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discussion papers

FS IV 00 - 05

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April 2000

ISSN Nr. 0722 - 6748

Forschungsschwerpunkt Marktprozeß und Unternehmensentwicklung

Research Area Market Processes and Corporate Development

Zitierweise/Citation:

Tomaso Duso, **Who Decides to Regulate? Lobbying Activity in the U.S. Cellular Industry,** Discussion Paper FS IV 00-05, Wissenschaftszentrum Berlin, 2000.

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ABSTRACT

Who Decides to Regulate? Lobbying Activity in the U.S. Cellular Industry

by Tomaso Duso*

How does the choice to regulate a market take place? And how does regulation influence market outcome? We argue that to explicitly model the *simultaneity* between these two issues makes a qualitative difference in the analysis of the role of regulation, and empirically test our model in the U.S. mobile telecommunications industry. We find support for our approach: Regulatory choice should be considered endogenous. We show that, correcting for the simultaneity, regulation's overall effect should have been a reduction of cellular tariffs. However, this result is not highly significant. Our explanation for this finding is that firms' lobbying activity on regulatory choice has been successful: some firms were able to avoid regulation in those market where it would have significantly reduced prices. We argue that this is the real source of the found simultaneity. Moreover, we provide evidence that the probability of regulation was higher, other things equal, when the regulator was appointed by politicians, when the State's Governor came from the democratic party, and when the government was politically stable.

Keywords: Price Regulation, Lobbying Activity, Mobile Telecommunications, Simultaneity Bias, Endogenous Switching Regression, U.S.

JEL classification: C34, C35, D43, L13, L43, L96

* I have benefitted from indepth discussions with Lars-Hendrik Röller. I also thank Paul Heidhues, Johan Lagerlöf, Rainer Nitsche, Ralph Siebert, Frank Verboven, and seminar participants at the Humboldt University Berlin, at the WZB, and at the YEC 2000 in Oxford for their useful comments. Remaining errors are my sole responsibility.

ZUSAMMENFASSUNG

Wer entscheidet zu regulieren? *Lobbying*-Aktivität in der U.S.-amerikanischen Mobilfunk-Industrie

In diesem Beitrag wird explizit berücksichtigt und modelliert, daß die Unternehmen durch ihr Marktverhalten die Regulierungsentscheidung der Aufsichtsbehörde beeinflussen können. Anhand von U.S.-amerikanischen Daten für die Mobilfunk-Industrie (1984-1988) kann die Hypothese, daß die Regulierungsentscheidung endogen durch das Verhalten der Unternehmen am Markt mitbestimmt wird, nicht verworfen werden. Bei Berücksichtigung dieser Simultaneität können wir im Gegensatz zur vorherigen Analysen zeigen, daß die Regulierung die Mobilfunktarife durchschnittlich gesenkt hat. Jedoch ist dieses Ergebnis nur von geringer statistischer Signifikanz. Dieses Phänomen läßt sich durch die Theorie des Lobbying erklären. Bewirkt Regulierung große Preissenkungen, so haben die Unternehmen einen großen Anreiz durch Lobbying eine Regulierung der Mobilfunktarife abzuwehren; mit der Wirkung, daß seltener reguliert wird. Sind die Wirkungen der Regulierung hingegen gering, so sind auch die Lobbying-Anreize klein, und Regulierung wird häufiger beobachtet. Die empirische Analyse zeigt, daß das Lobbying mancher Unternehmen erfolgreich war so, daß gerade solche Märkte nicht reguliert wurden, in den die Regulierung am effektivsten gewesen wäre. Außerdem zeigt sich, daß die Regulierungswahrscheinlichkeit eines Marktes – *ceteris paribus* - steigt, wenn die Regulierungsbehörde von Politikern einberufen wird, wenn der Gouverneur des Bundestaats der demokratischen Partei angehört und wenn die Regierung politisch stabil ist.

1 Introduction

How does the choice to regulate a market take place? And how does regulation influence market outcome? We believe that the analysis of these issues is qualitatively different, if one takes their *simultaneity* into account, since firms may influence the regulatory regime under which they operate. The approach adopted in this paper is a first step in this direction. We will propose a simple simultaneous model for firms pricing behavior and regulatory choice, which encompasses both economic and political factors. The study has different aims. First we want to make a methodological point and prove our conjecture that to analyze the impact of regulation on prices, regulatory choice must be considered endogenous rather then exogenous as previous studies assumed (Shew [1994], Ruiz [1995], Hausman [1995], and Parker and Röller [1997]). Second we want to determine the impact of price regulation on cellular tariffs, taking into account the simultaneity issue. Finally, we want to explain what are the main determinants of regulatory choice, considering some important issues such as the firms' lobbying activity as well as other political factors.

Because of its particular structure, the U.S. cellular telephone industry provides a unique environment to analyze the aforementioned issues. In the early 80's, as this industry began its rapid expansion, many economists and policy makers were somehow skeptical of the benefits of conventional public utility regulation. The regulatory policy towards mobile service then followed a quite unique pattern.[1] The first decision was to split entry and price regulation. Regulatory jurisdiction was assigned to different regulatory agencies: The federal government (Federal Communication Commission, FCC) kept the right to regulate entry through its authority to assign radio spectrum to cellular services providers. The concern according entry policy was with the natural monopoly aspects, which this industry could present. Despite the fact that the magnitude of economies of scale could have been substantial, the final decision of the commission in 1981 was to allow entry of two cellular service providers in each area.[2] The first ("wireline") license was typically awarded to a regional Bell operating company (the RBOC), which was oper-

[1] Shew [1994] provides very rich overview of the US. Cellular Telephone Industry and of its development.

[2] The FCC divided the country into nonoverlapping markets corresponding to the 306 Standard Metropolitan and 428 Rural Statistical Areas (SMSAs and SRSAs respectively). In this paper we will concentrate only on the former.

ating in the same area, and the second ("non-wireline" license) was assigned mainly to independent companies. On the other side, price regulation was left to the individual States, because of the service's local nature. Due to the general skepticism towards traditional public utility regulation, or because of firms' successful lobbying activity, in only a few States have cellular tariffs been strictly regulated, whereas in others only loosely regulated, and in most they have not been regulated at all. Some States even adopted some form of a regulatory ban, either at the legislative level or at the Public Utility Commission's (PUC) level. As some authors already noted, this particular regulatory environment provides an exceptional "natural experiment" for a study on the role of regulation on prices as well as of the determinants of regulatory choice. First, one can rule out any entry strategy, given that the entry process is common knowledge and firms in the market are not subjected to the threat of new entry. Second, one can observe many markets where a homogenous product is traded with similar demand and cost characteristics, but where firms are subjected to different regulatory regimes.

Some papers already exist that have analyzed the impact of regulation on the price level in the US cellular industry. They generally tested whether *exogenous* regulatory variables have a significant impact on prices using a reduced form approach.[3] The results they obtained are contradictory. Ruiz [1995] found that the regulatory variables did not significantly explain prices, and concluded that the analysis did not allow any policy suggestions. Shew [1994] and Hausman [1995] observed that the regulatory variables were (partially) significant and that the sign of the coefficient was positive. This fact would suggest that prices should have risen from regulation. The main explanation for this finding 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.[4] This information dispersion could have made it easier for firms to recognize if someone had chiseled, making collusion easier to substain. A further analysis of regulation's effect is presented by Parker and Röller [1997]. They made use of a full specified structural model in order to estimate whether the duopolis-

[3] Simil r n lyses were performed for the wireline telecommunic tions industry s well. See mong others M thios nd Rogers [1989], K estner nd K hn [1989], T rdiff nd T ylor [1993], Bl nk, K serm n nd M yo [1995], nd lso Kriedel, S ppington nd Weism n [1996] for survey.

[4] This kind of expl n tion c n be found in previous works on collusion nd price w rs in superg me fr mework. See Porter [1983 , 1983b].

tic industry structure led to a competitive outcome. Compared to previous works they did not test the impact of exogenous regulation on prices, but rather the impact of exogenous regulation on conduct. The main findings are that substantial collusion was present in the U.S. cellular industry and that regulation played a role in explaining this result.

This kind of approach may be affected -and indeed we will show that it is- by a mis-specification problem.[5] If regulated firms have some control over the regulatory regime under which they operate, then considering regulatory variables as exogenous may introduce problems of selectivity bias.[6] One should therefore try to endogenize regulatory choice. 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 some political and economic factors, which should underlie regulatory policy, as explanatory variables. The regulatory policy in the wireline US telecommunications industry has been empirically analyzed, first in a static and then in a dynamic setting, by Donald and Sappington [1995, 1997]. They found evidence that both the political as well as the regulatory history were the main drivers of the chosen regulatory regime in the different States. Teske [1991], instead, used a rent-seeking argument to answer more clearly the question how firms develop specific political strategies to achieve the desired regulatory environment in the wireline US telecommunications market. In particular he showed that US West, one of the "Baby Bells," seemed to have adopted the strategy of avoiding regulators, and aggressively influenced legislators in order to achieve the desired deregulation of the markets in which it operated. Yet, all these studies neglect the importance of firms' strategic behavior in influencing the regulatory game.

