Mandatory Unbundling, UNE-P, and the Cost of Equity: Does TELRIC Pricing Increase Risk for Incumbent Local Exchange Carriers?

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Introduction

The Telecommunications Act of 1996 sought to advance competition in the market for local exchange service by promoting facilities-based investment.[1] In implementing the new legislation, the Federal Communications Commission ("FCC") stressed the importance of preserving the investment incentives of both the incumbent local exchange carriers ("ILECs") and the competitive local exchange carriers ("CLECs").[2] However, economic research has explained that forcing an

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1 *See, e.g.*, Implementation of the Local Competition Provisions of the Telecommunications Act of 1996, Third Report and Order, 15 F.C.C.R. 3696 ¶ 219 (1999) [hereinafter UNE Remand Order] ("Goals of the Act. . . . [O]ur decision to unbundle [certain local network elements] is consistent with the 1996 Act's goals of rapid introduction of competition and the promotion of *facilities-based* entry.") (emphasis added).

2 *Id*. at ¶ 14 ("Specifically, unbundling rules that are based on a preference for development of facilities-based competition in the long run will provide incentives for both incumbents and competitors to invest and innovate, and should allow the Commission to reduce regulation once true facilities-based competition develops.").

ILEC to share its network with a competitor at total long-run incremental cost ("TELRIC") will deter it from investing in its network. Thomas M. Jorde, J. Gregory Sidak, and David J. Teece explained in the *Yale Journal on Regulation* that mandatory unbundling harms ILEC investment because it increases the ILEC's cost of equity.[3]

In particular, CLECs are more likely to lease unbundled network elements ("UNEs") when demand for telecommunications services is weak, because low prices for those services cannot support the high sunk costs of facilities-based investment in the short-term.[4] Alternatively, when demand for telecommunications services is strong, higher prices for those services will afford a CLEC additional revenue to build out its network.[5] Because TELRIC prices are not compensatory in economic terms, ILEC returns will suffer in times of recession and improve during an expansion.[6] When the return on an asset becomes more volatile relative to the market, an investor demands a higher premium on that stock because it has made the return on the investor's portfolio less certain.[7] Should an ILEC's systematic risk (commonly known as beta risk) increase in times of recession, its cost of equity would rise. Hence, the ILEC's ability to invest in its network would diminish.[8]

Recent stock market events seem to confirm the Jorde-Sidak-Teece hypothesis. On Monday, January 6, 2003, a front-page story in the *Wall Street Journal* speculated that the FCC would revise its rules on mandatory

3 Thomas M. Jorde, J. Gregory Sidak & David J. Teece, *Innovation, Investment, and Unbundling*, 17 YALE J. ON REG. 1, 19 (2000).

4 *Id.* at 19.

5 *Id.* at 19-20.

6 *Id.* at 19. For further discussion of why TELRIC pricing is not compensatory, see Jerry A. Hausman & J. Gregory Sidak, *A Consumer-Welfare Approach to the Mandatory Unbundling of Telecommunications Networks*, 109 YALE L.J. 417 (1999); Jerry A. Hausman, *Valuing the Effect of Regulation on New Services in Telecommunications*, 1997 BROOKINGS PAPERS ON ECON. ACTIVITY: MICROECONOMICS 1; J. Gregory Sidak & Daniel F. Spulber, *The Tragedy of the Telecommons: Government Pricing of Unbundled Network Elements Under the Telecommunications Act of 1996*, 97 COLUM. L. REV. 1081 (1997).

7 *See, e.g.*, MARK GRINBLATT & SHERIDAN TITMAN, FINANCIAL MARKETS AND CORPORATE STRATEGY 158 (1998).

8 One could reasonably argue that the demand for ILEC services would also fall during an economic slowdown. Thus, the ILECs' costs of capital would rise during a recession, which would render the Jorde-Sidak-Teece hypothesis more difficult to test. However, as we explain below, empirical evidence shows that, on the whole, the ILECs' betas were constant during the recession that spanned from July 1990 to March 1991. Consequently, any increase in the ILECs' betas during the current recession can be attributed to mandatory unbundling at TELRIC prices.

