. A description of the sources as well as a deeper analysis of the data can be found in their paper (Parker and Röller, 1997). Most variables have yearly frequency, although some of the prices were collected more than once per year when available.
4. Non-regulated markets are those markets where a ban on price regulation was imposed by legislative or regulatory actions. The regulatory data were courteously provided by W.B. Shew (see Shew, 1994: Table 4.2). In Table 3 we describe the regulatory variable in more detail.
5. The prices of a singular cellular operator are defined, as in Parker and Röller (1997), as the monthly bill paid for a given level of usage. Normally, cellular operators use nonlinear prices composed of a fixed fee, one usage fee for the "peak hours," as well as one for the "off-peak hours". Moreover, every operator offers different plans based on the intensity of usage (low, middle, or high usage). The prices reported represent monthly bills calculated for different monthly usage times (5, 500, 3000 minutes) assuming that consumers chose the least expensive plan.
6. This fact could suggest that in those markets collusive behavior was more probable. Indeed, Parker and Röller (1997) have shown that multimarket contacts and cross-ownership were among the most important determinants of the industry's collusive conduct. See also Busse (2000) who, using the data by Parker and Röller, found that multimarket contacts raised prices by approximately 7-10%.
7. We would have expected to observe higher values for ELECT in the regulated markets sub-sample, under the presumption that elected regulators should be more pro-consumer (see Besley and Coate, 2000) and therefore should regulate more often.
8. Grossman and Helpman (1994) develops a formal microfounded model of lobbying for trade protection, where the governemnt maximize such a welfare function. See also Spiller (1990) for a model of the political economy of regulation in a multiprincipal setting.
9. One can think more formally of the problem in the following way: regulate if $\frac{p_{ts}^0 - p_{ts}^1}{p_{ts}^0} > r_{ts}$. On the right hand side is the difference between non-regulated (p_{ts}^0) and regulated (p_{ts}^1) prices, while on the left hand side is the maximal price difference accepted by the regulator. This level r_{ts} can be made dependent on variables which should determine regulator's willingness to regulate.
10. The price differences can be considered as a measure for lobbying's benefits: the differences are smaller the less effective is regulation.
11. In the empirical literature on lobbying, the role of campaign contributions has been stressed as a possible mechanism which allows pressure groups to achieve their desired policy outcome (see Potters and Sloof (1996) for an excellent survey of the empirical literature on interest groups). In order to point out the potential relevance of this kind of mechanism, we can mention that "Telephone Utilities" were, in the 2000 election, among the most important campaign contributors, with a total amount of contributions equal to $ 21,898,265 (source: The Center for Responsive Politics).
12. Note that, for the sake of identification, we drop the BELLIND dummy because there is a constant term in our equation. BELLIND represents thus our reference market structure. For the same reason, we eliminate one firm dummy (CENTEL), as well.
13. The terms ρ_i $(i = 0, 1)$ represent the correlation coefficient between error terms u_{its} $(i = 0, 1)$ and ϵ_{st}. Note that $\mathrm{Cov}(u_{its}, \epsilon_{ts}) = \rho_i \sigma_i \sigma_\epsilon = \rho_i \sigma_i$ because $\sigma_\epsilon = 1$. Note also that the correlation between the error terms of the two price equations (ρ_{10}) is not estimable, since each observation comes from one regime. For references see Maddala (1987).

14. This is not surprising. The sample period corresponds to the U.S. cellular telecommunications' earliest development phase. During that period, most of the customers were business people who probably more extensively used cellular services. Firms' pricing behavior, thus, is likely to have followed different paths in the different market segments.
15. The most of firms' specific dummies are strongly significant in all specifications (PACTEL, BELLSTH, AMERTECH, SWBELL, and MCCAW); USWEST, REST, GTE, and CONTEL are significant only in some, while only NY NEX is not significant at all.
16. We compute the statistic $W = \left(\hat{\beta}^0 - \hat{\beta}^1\right)' \left[\mathrm{Var}\left(\hat{\beta}^0\right) + \mathrm{Var}\left(\hat{\beta}^1\right)\right]^{-1} \left(\hat{\beta}^0 - \hat{\beta}^1\right)$ which is distributed as a chi-squared with J degrees of freedom, where J represents the number of restrictions that we are testing.
17. This might partially be due to the heterogeneity of the regulatory schemes that we encompass under the label "regulated markets".
18. We calculate $E[p^1_{ts} | R_{ts} = 0] = \widehat{\beta}^{1\prime} x^0_{ts} + \widehat{\rho}_1 \widehat{\sigma}_1 \left[-\phi\left(\widehat{\alpha}' z_{ts}\right) / \left(1 - \Phi\left(\widehat{\alpha}' z_{ts}\right)\right)\right]$.
19. We could not exploit the panel component of our data set since the dependent variable, the regulatory dummy, did not vary along the time dimension for the sample period. The probit regression is thus run on a cross section.
20. We use the following variables: $\log \frac{pi^0_{ts}}{pi^1_{ts}} * \mathrm{DEM84}$, $\log \frac{pi^0_{ts}}{pi^1_{ts}} * \mathrm{GOVSTAB}$, $\log \frac{pi^0_{ts}}{pi^1_{ts}} * \mathrm{ELECT}$, $\log \frac{pi^0_{ts}}{pi^1_{ts}} * \mathrm{STAFF84}$, $\log \frac{pi^0_{ts}}{pi^1_{ts}} * \Delta\mathrm{STAFF}$ where $i = 1, 2, 3$.
21. This view is also expressed in Posner (1970) where Democratic amministrations are assumed to be "pro-consumer" while Republican ones to be "pro-business".
22. The positive sign of the ELECT variable is in line with Besley's and Coate's (2000) argument that elected regulators should be more pro-consumer. The fact that this variable is not strongly significant is also in line with the empirical findings by Teske (1991a) and (1991b) as well as Donald and Sappington (1995) and (1997).
23. USWEST and SWBELL are not significant in the second specification, while only USWEST is not significant in the last one.

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