The purpose of our paper is to bridge between these two different empirical approaches, accounting for the simultaneity between firms pricing behavior and regulatory decisions. This is not merely a question of proposing a more complex tool in order to enrich the analysis, but rather it is an important qualitative step into the modelling of the political economy of regulation as well as of its impact on market outcome. The environment in which firms operate is not exogenous to them: Firms not only interact with each other in the product market, but they also interact with other subjects, such as the state regulatory decision making, to determine the "world" in which they

[5] See M thios nd Rogers [1989], Don ld nd S ppington [1995, 1997], nd B ron [1995]
[6] Heckm n [1976, 1979] is the typic l reference for the concept of selectivity bi s.

operate. The econometric tool that is appropriate to achieve this goal is a endogenous switching regression model (Maddala and Nelson [1975], Lee [1978, 1979]), which is a simultaneous equations model with a binary qualitative variable (regulatory status) and limited dependent variables (regulated and non-regulated tariffs). There are, thus, several issues that we want to consider in our analysis. First, we want to stress that the right way to study the impact of regulation on prices should be to consider regulatory decisions as *endogenous* rather than as exogenous: the self-selection problem. This presumption can be econometrically tested. We shall show that the correction terms we introduce in the price equation to control for the endogeneity of regulation are highly significant, supporting our presumption that this is an important issue to account for. Second, we want to analyze which impact regulation had on prices. We are then interested to know what would have been the average price in regulated markets, had these markets not been regulated. The typical answer to this question was based on the sign of the exogenous regulatory variables, but this would be incorrect if there is selectivity bias (Kenny et al. [1979]). We shall show that regulated prices are on the average lower than prices one would have expected without regulation, but this finding is not overall strongly statistically significant, particularly in the subsample of regulated markets. Thus, effective regulation does not seem to have had a strong impact on cellular tariffs. On the other hand, we also observe that regulation would have strongly significantly decreased prices, if adopted in those markets which were not regulated. This would suggest that the "wrong" markets were regulated. Our approach is particularly helpful at this point, since it allows us to understand how regulatory decisions were taken and thereby to further explain the previous finding. This is the third aim of our analysis. We observe that some firms have been effective in their lobbying activities, and have achieved a regulatory ban exactly in those markets where regulation would have had the strongest impact in reducing prices. Similar to Teske [1991], also our analysis shows that some firms were better able than others to understand the political environment in which they operated. In some States they could bypass the activity of the less favorable regulator and go directly to the legislator, who might be easier captured and who could decide about a legislative regulatory ban. In others firms could directly influence the regulator and achieve either a regulatory ban by the PUC or particularly favorable regulated tariffs. Finally, in some States firms did not accomplish their rent seeking strategy and consumers' protection seems to have mainly determined regulatory choices. Furthermore, we controlled

for political factors as well as for regulator's specific characteristics since they are suppose to play a crucial role in the regulatory game. We shall show that, ceteris paribus, States where the Governor came from the democratic party and the regulatory commission was appointed by politicians were more favorable to regulation, whereas States where a political change happened in the sample period were more favorable to a form of regulatory ban. The conclusion that we draw from our analysis is that effective regulation seems to have worked in the right direction, but that firms were able to partially avoid its effect achieving, through their lobbying activity, a regulatory ban exactly in those markets where regulation would have had the more visible impact.

The paper proceeds as follows. In Section 2 we give a short description of the market analyzing some preliminary statistics. In Section 3 we derive a theoretical framework which will be our 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 Short Description of the Market and of the Data

The regulatory environment in the U.S. cellular market is quite unique. The FCC regulated entry, allowing only two firms to operate in every market.[7] The first license (wireline license) was awarded to a regional Bell operating company beginning in 1981. The second (nonwireline license) was awarded to an independent firm. Reselling of licences was allowed, the only prohibition being that the same operator may not own both licences in one area. The process of awarding licences took several years and some of the nonwireline licences were resold by firms who won the lottery but were not really inter-

[7] This decision w s controversi l. FCC's m in concern w s th t of the n tur l monopoly n ture of the industry (this view w s lso sust ined by AT&T), which would suggest to llow only one firm oper ting in the m rket. A different ppro ch w s proposed by the Antitrust division of the Dep rtment of Justice (DOJ), which dvoc ted the w rding of higher number of licences (4 or 8). The concern w s th t, given the uncert inty bout the m gnitude of economy of sc le, there w s the risk of llowing too little entry. The m in point of the Antitrust Division of the DOJ w s th t the m rket should determine the optim l number of firms which c n oper te efficiently.

ested in operating in the cellular market. The long discussion about how the licences should be awarded and the length of time it took to allocate the licenses,[8] led to delays in the introduction of cellular services which implied high cost to the U.S. economy.[9] At the beginning of the 1990's in almost all of the SMSAs two operators were able to offer their services. Regarding the concern about market competitiveness where only two firms operate, the FCC required cellular operators to offer service at wholesale prices also to "resellers". Furthermore it imposed the prohibition of limiting the number of resellers in a market. As Shew [1994] pointed out, the positive effect of reseller competition was limited in many markets.

Even if the entry policy of the FCC raised some doubts in relation to the effective competitiveness, which could be reached in a duopoly market, and even though there were some concerns about the fact that wireline companies had some advantages given by their head-start position, many States decided against the use of price regulation (in Table 1, Column 1 one can see that non-regulated markets are more or less 50% of the sample). Some of the reasons can be found in a general skepticism against price regulation. As well the lack of information about costs was one major problem. A fact which would have made an assessment of proposed prices difficult. Moreover, many policy makers were quite sure that "two is enough for competition," even if warnings about competitiveness, which might be expected from two licences operating in the market, came from many directions. An alternative explanation, which will be the center of our analysis, is that many States adopted some form of regulatory ban, because of the lobbying activity of some firms, whose rent seeking strategy was to avoid a regulated environment. Shew [1994] and Ruiz [1995] provide detailed information about the different regulatory regimes implemented in the individual States. We refer to these papers for a deeper analysis. In our work we will not concentrate on the different forms of regulation. In this first approach we want to test if regulation, in any form, had some clear effect on firms pricing behavior compared to a non-regulation situation, and to investigate what determines the choice for a regulatory ban.[10]

[8] Gruber nd Verboven [1998] show using OECD d t th t the role th t the timing of the licences pl yed in expl ining diffusion of cellul r services is signific nt: st tes which first gr nted licences seem to h ve f irly long persistent le d.

[9] The cost w s estim ted to be bout 86 billion doll rs (Rohlfs, J ckson, nd Kelly [1991]).

[10] It is worth noting th t different regul tory regimes m y h ve different effects on pricing

Our data come from different sources and cover the time spanning December 1984 to July 1988.[11] The original data set contains information about service prices, output quantities, input factor prices, demand variables, and industry structure variables. The sample contains information about 122 SMSAs. For our purpose we enlarged the original data set to encompass information about the political and regulatory environment using data from the Statistical Abstract of the United States, and information from the states' regulatory commissions. Table 1 presents the summary statistics for the relevant variables. 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.[12] In the Appendix we provide a short description of the variables.

[Insert here Table 1]

We can observe that prices in regulated markets are, on the average, slightly higher than in non-regulated markets.[13] 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.[14] We don't have firm specific measures of cost, but we can relay on market specific data. One can not observe large differences among regulated and non-regulated markets, even though in the former most

beh vior. In this p per we will not consider this issue, even though l ter we will briefly discuss this point.

[11]We owe p rticul r th nk to L.H. Röller nd P. P rker for providing us with the m in d t set. A description of the sources s well n n lysis of the d t c n be found in their p per (P rker nd Röller [1997]).

[12]Non-regul ted m rkets re those m rkets where b n on price regul tion w s imposed by legisl tive or regul tory commission ction. The regul tory d t were courtesely provided by W.B. Shew (see Shew [1994] T ble 4.2).

[13]The prices of singul r cellul r oper tor re defined, s in P rker nd Röller, s the monthly bill p id for given level of us ge. Norm lly, cellul r oper tors use nonline r prices composed by fixed fee, us ge fee for the "pe k hours", nd us ge fee for the "off-pe k hours". Moreover, every oper tor offers different pl ns rel ted to the intensity of us ge (high, ver ge, or low us ge). The prices reported represent the monthly bill c lcul ted for different monthy us ge times (5, 500, 3000 minutes) ssuming th t consumers chose the le st expensive pl n.

[14]Given the high st nd rd devi tion, ll price differences re not st tistic lly signific nt.

cost drivers take slightly higher values. Only ENERGY and PRIME are on the average higher in non-regulated markets.

Significant differences can instead be observed with regard to the variable POP. In regulated markets population is on the average much higher (40%) than in non-regulated ones. Also CROSSOWN and MULTIMKT take significantly different values in the two subsamples. In particular both variables assume higher values in non-regulated markets; a fact which could suggest that in those markets collusive behavior was more probable.[15] ENTRY happened slightly more often in regulated markets. We do not observe differences in the number of cellular antennas (N. of CELLS). As Parker and Röller [1997] stressed, the number of cellular antenna sites can be seen as a good proxy for industry output.[16] Finally, as we expected, the State's Governor was more often from the republican party (REP) in non-regulated markets, supporting the hypothesis that republicans are more oriented towards a liberalized industry, whereas in regulated markets the Governors were principally from the democratic party (DEM). Instead, we observe more appointed regulators (APPOINT) in regulated markets than elected ones (ELECT).[17]

Concluding, we do not observe strongly significant differences among regulated and non-regulated markets, but we still want to analyze why some markets were regulated and what kind of effects did regulation have.