One could also argue that, because TELRIC is not compensatory, ILECs will be subjected to increased risk from mandatory unbundling in both expansions and recessions. In particular, certain CLECs would take advantage of an arbitrage opportunity regardless of a recession. Although such a phenomenon would make it more difficult to test the validity of the Jorde-Sidak-Teece hypothesis, it would not invalidate that hypothesis or make it inconsequential. Certain CLECs build their own networks or build portions of their own networks. These CLECs would be more likely to lease from the ILECs during a recession, when economic conditions are unfavorable to facilities-based investment.

unbundling at TELRIC prices in a manner that would benefit the ILECs.[9] Specifically, the report implied that CLECs would lose the opportunity to lease all network elements as an "unbundled network element platform," better known as UNE-P. The report was significant because UNE-P had become an entry strategy for CLECs that relied on regulatory arbitrage: UNE-P is functionally equivalent to resale, yet it is more favorably priced for the CLECs than is resale. UNE-P is priced at the sum of the TELRIC estimates of each of the ILEC's network elements required to provide local access service. In contrast, resale is priced by deducting avoided retailing costs from the ILEC's retail rate for local access service. The practical effect of ending the pricing arbitrage created by UNE-P would be to force CLECs to pay resale prices or resort to an entire or partial facilities-based business model for providing local telephony. Put differently, UNE-P would not go away; it would simply be priced by arms-length negotiation between ILECs and CLECs rather than by a regulatory commission. As a result of the dramatic competitive ramifications of this regulatory development, the stock prices of the ILECs and telecommunications equipment manufacturers rose sharply.[10] However, a rigorous statistical test of the Jorde-Sidak-Teece hypothesis is necessary before a conclusion can be drawn on the effect that mandatory unbundling at TELRIC prices exerts on an incumbent's cost of equity.

A formal test of the Jorde-Sidak-Teece hypothesis would estimate the ILECs' beta parameter over the business cycle and determine whether beta had risen, fallen, or remained unchanged during the recession. The National Bureau of Economic Research ("NBER") has declared the U.S. economy in a state of recession since March 2001.[11] With stock market data from a recent recession now available, this paper seeks to perform the Jorde-Sidak-Teece test to determine whether mandatory unbundling at TELRIC prices increases the ILECs' cost of equity. Part II reviews the relevant literature on beta estimation and the estimation of structural change in beta parameters. Part III presents our econometric findings, and Part IV compares those results to the empirical research by Robert B.

9 Yochi J. Dreazen & Shawn Young, *FCC Plans To Erase a Key Rule Aiding Local Phone Competition*, WALL ST. J., Jan. 6, 2003, at A1.

10 The stock prices of BellSouth, Qwest, SBC, and Verizon each rose more than 7.8%. The stock prices of Lucent and Nortel rose more than six percent. Stock market data are available at http://finance.yahoo.com.

11 NAT'L BUREAU OF ECON. RESEARCH, NBER'S BUSINESS-CYCLE DATING PROCEDURE 1 (Feb. 12, 2003). NBER does not adhere to the common definition of a recession as two successive quarters of negative growth. Rather, it uses a series of broad economic indicators to understand the overall performance of the U.S. economy. Given those indicators, NBER had yet to determine, as of January 2003, that the economy was again expanding and that a new downturn would constitute a new recession.

Ekelund and George S. Ford,[12] whose results conflict with the Jorde-Sidak-Teece hypothesis.[13]

I. The Estimation of Beta

An ILEC's beta is the slope coefficient from the time-series regression of the ILEC's stock returns to the return on a market index.[14] One can obtain a single estimate for beta during a given time interval, or one can obtain beta estimates from different time intervals and perform an analysis that statistically compares those two estimates. We discuss these two methods below.

A. *Obtaining a Single Estimate for Beta*

Define the returns to stock i in period t as

$$R_{i,t} = (P_{i,t} - P_{i,t-1}) / P_{i,t-1}, \qquad (1)$$

where $P_{i,t}$ is the closing stock price at time t, and $P_{i,t-1}$ is the closing stock price from the prior period. Similarly, define the market returns in time period t as follows:

$$R_{M,t} = (P_{M,t} - P_{M,t-1}) / P_{M,t-1}. \qquad (2)$$

$P_{M,t}$ is the closing market value in period t, and $P_{M,t-1}$ is the market value at the close of the prior period. Firm i's beta, denoted β, is the slope parameter from the linear regression that estimates Equation 3:

$$R_{i,t} = \alpha + \beta R_{M,t} + u_t. \qquad (3)$$

The parameter α is the intercept parameter, and u_t is a disturbance term. The sample includes all observations where t is within the interval $\{1, 2, . . . , T\}$. Using econometric techniques, we seek to find an estimate of β, which we will call $\hat{\beta}$.

Obtaining an accurate estimate of beta can be difficult, because that estimate can change as T, the number of observations in the regression, changes.[15] This finding complicates the estimation in two ways. First, one can obtain systematically lower or higher estimates of beta when one uses

12 Robert B. Ekelund, Jr. & George S. Ford, *Innovation, Investment, and Unbundling: An Empirical Update*, 20 YALE J. ON REG. 383 (2003).

13 *Id.* at 386-87.