3 A Theoretical Framework

In this Section we present a theoretical background on which we will base our empirical analysis, and from which we will try to derive some hypotheses to test. It will not be a structural but rather a reduced form model. Despite the fact that this approach has the advantage of being more general, it lacks a rigorous micro foundation.

[15] P rker nd Röller [1997], in f ct, h ve shown th t multim rket cont cts nd crossownership were mong the most import nt determin nts of the industry's collusive conduct.

[16] They report simple Pe rson correl tion of .9237 (p-*value* $<$ .0001) between cell sites nd subscribers t the firm level, nd of .9251 (p-*value* $<$. 0001) t the m rket level.

[17] We would h ve expected to observe higher v lues for ELECT in the regul ted m rket subs mple, under the presumption th t elected regul tors should be more pro-consumers (see Besley nd Co te [2000]) nd therefore should regul te more. However, s stressed by Gormley [1981], consumer movements -which should prefer regul tion whenever it decre ses prices- seem to be more ctive in st te with ppointed regul tors.

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. Market s will be regulated if:

$$\frac{p_{ts}^{NR} - p_{ts}^{R}}{p_{ts}^{NR}} > \rho_{ts},$$

where p_{ts}^{NR} and p_{ts}^{R} are respectively the non-regulated and the regulated price, and ρ_{ts} is a maximal price difference that the regulator would accept. The level of ρ_{ts} should depend on some measures of regulator's specific preferences and on the political environment in which the regulatory agency operates.[18] As a first order approximation we can assume that:

$$\rho_{ts} = \delta_1 RSC_{ts} + \delta_2 PV_{ts} + error\ term_{ts},$$

where RSC is a vector of characteristics specific to the regulator and PV is a vector of political variables.[19] Thus we observe regulation if:

$$\frac{p_{ts}^{NR} - p_{ts}^{R}}{p_{ts}^{NR}} > \delta_1 RSC_{ts} + \delta_2 PV_{ts} + error\ term_{ts}. \tag{1}$$

We can rewrite equation (1), which constitutes the criterion that determines the regulatory choice, in the form of a probit model. We observe a regulated market ($R_{ts} = 1$) if and only if $R_{ts}^{*} > 0$ and a non-regulated market otherwise, where:[20]

$$R_{ts}^{*} = \alpha_1 \left[\log\left(p_{ts}^{NR}\right) - \log\left(p_{ts}^{R}\right)\right] + \alpha_2 RSC_{ts} + \alpha_3 PV_{ts} + \epsilon_{ts}. \tag{2}$$

Now we are able to postulate one general hypothesis, which we want to test in our empirical analysis. If we would assume a benevolent regulator,

[18] Ide lly the cost of regul tion should lso be t ken into ccount. Unfortun lly it is not n e sy t sk to find good proxy for it.

[19] The only me sures for regul tor specific ch r cteristics we could use is whether the regul tor w s ppointed by the St te's Governor, or directly elected. B sley nd Co te [2000] gives theoretic l r tion le for the import nce of this issue.

[20] In the empiric l n lysis we will m ke use of three different price me sures, in order to c pture different str tegies th t firms might h ve dopted in the different m rket segments. Accordingly, we will construct three differences between non-regul ted nd regul ted prices th t we will use simult neously s regressor in the probit n lysis.

who cares mainly for consumers surplus, then we would expect to observe a significant and positive value for the coefficient α_1: regulation is more probable when the benefits that it implies in terms of lower prices are larger. This assumption would be in line with a model, which assumes that the regulator takes its choice in order to maximize a weighted sum of consumer and producer surplus.[21] On the other hand, one can also assume that the regulator

will use an approach similar to Kaestner and Kahn [1990] and to Ruiz [1994]. Ruiz developed a supergame framework to determine firms' pricing strategies. He has shown that the monopoly price can be part of a tacitly collusive equilibrium outcome for certain conditions on the discount factor.[23] The cellular price in market s at time t should be such that:

$$p_{ts} = MC_{ts} \cdot \mu_{ts}, \tag{3}$$

where MC_{ts} is the marginal cost and μ_{ts} is the mark-up at time t in market s. We can linearize the previous expression taking logarithms of both sides:

$$\log(p_{ts}) = \log(MC_{ts}) + \log(\mu_{ts}). \tag{4}$$

Since we can not observe marginal costs and mark-up, we need to model them through an equation. We assume that the marginal cost function takes the following form:

$$\log(MC_{ts}) = a_o + a_1 CD_{ts} + a_2 firm\_i_{ts} + error\ term_{ts}, \tag{5}$$

where CD is a vector of cost drivers, and $firm\_i$ are firms' specific dummies, which should capture the possible heterogeneity in firms' technology. We assume that the mark-up depends on the level of demand (Q) and on vector of market structure variables (MSV) such as multimarket contacts, crossownership, and competitive pressure as generated by the second firm entering the market. We also insert some dummies which account for the status of the wireline/non-wireline pair ($Pair\_j_{ts}$), which should capture the argument that some firms' pairs achieve collusive agreements easier than others. We have then:

$$\log(\mu_{ts}) = b_o + b_1 Q_{ts} + b_2 MSV_{ts} + b_3 Pair\_j_{ts} + error\ term_{ts}. \tag{6}$$

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

$$Q_{ts} = c_o + c_1 \log p_{ts} + c_2 DD_{ts} + error\ term_{ts}. \tag{7}$$

where DD are demand drivers. Substituting equations (5), (6), and (7) in equation (4) we obtain a reduced form price equation as follows:

[23] Kaestner and Kahn [1990], instead, made use of conjectural variations argument to come to the same kind of specification.

$$\log p_{ts} = \beta_0 + \beta_1 CD_{ts} + \beta_2 DD_{ts} + \beta_3 MSV_{ts} + \beta_4 firm\_i_{ts} + \beta_5 Pair\_j_{ts} + u_{ts}, \tag{8}$$

where u_{ts} is an error term. We also expect that regulation might have an impact on firms' pricing behavior, since different 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 should account 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 control over the regulatory regimes under which they operate.[24] Or, said in another way, there can be simultaneity between the regulatory regime's choice and firms' pricing behavior. We take this issue into account in our empirical analysis, estimating a model of endogenous switching (Maddala and Nelson [1975], Lee [1978]). This is a simultaneous equations model with a binary qualitative variable for the regulatory status and limited (censored) dependent variables: the prices. The empirical implementation of the theoretical framework analyzed in the previous Section implies thus the specification of equation (2), and of two price equations like (8), one for each of the two subsamples:

$$\log p_{ts}^{R} = \beta_{0R} + \beta_{1R} X_{ts}^{R} + u_{1ts} \tag{9}$$

$$\log p_{ts}^{NR} = \beta_{0NR} + \beta_{1NR} X_{ts}^{NR} + u_{2ts} \tag{10}$$

$$R_{ts}^{*} = \alpha_1 \left(\log p_{ts}^{NR} - \log p_{ts}^{R} \right) + \alpha_2 Z_{ts} + \epsilon_{ts} \tag{11}$$

$$R_{ts} = 1 \qquad \text{if } R_{ts}^{*} > 0$$

[24] See Donald and Sappington [1995, 1997] and Kridel, Sappington, and Weisman [1996].

$$R_{ts} = 0 \qquad \text{if } R^*_{ts} \leq 0$$

$$Cov\left(u_{1ts}, u_{2ts}, \epsilon_{ts}\right) = \begin{bmatrix} \sigma^2_{11} & \rho_{12}\sigma_{11}\sigma_{22} & \rho_{1\epsilon}\sigma_{11} \\ & \sigma^2_{22} & \rho_{2\epsilon}\sigma_{22} \\ & & 1 \end{bmatrix}. \tag{12}$$

Where X^r_{ts}, $r = R, NR$, contains cost drivers (OPERATE, ENERGY, WAGE, RENT, and PRIME) demand drivers (POP and BUSINESS), and a time trend (T) to control for market growth. Furthermore we insert some variables to control for market structure: 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 (CROSSOWN and MULTIMKT), a variable controlling for the monopolist's lead over the second entrant (LEAD), firm specific dummies for the major carriers, and some dummy variables to control for market structure (BELLBELL, INDBELL, and INDIND).[25] The vector Z_{ts} contains regulator specific variables (ELECT and APPOINT), as well as political variables (GOVCHANGE and DEM). As already mentioned we assume that the independent variables' coefficients in (9) and (10) 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 normal distributed, with a variance-covariance matrix given by (12).[26]

If one thinks that the selectivity bias problem is not relevant, i.e. that there is no correlation between error terms in the price equations and in the selection equation, then one can consistently estimate the previous model

[25] According to P rker nd Röller [1997] e ch of these dummy v ri bles (see the Appendix for definition) "signifies the st tus of the wireline-nonwireline p ir". Note th t we don't insert the dummy BELLIND bec use there is const nt term in our equ tion. BELLIND represents thus our reference m rket structure. As well, we elimin te one firm dummy (CENTEL).

[26] The terms $\rho_{i\varepsilon}$ $(i = 1, 2)$ represent the correl tion cofficient between error terms u_{its} $(i = 1, 2)$ nd ϵ_{st}. Note th t $Cov\left(u_{its}, \epsilon_{ts}\right) = \sigma_{i\epsilon} = \rho_{i\epsilon}\sigma_{ii}\sigma_{\epsilon} = \rho_{i\epsilon}\sigma_{ii}$ bec use $\sigma_{\epsilon} = 1$. Note lso th t the correl tion between the error terms of the two price equ tions (ρ_{12}) is not estim ble since e ch observ tion comes form one regime. For references see M dd l [1987].

with simple techniques. The two price equations are then separately estimated by OLS, while the equation that explains the choice of price regulation can be estimated by probit. But as Heckman [1976] and others already stressed, if the errors' terms in (9) and (10) are correlated with the error term in (11), then OLS estimates are inconsistent. We can briefly summarize the typical approach. In the selected sample of regulated markets we know that:

$$\begin{aligned} E\left[\log p_{ts}\left|x_{ts}, in\ sample\right.\right] &= E\left[\log p_{ts}\left|x_{ts},\ R_{ts}=1\right.\right] \\ &= \beta_R' x_{Rts} + E\left[u_{1ts}\left|\epsilon_{ts} > -\alpha' z_{ts}\right.\right] \\ &= \beta_R' x_{Rts} + \rho_{1\epsilon}\sigma_{11}\left[\phi\left(\alpha' z_{ts}\right)/\Phi\left(\alpha' z_{ts}\right)\right] \\ &= \beta_R' x_{Rts} + \gamma_R \lambda_{1ts} \end{aligned} \tag{13}$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are respectively the density and the cumulative function of a normal distribution. For the second price equation the same argument in equation (13) applies, though the selectivity term will be different, since we consider the second subsample ($R_{ts}=0$). Following Lee [1978] we can construct a selectivity bias term for the price equation related to non-regulated markets as follows: $\rho_{2\epsilon}\sigma_{22}\left[-\phi\left(\alpha' z_{ts}\right)/\left(1-\Phi\left(\alpha' z_{ts}\right)\right)\right] = \gamma_{NR}\lambda_{2ts}$. The selectivity bias problem arise from the fact that estimating (9) and (10) by OLS one obtains inconsistent coefficient estimates, because $E\left[u_{its}\left|\epsilon_{ts} > -\alpha' z_{ts}\right.\right] \neq 0$ $(i=1,2)$. To overcome this problem, one can use the endogenous switching regression model (Maddala and Nelson [1975]).[27] This can be consistently estimated in two different fashions: either using a two step estimator (Lee [1978]) or using a full information maximum likelihood estimator (Kenny, Lee, Maddala, and Trost [1979]).[28] We will use the latter, since it guarantees efficient estimates.

The estimation procedure is as follows. Equation (11) should account for the separation criterium 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 (9) and (10) in (11). Once we get consistent estimates of the α's, we can

[27] See also Lee [1978, 1979], Kenny, Lee, Maddala, and Trost [1980], and Maddala [1987] among others.

[28] Both these estimators present some problems. The two step is inefficient, while the FIML is efficient but ignores the fact that the probit parameters are estimated twice, differently. See Limdep 7.0 Manual page 668. Note also that the FIML estimators allow us to estimate both σ_{ii} and $\rho_{i\epsilon}$ $(i=1,2)$ in (13), while the two step estimators allows us only to determine the coefficients γ_R and γ_{NR}.

compute $\hat{\lambda}_{1ts} = \phi(\hat{\alpha}' z_{ts}) / \Phi(\hat{\alpha}' z_{ts})$ and $\hat{\lambda}_{2ts} = -\phi(\hat{\alpha}' z_{ts}) / (1 - \Phi(\hat{\alpha}' z_{ts}))$, using the estimated parameters' values instead of the real ones. Then we can consistently estimate the β's by simultaneously estimating (11), (9) and (10) by FIML after inserting the selectivity bias term as a control in the pricing schedules. The last step consists of estimating the structural probit where we insert the estimated prices instead of the real values.

The typical test of selectivity bias is to analyze whether the coefficients of λ_{its} $(i = 1, 2)$ 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, since they represent the covariance between the error terms of the price equations and of the separation criterion. As Maddala [1987] has pointed out, "[...] we ought to observe $\sigma_{2\epsilon} - \sigma_{1\epsilon} > 0$, but the two covariances can have any sign. It is also important to estimate the mean values of the dependent variable for the alternative choices." In our model this would mean estimating the price in regulated markets had they not been regulated and vice versa. In this way we can determine regulation's effects on prices.

To summarize, the questions we want to address with our empirical analysis are the following: (i)Is there selectivity bias? (ii) Do the explanatory variables in different regimes have different effects on the dependent variable? (iii) Does regulation imply higher or lower prices? (iv) Which markets are regulated? (v) Why is a market regulated?

5 Results and Interpretation

In this Section we report our main results. First we replicate previous analyses by running simple OLS regressions of the reduced form price equation on the full sample using exogenous regulation dummies, and on the two subsamples of regulated and non-regulated markets. Then we asses the selection problem and the simultaneity problem estimating the endogenous switching regression model discussed in the previous Section. To enrich our analysis, and to observe whether regulation had different effects on different cellular tariffs, we will propose different specifications in which we use as dependent variable the three measures of prices which are available to us.

5.1 The Simple OLS Estimates

In order to obtain some first results to compare with previous analyses, we run a simple OLS regression of the reduced form price equation. These preliminary results are also useful in order to obtain a starting point for understanding the role of selection bias. In Table 2.1 we adopt a specification which makes use of an exogenous regulatory dummy among the independent variables. We analyze three cases corresponding to the three different dependent variables: the logarithm of the price for low, middle, and high usage time. The main finding is that only the low usage price is significantly and positively dependent on the regulatory dummy. In this case we observe a result similar to Shew [1994] and Hausman [1995]: regulation seems to have increased cellular prices. On the other side this result does not hold for the other two price measures (middle and high usage time). In those cases in fact, the regulatory dummy is not significant, which is more in line with Ruiz's [1995] findings.

Many of the other independent variables are significant in the three specifications, however one can note some differences in their effects on the different cellular tariffs. The cost drivers are generally positive, as expected, except ENERGY which is significant and negative in all specifications. In the second and third specifications POP presents a positive and significant coefficient estimate, while in the first the coefficient estimate is not significant, although positive. The cost of cellular service should be higher when population is greater because of economies of scale in supplying cellular services. In the case of high usage tariffs one observes a significant and negative coefficient for BUSINESS. This variable is not significant in the second specification and it is positive and significant in the third. The time trend (T) is negative and strongly significant in all specifications as expected: the market growth generated downward pressure on prices.[29] This effect was stronger for low usage time tariffs.

[Insert here Table 2.1]

The most unexpected results are those related to the market structure variables. Only in the first specification are the coefficients of CROSSOWN

[29] This is bec use one should expect dem nd to exp nd nd to become more price el stic with time.

and MULTIMKT significant. Furthermore, the former of the two variables present the negative sign, which was not expected. The other two price measures don't seem to be significantly influenced by multimarket contacts and by crossownership. Also the competitive pressure generated by the entrant firm (ENTRY) does not seem to have had a strong impact, especially on middle and high usage time prices. Instead, it had a significant effect in reducing low usage tariffs as expected.[30] The dummies relative to the wireline-nonwireline pairs and the firms specific dummies are partially significant, but present different signs and significance levels in the different specifications. Again the main differences can be observed in relation to the first specification, whereas the second and third show more similar results. Finally, firm specific dummies are in all specifications highly significant.

It is also interesting to run the OLS regression on the two subsamples of regulated and non-regulated markets to investigate whether coefficient estimates are equal for the two subgroups (Table 2.2).[31] The coefficients' size and significance differ strongly in the two subsamples: many variables are significant only in one specification and some variables have even the opposite sign.[32]

[Insert here Table 2.2]

In particular one can observe that cost and demand drivers are significant mainly in the regulated markets' subsample, while in non-regulated markets firm specific effects are the main price determinants.[33] One possible explanation for this result is that these are the variables on which a benevolent regulator should have based regulated tariff, since they should explain

[30] This f ct c n suggests th t this m rket segment w s more competitive the others, lso given the neg tive, signific nt nd l rger coefficient estim tes for the time trend (T). It m y then be th t regul tion wouldn't h ve been necess ry in this segment, but r ther th t it h d neg tive imp ct on the degree of competition.

[31] The dependent v ri ble is in this c se $log(p2)$. We report only this result for m tter of sp ce. Anyw y, s P rker nd Röller [1997] stressed, oper tors refer to this us ge s the *typical* cellul r subscriber's us ge time.

[32] If the coefficent estim tes were re lly different in the two regimes, it would me n th t there is some inter ction between the expl n tory v ri bles nd the f ct of being in regul ted or in non-regul ted m rket.

[33] Except for GTE nd REST ll firms' dummies re signific nt t the 1% level in the non-regul ted m rkets subs mple, where s ony NYNEX is signific nt in the other subs mple.

consumer surplus. Firm specific terms, instead, played a more central role in non-regulated markets. Later we will come back to this point when we discuss the results of the endogenous switching model.