14 GRINBLATT & TITMAN, *supra* note 7, at 159.

15 *See, e.g.*, Gabriel Hawawini, *Why Beta Shifts as the Return Interval Changes,* 39 FIN. ANALYSIS J., May-June 1983, at 73.

weekly, as opposed to daily, stock returns.[16] Second, for a single type of returns data—daily returns, for example—the estimate of beta can systematically increase or decrease as more observations are added.[17] The direction of the bias depends on the number of outstanding shares of the particular firm's stock relative to the number of outstanding shares for the average firm in the market index.[18] If firm i's volume of outstanding shares exceeds that of the average firm in the market index, then adding more observations to the sample causes $\hat{\beta}$ to rise.[19] Alternatively, the inclusion of more trading days causes $\hat{\beta}$ to decrease when firm i is small relative to the average firm in the market index.[20] Therefore, one must consider the impact that the number of observations has on the regression results when estimating β within fixed time periods.[21]

Monte Carlo studies have found that increasing the number of observations improves the efficiency of the least-squares estimator for β.[22] It is therefore desirable to use daily returns (rather than weekly or monthly returns) to estimate beta. However, increasing the estimation period increases the likelihood that the structure of the firm in question has changed, causing beta to change.[23] If one were to estimate a single beta during a particular time interval when two different beta values existed, the beta estimate would be biased.[24] Consequently, one should not assume that beta has remained stationary over an entire estimation period. Furthermore, it is wise to test for structural change in beta to better gauge the proper time interval to use during the estimation.

B. *Testing for Structural Change in β*

One can use a simple F-test to determine whether beta has structurally changed within a time interval.[25] We seek to determine whether the ILECs' betas are higher during recessions than during expansions. To test for this difference, one would estimate the following:[26]

16 *Id.*
17 *Id.*
18 *Id.* at 75-76.
19 *Id.*
20 *Id.*
21 Because the firms in this study (BellSouth, Qwest, SBC, and Verizon) are large, increasing the number of observations in a regression sample could place upward bias on the beta estimates. Therefore, we perform our beta regressions with varying sample sizes to control for the effect that firm size might have on our estimates of beta.
22 *See, e.g.*, Phillip R. Daves, Michael C. Ehrhardt & Robert A. Kunkel, *Estimating Systematic Risk: The Choice of Return Interval and Estimation Period*, 13 J. FIN. STRATEGIC DECISIONS 7, 8, 12 (2000).
23 *Id.* at 8.
24 *Id.* at 8.
25 *Id.* at 11.
26 *See id.* at 11. Ekelund & Ford, *supra* note 12, at 385-86, use this method to test the

$$R_{i,t} = \alpha + \alpha_r D_r + \beta R_{M,t} + \beta_r D_r R_{M,t} + e_t \,, \tag{4}$$

where D_r is an indicator variable that equals 1 when the economy is contracting. Applying the least-squares estimator to Equation 4, one obtains the regression estimates in Equation 5.

$$R_{i,t} = \hat{\alpha} + \hat{\alpha}_r D_r + \hat{\beta} R_{M,t} + \hat{\beta}_r D_r R_{M,t} \,. \tag{5}$$

During an economic expansion, D_r equals zero, and therefore the predicted return for firm i is written as

$$R_{i,t} = \hat{\alpha} + \hat{\beta} R_{M,t} \,. \tag{6}$$

During a recession, the indicator variable D_r equals one, and the return equation then becomes

$$R_{i,t} = \hat{\alpha} + \hat{\alpha}_r + (\hat{\beta} + \hat{\beta}_r) R_{M,t} \,. \tag{7}$$

To determine whether beta is structurally different during the recession period, one could test statistically the null hypothesis that $\hat{\beta}_r = 0$. If this hypothesis were rejected, then one would conclude that beta has fundamentally changed during the recession.

II. Econometric Results

We regress daily returns for the three largest ILECs (BellSouth, SBC Communications, and Verizon) on daily returns for both the S&P 500 Index and the Dow Jones Industrial Average ("DJIA"). We use both indexes in our analysis to determine whether our results are consistent. The dataset contains daily returns between January 1996 and December 2002. Table 1 summarizes this dataset.

hypothesis that mandatory unbundling increases the ILECs' costs of equity.

Table 1. Summary Statistics for Daily Percentage Returns for the Four Largest ILECs, January 1996-December 2002

	Mean	Standard Deviation	Minimum	Maximum
BellSouth	0.040	2.281	-18.105	10.757
SBC	0.031	2.196	-12.659	11.266
Verizon	0.042	2.126	-11.834	12.271
DJIA	0.036	1.233	-7.183	6.349
S&P 500 Index	0.029	1.269	-6.866	5.733

Note: Data were downloaded from http://finance.yahoo.com. Prices for the trading days of August 15, 2002 and September 16, 2002 were not available.