To conclude this preliminary analysis, the regularities we observed using this simple approach suggest that firms used different strategies in the different market segments as expressed by the different cellular price measures. Furthermore, the effect of regulation on prices is not clear: on the one side the regulatory dummy is significant only in one specification, on the other side we observe that in the two subsamples of regulated and non-regulated markets independent variables had strongly different effects on cellular prices, suggesting that regulation did influence firms' strategic behavior. Our more sophisticated approach should help us to derive clearer results.

5.2 The Endogenous Switching Model

In this section we analyze the results of the full information ML estimation of the switching regression model presented in Section 4. We first present the result concerning the two pricing relations. Table 3.1 reports the coefficient estimates for the reduced form price equation in the subsample of regulated markets and presents three different specifications depending on the adopted price measure. Table 3.2 reports the results relative to the non-regulated markets.

[Insert here Table 3.1]

Before analyzing in detail the coefficient estimates for the other dependent variables, we want to observe the role of selectivity bias in both subsamples, since this is one of the main points of our analysis. With respect to the simple OLS regression, we have one more regressor which has to account for the self selection. Its coefficient is given by the product between $\rho_{i\epsilon}$ and σ_{ii}, $i = 1, 2$. In the regulated markets' subsample both $\rho_{1\epsilon}$ and σ_{11} are strongly statistically significant. Also in non-regulated markets the coefficient of the selectivity bias correction are highly significant. Both $\rho_{2\epsilon}$ and σ_{22} are strongly statistically significant in the first specification, while only the variance σ_{22} is significant in the second and third ones. The strong significance of these terms in both subsamples and in all specifications is the first compelling result of our analysis: regulatory choice has to be considered endogenous.

The price estimate we would obtain without correcting for selectivity bias would in fact be inconsistent and biased.

[Insert here Table 3.2]

Now we turn to a more detailed description of the regression results relative to firms' pricing behavior. We start with the regulated markets' subsample (Table 3.1). The results reflect many of the findings that we observed with the simple OLS regression. First, there are evident differences in pricing behavior among low usage time tariffs on the one side and middle and high usage time tariffs on the other.[34] Second, similar to the results observed in Table 2, the only determinants of regulated prices, a part of the selectivity bias term, are some demand and costs drivers. Firm specific terms and market structure variables are not significant at all in the second and third specification: regulated prices are not set by firms rather by the regulator.

Also in the non-regulated markets' subsample we observe strong differences among the first specification on the one hand and the second and third on the other. In this case we observe that prices hardly depend on demand and costs drivers, but are very significantly dependent on firm specific effects. Not only are the firms' dummies very significant, but also the wireline/ non-wireline pairs dummies.[35] In particular it seems that markets, where an independent carrier owned the wireline license, 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 market seems instead to have increased prices. It also seems that most firms set prices more aggressively than the excluded CENTEL.

A last minor but interesting comment may be done with regard to the entry policy. Competitive pressure imposed by the second firm entering the market did not push prices downwards, at least not middle and high usage time tariffs. Thus, it might have been possible that the entry of more firms

[34] This is not surprising. The s mple period corresponds to the very e rly ph se of cellul r telecommunic tions in the US. In th t period most of the customers were business people who prob bly preferred higher us ge times. Firms' pricing beh vior, thus, is likely to h ve followed different p ths in the different m rket segments.

[35] The most of firms' specific dummies re signific nt (BELLSTH, AMERTECH, US WEST, SWBELL, nd MCCAW); only NY NEX, GTE, CONTEL nd REST re not signific nt. REST cont ins lso PACTEL.

could have had a more visible impact on reducing prices. This would suggest that the proposal of the DOJ's Antitrust Division for a less restrictive entry regulation could have led to a more competitive industry structure than under the achieved duopolisitc competition.

Before moving to the direct analysis of the effect that price regulation had on tariffs, we want to statistically test whether coefficient estimates differ among the two subsamples using a Wald test.[36] We strongly 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, since they interact with 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 price. Our OLS regressions partially confirmed this result, at least for low usage fees. To asses more directly the regulation's impact on price, we can ask which would have been the price in regulated markets, had these markets not been regulated. We must then determine $E[\log p_{ts}^{NR} | R_{ts} = 1]$. Observe that:

$$\begin{aligned} E[\log p_{ts}^{NR} | R_{ts} = 1] &= E[\log p_{ts}^{NR} | R_{ts}^{*} > 0] \\ &= \beta_{NR}' x_{Rts} + E[u_{2ts} | \epsilon_{ts} > -\alpha' z_{ts}] \\ &= \beta_{NR}' x_{Rts} + \rho_{2\epsilon}\sigma_{22} [\phi(\alpha' z_{ts}) / \Phi(\alpha' z_{ts})] \end{aligned}$$

We can now use the consistent estimates of β_R', β_{NR}', $\rho_{i\epsilon}$, and σ_{ii}, $i = 1, 2$, and determine the predicted prices with and without regulation for the subsample of regulated markets. Table 4.1. reports the summary statistics for the predicted prices in regulated markets ($\hat{p}^R$), in regulated markets had they not been regulated ($\hat{p}_R^{NR}$), and for the difference between the two. The predicted prices with regulation are on the average lower than the predicted prices without regulation in the second and third specification, while higher in the first. This would mean that (on the average) regulation has substantially decreased middle and high usage time prices and increased low usage tariffs. This would partially reverse the results obtained in the literature with dummy variables models. However, we can also note that the standard deviation of the difference between the two prices is very large. Hence, to reach a more

[36] We compute the statistic $W = \left(\hat{\beta}_{NR} - \hat{\beta}_R\right)' \left[Var\left(\hat{\beta}_{NR}\right) + Var\left(\hat{\beta}_R\right)\right]^{-1} \left(\hat{\beta}_{NR} - \hat{\beta}_R\right)$ which is distributed as chi-squared with J degrees of freedom, where J is the number of restrictions we are testing (in our case 27). See Green [1993].

robust conclusion, we can make use of a more precise statistical analysis and test the null hypothesis $\hat{p}^R = \hat{p}_R^{NR}$. This is a simple statistical test and we can not accept the null hypothesis at any usual confidence level for any of the used price measures.

Table 4. Predicted Prices With and Without Regulation: Regulated Markets

	Low Us ge Time	Middle Us ge Time	High Us ge Time
$\hat{p}^R$	16.5986	196.5143	1022.5531
	(10.9783)	(32.0725)	(169.0044)
$\hat{p}_R^{NR}$	15.1156	219.8076	1180.4176
	(5.7072)	(71.0541)	(421.2151)
$\hat{p}_R^{NR} - \hat{p}^R$	-1.4831	23.2934	157.8645
	(12.6154)	(69.3374)	(417.6180)

St nd rd errors in p renthesis

Predicted prices in regulated markets, had these markets not been regulated, are on the average different than regulated prices but not significantly. This finding would then mean that regulation, where it was applied, did not have very evident effects in reducing prices: in some markets it was effective, in other not. Yet, one main simplifying assumption for our approach is to consider regulation as a single entity. This need not be the case. As we already mentioned regulatory plans vary widely in the different States. Furthermore, it is also not clear to what extent the regime, which is "formally" chosen, is also implemented, especially due to problems such as asymmetric information about firms' costs. That is to say that there is much heterogeneity in regulatory decisions, which is not encompassed in our approach and which could be an important element to explain the observed result that effective regulation did not have a strong impact on prices.[37]

[37] A possible extension of our model, which would t ke this issue into ccount, could be to use nested logit ppro ch to expl in regul tory choice inste d of the simple probit n lysis s we did. This would llow us to consider th t, once the regul tor h s chosen to regul te, it must lso choose which kind of regul tion to pply. In this w y we would be ble to ccount for the different regul tory choices th t the uthority h s to t ke.

We can also do the same exercise for non-regulated markets and ask what would have been the price had they been regulated ($\hat{p}^R_{NR}$).[38] In Table 5 we report our results. Predicted prices in non-regulated markets, had regulation occurred, would have been lower than predicted prices without regulation in the second (-6.10%) and third specification (-10.67%) but much higher in the first (+49.94%). Again the standard deviation of the difference between the two prices is large. We can again perform a simple test of the null hypothesis $\hat{p}^R_{NR} = \hat{p}^{NR}$.

Table 5. Predicted Prices with and without Regulation: Non-Regulated Markets

	Low Us ge Time	Middle Us ge Time	High Us ge Time
$\hat{p}^{NR}$	11.9414	208.7726	1126.0728
	(4.5836)	(32.6688)	(191.1669)
$\hat{p}^R_{NR}$	17.5177	196.0327	1005.9487
	(8.5838)	(31.7634)	(171.3675)
$\hat{p}^R_{NR} - \hat{p}^{NR}$	5.5763	-12.7398*	-120.1241*
	(5.3633)	(8.2788)	(76.0111)

St nd rd errors in p renthesis

* represents signific nce t the 10% level

In this case we can accept the null hypothesis at the 10% confidence level for middle and high usage tariffs, but not for low usage ones.[39] This means that regulation would have significantly decreased prices for those customers who made extensive use of cellular services in non-regulated markets. The second line of Figure 1 represents the sample distribution for the price difference in the non-regulated markets' subsample. The positive effects, which

[38] We c lcul te $E[p^R_{ts} | R_{ts} = 0] = \beta'_R X_{NRts} + \sigma_{1\epsilon}\sigma_{11}\left[-\phi\left(\alpha' z_{ts}\right) / \left(1 - \Phi\left(\alpha' z_{ts}\right)\right)\right]$.

[39] At this point, note the import nce of the selection bi s. From our simple OLS regression we would h ve concluded th t regul tion h s *significantly* incre sed low us ge t riffs, while it did not h ve ny signific nt imp ct on the other two price me sures. With our more complex ppro ch, inste d, we obt in evidence th t regul tion would h ve significantly (even though only p rti lly) decre sed middle nd high us ge t riffs, while the positive imp ct on low us ge prices is not observed to be signific nt.

regulation would have had, are clear to see. There is no observation above the zero line: in all markets prices would have fallen.[40]

Summarizing, we observed that regulation was not very effective in reducing cellular tariffs in regulated markets, and it even had negative effects on some price measures as previous analyses observed. On the other hand it seems that cellular tariffs would have significantly fallen if regulation would have been adopted in non-regulated markets: were the "wrong" markets regulated?

Table 6. Structural Probit: The Probability of Regulation

Variables	**Coeff.**		**St.Er.**
$\log p1_{ts}^{NR} - \log p1_{ts}^{R}$	0.143	**	0.70E-01
$\log p2_{ts}^{NR} - \log p2_{ts}^{R}$	4.624	***	1.058
$\log p3_{ts}^{NR} - \log p3_{ts}^{R}$	-4.796	***	0.927
DEM	1.391	***	0.205
GOVCHANGE	-1.392	***	0.279
ELECT	0.24E-01		0.161
APPOINT	0.467	***	0.139
Log likelihood	-326.052		
Chi squ red	93.2469		
Obs.	538		
Correct Predictions	60.59%		

*** represents signific nce t the 1% level

To answer this question we perform the structural probit analysis, where we insert as a regressor the difference between predicted prices without and with regulation, as we derived in the previous Section. Also, since we think that the three prices can represent firms' strategies in different market segments, we use the three derived differences simultaneously as regressors in the probit equation. As we already noted, the coefficient of the difference between the prices should help us to distinguish between two effects: firms

[40]The opposite c n be observed for low us ge prices. However in this c se the distribution is much more fl ttened ne r to zero (Skewness' me sure= -1.4799 nd Kurtosis' me sure= 6.3462), which should expl in the re son for the rejection of the null hypothesis.

lobbying activity, which would imply a negative coefficient; and consumers' protection, which would instead imply a positive coefficient. This is true only if regulation decreased prices. In the previous Section we observed that regulation seems to have decreased middle and high usage tariffs, while increasing low usage tariffs. Therefore a coefficient with a poitive sign for the first difference could also be interpreted as a sign that lobbying activity was successful, since firms achieved to be regulated in markets where regulation would have increased tariffs.[41]

The results we obtain are helpful to clarify the previous findings. Both consumers' protection and firms' lobbying activity seems to have played a role on the choice of regulatory regime, since the first and second price difference present a positive sign, while the third presents a negative one. This would suggest that firms concentrated their rent seeking strategies in those markets were regulation would have hurt more, i.e. those markets where most of the customers were long-time cellular services users.[42] From the previous results, in fact, we know that regulation would have strongly and significantly decreased exactly those prices. Moreover, it is worth noting that the sample period we are considering corresponds to the very early phase of the US cellular industry. In that period the main market segment was constituted by business customers, who probably made extensive use of cellular services. One can not say much concerning the magnitude of the coefficients' estimates, which are evaluated at the overall means of the data set. This is because the probit model is a non linear model, and the magnitude of the effect of exogenous variables on the dependent variable varies with the values of the exogenous variables.[43]

Turning to the other explanatory variables we can observe that they are all highly significant. If the State Governor in the second half of the sample period came from the democratic party, the probability to observe price regulation was higher. This result was somehow expected, given that the

[41] Unfortun tely our ppro ch does not llow us to fully distinguish mong the different regul tory decisions, nd consequently firms' lobbying str tegies. One should in f ct model both choices th t the regul tory commission must t ke: whether to regul te, nd the decision bout price levels.

[42] This finding is lso consistent with the f ct th t the regul tor might h ve concentr ted its ction in those m rkets where fin l consumers - nd not intermedi te customers such s business people- were more import nt. This is suggested by the positive sign of the second difference.

[43] As pointed out by Aldrich nd Nelson [1984] "The sign of the coefficient determines the direction of the effect nd the effect tends to be l rger, the l rger is the coefficient."

democratic party is supposed to pursue a more consumers-oriented policy. On the other side the probability of regulation was lower in States, which experienced a political change during the sample period. This fact might reflect the idea that States in which political changes occurred were more open to a more innovative regulatory policy, such as full price liberalization. Finally, we observe that appointed regulators increased the probability of regulation, if compared to an elected ones. Given the theoretical and empirical findings by Besley and Coate [2000], we would have expected the opposite result, since elected regulators are supposed to be more pro-consumer, and therefore should more often adopt regulation, given that it seems to reduce prices.[44] On the other side, Donald and Sappington [1997] and Teske [1991] did not find any evidence of the fact that elected regulators had an influence on regulatory decisions.

This version of our model generates correct predictions for the probability of regulation in 60.59% of the analyzed cases.

[Insert here Table 7]

Before concluding we also tested whether lobbying intensity was different across firms. To do this we made the coefficient of the price difference dependent on firms' specific dummies (Table 7). We can observe that lobbying intensity was different across firms: SOUTHBELL, GTE, CENTEL and minor firms seem to have been more successful in their rent seeking strategy.[45] Controlling for the effect of individual firms dramatically increases the fit of our model: it generates correct predictions for the probability of regulation in 96.65% of the analyzed cases, that makes us quite confident about its correctness.

[44] One should however t ke into ccount th t Besley nd Co le n lysis is of the "exogenous dummies type". This ppro ch, s we h ve shown, might be ffected by selectivity problem, if the choice to elect or to ppoint regul tor is endogenous. Furthermore, in their s mple they observe th t the number of elected regul tors is higher in St tes with democr tic government. Where s in our s mple (which is much sm ller) we observe the contr ry. It could then be th t their results re bi sed by the f ct th t they did not control for politic l effects.

[45] Note th t lso PACBELL is now considered mong "minor" firms.

6 Conclusions

This paper tried to bridge two different approaches of the empirical literature on regulation, and empirically analyze the simultaneity between the price regulation's choice and firms' pricing behavior. We used data from the U.S. mobile telecommunications industry since it shows a very particular regulatory environment. The industry under consideration is quite homogenous for product characteristics, firms' technology and demand, but at the same time it is heterogenous for the kind of price regulation, which was adopted. Some States adopted strict price regulation, some loose price regulation, and others even banned price regulation. The study had different aims. First we wanted to prove the endogeneity of regulation. Second we wanted to determine the impact of price regulation on cellular tariffs, taking the simultaneity issue into account. Finally, we wanted to explain what are the main determinants of regulatory choice. The econometric method we adopted consists of the estimation of a endogenous switching regression model (Maddala and Nelson [1975], Lee [1978]), which fits the questions we wanted to address, as well as the information contained in our data set. To enrich the analysis we consider three measures for cellular prices, corresponding to different usage times, which allows us to take into account different firms' strategies in the different demand segments.

We have shown that the selectivity bias problem, i.e. the endogeneity of regulation, is an important issue to account for. Simple OLS estimations of the reduced form price equation, which use exogenous dummy variables to explain the role of regulation, would then lead to inconsistent and biased estimates. Controlling for the selectivity bias, we have shown that prices in regulated markets were on the 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: regulation seems therefore not to have been very effective. On the other hand, however, we observed that prices in non-regulated markets would have significantly fallen if regulation would have been adopted. It seems thus that the wrong markets were regulated. In order to explain this unexpected result we also modeled the regulatory choice, making use of a probit analysis. The equation that we used allowed us to encompass different approaches to regulation, and enable us to analyze whether firms' lobbying activity or consumer protection were the main determinants of the regulatory choice, after controlling for other important factors such as the political environment and regulator specific

characteristics. We provided some robust evidence that, because of firms' lobbying activity, the "wrong" markets were regulated, i.e. those markets where regulation would have significantly decreased prices. Furthermore we can qualify our result. Firms' lobbying activities seem to have been more concentrated in those markets where business customers played a relevant role, since their regulation would have more severely hurt firms. Also, the intensity of the lobbying activities seems to have been different among firms: some firms better understood the environment in which they operated. Finally, we have shown that also regulator's characteristics as well as political variables have very high explanatory power for the regulatory choice. Appointed regulators, ceteris paribus, enhanced the probability of regulation more than elected ones. Furthermore, States where the Governor came from the democratic party and whose government was politically stable in the sample period were more favorable to some kinds of price regulation.

We can then conclude that our new approach, which allows a more careful and complete analysis of the studied issues, leads to new results in comparison to those already observed in both streams of the considered literature. We do provide some evidence that price regulation, per se, would have worked in the right direction, decreasing cellular tariffs. Effective regulation, though, did not have a strong impact, because of the ability of firms to avoid it in those markets where it would have been more effective. We were thus able to shed new light on the political economy of regulation.

Some major caveat applies to our analysis. First, even though our data set is quite rich, there are still some important facts that have not been considered in the analysis for lack of data. For instance, we do not have any information about the costs of regulation or about 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 kinds of price regulation were actually adopted, and that they could have had very different impacts on prices. In particular, this consideration might help to understand more clearly which kinds of regulatory scheme did not work. Regarding this issue we already mentioned one possible extension of our approach in the previous Section. 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 about many other issues, which are likely to have an influence on the choice of whether to regulate or not. These issues could be therefore simultaneously studied in a more general model of regulation, but in this case

new data would be probably necessary. 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, the interaction among regulatory commissions, legislators, and interest groups should be more deeply considered. Hence the results we reported do not have to be considered definitive, even if we believe that they are a first important step into a deeper understanding of the choice of regulation and of the effects of regulation on firms pricing behavior.

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Appendix: Variables Definition

Variables	Definition	Vector	Source
p_1, p_2, p_3	Monthly bill c lcul ted for different monthly us ge times (5, 500, 3000 minutes)		Parker-Röller [1997]
ENERGY	Aver ge monthly cost per squ re foot	CD	
PRIME (lagged)	One period l gged prime lending r te		
RENT	Aver ge monthly rent per squ re foot of office sp ce		
WAGE	Aver ge weekly s l ry per employee for the cellul r industry		
OPERATE	Aver ge monthly gener l overhe d nd oper ting expenses per squ re foot		
POP	M rket Popul tion in millions	DD	
BUSINESS	Number of high potenti l business est blishments (divided by 100)		
T	Time trend in months		
ENTRY	Dummy=1 when the second c rrier enters into the m rket	MSV	
CROSSOWN	Dummy=1 when the two competitors in one m rket re p rtner in ny other m rket		
MULTIMKT	Tot l number of m rkets where the two competitors f ce e ch other		
LEAD	Length of the monopoly period in months		
N.of CELLS	Tot l number of cells in given network		
BELLBELL	Dummy=1 if both wireline nd nonwireline competitors re RBOCs	$Pair\_j$	
BELLIND	Dummy=1 if the wireline is BELL nd the non-wireline is n independent c rrier		
INDBELL	Dummy=1 if wireline is n independent c rrier nd the non-wireline is BELL		
INDIND	Dummy=1 if both wireline nd nonwireline competitors re n independent firm		
Firm Dummies	Uswest, Bellsth, Amertech, Nynex, Swbell, Gte, Contel, Mcc w, Centel, Rest	$Firms\_i$	
REG	Dummy=1 if in the m rket no regul tory b n w s imposed		Shew [1994]
DEM	Dummy=1 if the St te's Governor in 1986 w s from the democr tic p rty	PV	US Statistical abstract
GOVCHANGE	V ri ble=1 if in both elections in the s mple period the Governor c me from the democr tic p rty, 0 if he c me from the republic n p rty, 0.5 if there w s politic l ch nge		
ELECT	Dummy=1 if the regul tor w s elected	RSC	The Book of The States
APPOINT	Dummy=1 if the regul tor w s ppointed by politici ns		Besley-Coate [2000]

Tables

Table1. Summary Statistic

Variables	Full sample		Sub-sample Regulation		Sub-sample No Regulation	
	Mean	**Std.Dev.**	**Mean**	**Std.Dev.**	**Mean**	**Std.Dev.**
p_1	16.286	12.693	16.865	11.918	15.689	13.440
p_2	196.266	39.4953	198.220	39.932		

Table 2.1. OLS Estimates - Regulation Dummies

	Low Usage ($\log p_1$)			Middle Usage ($\log p_2$)			High Usage ($\log p_3$)		
Variables	**Coeff.**		**St.Er.**	**Coeff.**		**St.Er.**	**Coeff.**		**St.Er.**
CONSTANT	3.319	***	0.457	5.123	***	0.150	6.810	***	0.173
OPERATE	0.98E-01	***	0.24E-01	0.50E-02		0.79E-02	0.42E-02		0.91E-02
ENERGY	-0.1349	**	0.64E-01	-0.41E-01	*	0.21E-01	-0.41E-01	**	0.24E-01
WAGE	0.40E-03	**	0.19E-03	-0.54E-05		0.54E-04	0.11E-04		0.62E-04
RENT	-0.76E-02		0.80E-02	0.12E-01	***	0.26E-02	0.13E-01	***	0.30E-02
PRIME (l gged)	-0.121	***	0.33E-01	0.13E-01		0.11E-01	0.20E-01		0.12E-01
POP	0.147		0.124	0.175	***	0.41E-01	0.165	***	0.47E-01
BUSINESS	0.14E-03	**	0.64E-04	-0.20E-05		0.21E-04	-0.74E-04	***	0.24E-04
T	-0.11E-01	***	0.32E-02	-0.46E-02	***	0.10E-02	-0.36E-02	***	0.12E-02
CROSSOWN	-0.168	**	0.85E-01	-0.32E-01		0.28E-01	-0.44E-01		0.32E-01
MULTIMKT	0.61E-01	***	0.17E-01	0.14E-02		0.54E-02	-0.25E-02		0.63E-02
LEAD	0.19E-02		0.36E-02	0.24E-02	**	0.12E-02	0.11E-02		0.14E-02
ENTRY	-0.469	***	0.89E-01	0.22E-01		0.29E-01	0.56E-01	*	0.33E-01
BELLBELL	-0.565	***	0.153	0.300	***	0.50E-01	0.339	***	0.57E-01
INDBELL	-0.915	***	0.1521	-0.38E-01		0.50E-01	-0.228	***	0.57E-01
INDIND	0.76E-01		0.151	-0.118	**	0.49E-01	-0.195	***	0.57E-01
Firm dummies		***			***			***	
REG	0.107	***	0.50E-01	0.95E-02		0.16E-01	13E-01		0.19E-01
Adj. R^2	0.5670			0.4313			0.493		

***,**,* represent signific nce t the 1%, 5%, 10% levels respectively

Table 2.2. OLS Estimates: Different Samples
Dependent Variable log($p2$)

	Subsample Regulation			Subsample No Regulation		
	Coeff.		**Std.Err.**	**Coeff.**		**Std.Err.**
CONSTANT	5.191	***	0.253	4.629	***	0.208
OPERATE	0.22E-01	*	0.12E-01	-0.78E-02		0.11E-01
ENERGY	-0.83E-01	**	0.33E-01	0.23E-01		0.37E-01
WAGE	-0.37E-03	**	0.15E-03	0.65E-04		0.53E-04
RENT	0.86E-02	***	0.33E-02	0.28E-02		0.37E-02
PRIME (l gged)	0.30E-02		0.14E-01	0.63E-01	***	0.14E-01
POP	0.137	***	0.47E-01	0.246	**	0.96E-01
BUSINESS	0.11E-03	***	0.30E-04	0.20E-04		0.31E-04
T	-0.61E-02	***	0.14E-02	0.19E-02		0.14E-02
CROSSOWN	-0.56E-01		0.53E-01	0.43E-02		0.32E-01
MULTIMKT	-0.15E-01		0.98E-02	0.48E-02		0.61E-02
LEAD	0.44E-02	***	0.19E-02	0.90E-03		0.16E-02
ENTRY	0.16E-01		0.39E-01	0.20E-01		0.38E-01
BELLBELL	0.168		0.116	0.478	***	0.59E-01
INDBELL	-0.16E-02		0.77E-01	-0.141	**	0.66E-01
INDIND	-0.66E-01		0.111	-0.210	***	0.65E-01
Firm dummies		*			***	
Adj. R^2	0.5127			0.6554		
Obs.	278			270		

***,**,* represent signific nce t the 1%, 5%, 10% levels respectively

Table 3.1 FIML Estimates: Price Equation
Regulated Markets

	Low Us ge			Middle Us ge			High Us ge		
	Coeff.		St.Err.	Coeff.		St.Err.	Coeff.		St.Err.
CONSTANT	2.664	***	0.760	5.132	***	0.421	6.719	***	0.440
OPERATE	0.41E-01		0.41E-01	0.21E-01		0.22E-01	0.22E-01		0.22E-01
ENERGY	-0.118		0.143	-0.86E-01	*	0.53E-01	-0.98E-01	*	0.54E-01
WAGE	-0.42E-03		0.56E-03	-0.39E-03	**	0.17E-03	-0.29E-03	*	0.18E-03
RENT	0.14E-01		0.13E-01	0.93E-02		0.62E-02	0.13E-01	**	0.61E-02
PRIME (l gged)	-0.94E-02		0.54E-01	0.71E-02		0.22E-01	0.14E-01		0.23E-01
POP	0.359	**	0.179	0.134	*	0.78E-01	0.72E-01		0.85E-01
BUSINESS	0.70E-05		0.12E-03	0.11E-03	***	0.38E-04	0.30E-04		0.36E-04
T	0.42E-02		0.48E-02	-0.58E-02	***	0.21E-02	-0.44E-02	*	0.23E-02
CROSSOWN	-0.168		0.237	-0.49E-01		0.72E-01	0.52E-01		0.97E-01
MULTIMKT	0.35E-01		0.37E-01	-0.15E-01		0.17E-01	-0.28E-01		0.20E-01
LEAD	-0.83E-03		0.79E-02	0.45E-02	*	0.27E-02	0.28E-02		0.28E-02
ENTRY	-0.219		0.156	0.23E-01		0.67E-01	0.43E-01		0.77E-01
BELLBELL	-0.320		0.589	0.147		0.154	0.99E-01		0.156
INDBELL	-1.614	***	0.271	-0.29E-02		0.120	-0.168		0.145
INDIND	-0.323		0.345	-0.59E-01		0.136	-0.32E-01		0.130
Firms dummies		**							
σ_{11}	0.396	***	0.43E-01	0.149	***	0.112E-01	0.216	***	0.13E-01
$\rho_{1\epsilon}$	0.391		0.435	-0.825	***	0.676E-01	-0.943	***	0.33E-01
Adj. R^2	0.8071			0.5149			0.5438		

***,**,* represent signific nce t the 1%, 5%, 10% levels respectively

Table 3.2 FIML Estimates: Price Equation
Non-Regulated Markets

	Low Us ge			Middle Us ge			High Us ge		
	Coeff.		St.Err.	Coeff.		St.Err.	Coeff.		St.Err.
CONSTANT	3.760	***	0.853	4.679	***	0.301	6.354	***	0.425
OPERATE	-0.50E-01		0.53E-01	-0.20E-01		0.17E-01	-0.80E-02		0.29E-01
ENERGY	-0.229		0.160	0.50E-01		0.55E-01	0.72E-01		0.77E-01
WAGE	-0.12E-03		0.25E-03	0.10E-03		0.13E-03	0.74E-04		0.21E-03
RENT	-0.76E-02		0.16E-01	0.24E-02		0.61E-02	-0.15E-02		0.87E-02
PRIME (l gged)	-0.38E-02		0.56E-01	0.62E-01	***	0.18E-01	0.60E-01	***	0.26E-01
POP	0.278		0.35	0.219		0.151	0.171		0.195
BUSINESS	0.66E-04		0.18E-03	0.53E-04		0.49E-04	0.59E-04		0.73E-04
T	-0.40E-02		0.60E-02	0.31E-02		0.17E-02	0.41E-02	*	0.25E-02
CROSSOWN	-0.22E-01		0.151	-0.77E-02		0.46E-01	-0.83E-01		0.69E-01
MULTIMKT	0.65E-01	**	0.32E-01	0.14E-01		0.88E-02	0.21E-01		0.14E-01
LEAD	0.48E-03		0.68E-02	-0.37E-03		0.21E-02	-0.66E-03		0.35E-02
ENTRY	-0.426	***	0.132	0.20E-01		0.48E-01	0.88E-01		0.68E-01
BELLBELL	-0.64E-01		0.220	0.385	***	0.93E-01	0.298	**	0.125
INDBELL	-0.239		0.545	-0.141	*	0.85E-01	-0.389	***	0.142
INDIND	-0.136		0.262	-0.224	***	0.79E-01	-0.372	**	0.146
Firms dummies					***			***	
σ_{22}	0.495	***	0.30E-01	0.150	***	0.12E-01	0.152	***	0.15E-01
$\rho_{2\epsilon}$	0.928	***	0.49E-01	0.146		0.663	0.225		0.673
Adj. R^2	0.4899			0.6576			0.6620		

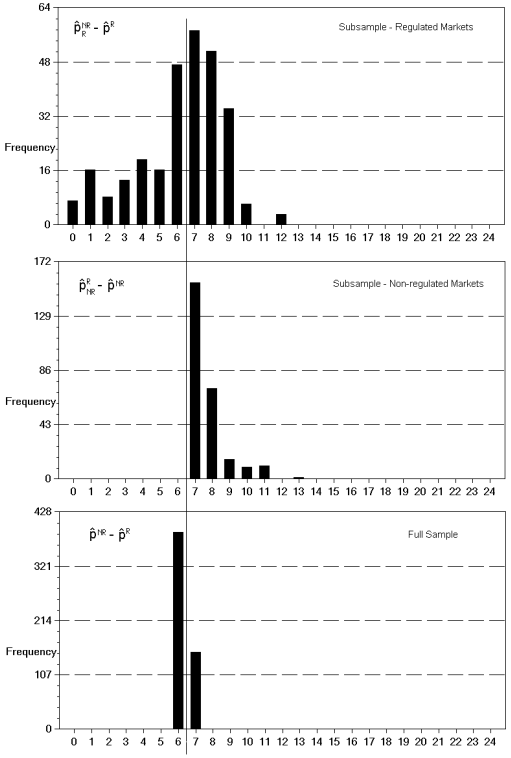
***,**,* represent signific nce t the 1%, 5%, 10% levels respectively

Table 7. Structural Probit: Firms Lobbying Intensity

	$\log p1_{ts}^{NR} - \log p1_{ts}^{R}$			$\log p2_{ts}^{NR} - \log p2_{ts}^{R}$			$\log p3_{ts}^{NR} - \log p3_{ts}^{R}$		
	Coeff.		**St.Err.**	**Coeff.**		**St.Err.**	**Coeff.**		**St.Err.**
USWEST	19.99		79.75	1352.36		4596.68	-938.10		3362.82
BELLSTH	7.56	***	2.32	35.81		22.96	-30.46	***	16.40
AMERTECH	165.52		468356.01	205.92		2835124.0	-161.50		1403292.2
NYNEX				323.53		3815116.6	-239.36		3569575.6
SWBELL	-22.41		242662.41	303.02		3095096.7	-492.30		2075926.0
GTE	2.21	**	1.10	-34.55	***	15.06	31.24	**	10.08
CONTEL	1.92		1.39	3.23		5.72	-9.63		8.41
MCCAW	-20.30		458493.33	1288.83		2174560.5	-1218.19		1497249.3
CENTEL	9.23	**	4.37	14.75	**	6.39	-16.02	**	7.60
REST	-1.35	***	0.35	2.15		4.90	-14.42	***	4.61
Log likelhihood				-46.72363					
Chi squ red				651.9032					
Correct Predictions				96.65%					

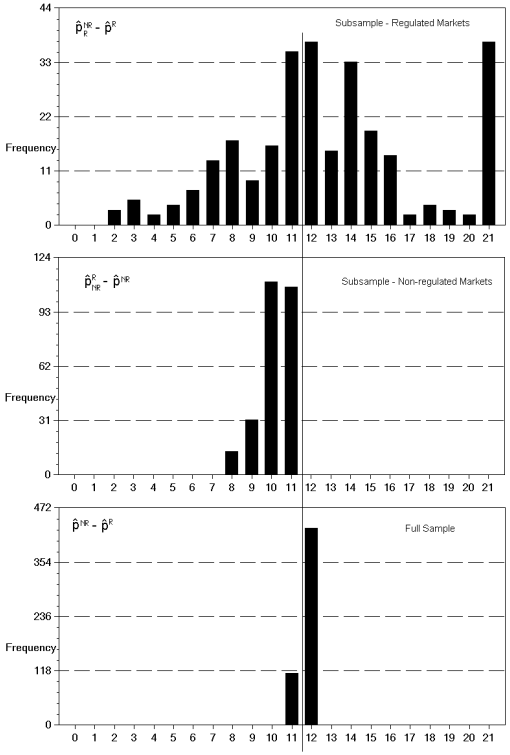
*** nd ** represent signific nce t the 1%, nd 5% levels respectively

Figure 1. Sample Distribution of the Difference Between Non-regulated and Regulated Prices



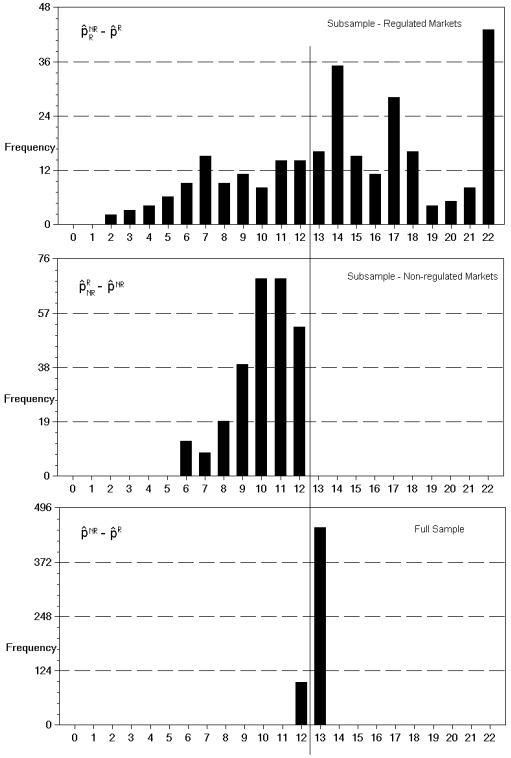
Class Size 5$ (ex. 6: [-5$,0$], 7: [0$,5$])

Low Usage Time



Class Size 10$ (ex. 11: [-10$,0$], 12: [0$,10$])

Middle Usage Time



Class size 50 $ (ex. 12: [-50$, 0$], 13:[0$,50$])

High Usage Time