NBER declared that the U.S. economy has been in recession since March 2001.[27] Therefore, an appropriate test of the Jorde-Sidak-Teece hypothesis is to compare β before March 2001 to an estimate of β during the recession.[28] We use two different time periods for the regression. The first period spans trading days between May 1, 1999 and December 31, 2002, so that the sample contains exactly twenty-two months of expansionary data and twenty-two months of recessionary data. Comparing an equal number of trading days under both the expansion and the recession allows us to mitigate any potential beta bias that firm size could place on the beta estimates. The second sample in our analysis contains returns from trading days between March 1, 1998 and December 31, 2002, such that three years of expansion data are included in this dataset. We include these regressions in our analysis to determine if our empirical findings are robust. Table 1 contains regression results from β estimation using daily returns between May 1, 1999 and December 31, 2002. Regression results that used the

27 NAT'L BUREAU OF ECON. RESEARCH, *supra* note 11, at 1.

28 Using March 2001 as the starting point for the recession has several advantages. First, it is practical, because economists defer to NBER's expertise in calculating critical points of the business cycle. One could argue, however, that financial markets would have anticipated the recession before March 2001. However, if financial markets began to account for the recession before March 2001, then one's ability to reject the hypothesis that the ILECs' betas were identical before and after March 2001 would diminish because the ILECs' betas would have adjusted *before* March 2001. Therefore, using March 2001 as the starting point for the recession increases the power of our test.

Also relevant to the validity of this test is the volatility of the ILECs' returns during the recession that spanned from July 1990 to March 1991. *See* NAT'L BUREAU OF ECON. RESEARCH, BUSINESS CYCLE EXPANSIONS AND CONTRACTIONS, *available at* http://www.nber.org/cycles.html/. If the ILECs' betas increased during the recession of 1990, a test of Jorde-Sidak-Teece would need to show that any increase in the ILECs' betas during the 2001 recession exceeded the increase in their betas during the 1990 recession. However, a regression of the daily return to an average index of ILECs (Bell Atlantic, BellSouth, Southwestern Bell) returns shows that their betas were constant during the 1990 recession. In particular, regressing daily returns from the ILEC Index on daily returns from the S&P 500 Index from between July 1990 and February 1994, one finds that the coefficient on R_M*D_r equals -0.003 and is not significant statistically. Using the DJIA as the market index, the regression parameter on R_M*D_r equals 0.06 and is not significant in a statistical sense.

S&P 500 Index as the market index are presented first, and estimates that used the DJIA as R_M follow.

Table 2. Regression Estimates for the ILECs' Daily Returns, May 1, 1999- December 31, 2002

	BellSouth		SBC		Verizon	
Variable	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
S&P 500 Index						
R_M	0.45	5.77	0.67	8.18	0.62	7.92
$R_M{*}D_r$	0.46	4.56	0.18	1.64	0.27	2.59
D_r	-0.03	-0.22	-0.04	-0.29	0.02	0.14
Const.	0.02	0.23	0.01	0.11	0.01	0.14
R^2	0.20		0.19		0.21	
Obs	918		918		918	
DJIA						
R_M	0.59	6.86	0.77	8.60	0.63	7.23
$R_M{*}D_r$	0.29	2.63	0.05	0.42	0.21	1.95
D_r	-0.05	-0.36	-0.06	-0.40	0.00	0.02
Const.	0.02	0.19	0.01	0.06	0.01	0.08
R^2	0.19		0.19		0.19	
Obs	918		918		918	

Note: The S&P 500 Index and DJIA beta regressions for BellSouth show evidence of heteroskedasticity at the 5 percent significance level. When we re-estimated these equations using White-Huber standard errors, we found that the coefficient on $R_M{*}D_r$ was still significant in both BellSouth equations at the 5 percent level.

In Table 2 we find that the estimated coefficients on $R_M{*}D_r$ are positive for the BellSouth, SBC, and Verizon regressions. This finding holds regardless of whether one uses the returns on the S&P 500 Index or the returns on the DJIA. Also, the coefficient on $R_M{*}D_r$ is statistically significant at the 5 percent level for BellSouth and Verizon.[29]

The β estimates in Table 2 are economically significant. Using S&P 500 Index returns, we estimated that Verizon's β was 0.62 during the expansion period, and 0.89 during the recession. Therefore, a 1 percent increase in the S&P 500 Index had an impact on Verizon's stock returns that was 0.27 percentage points greater during the recession. Put

29 In the Verizon regression using DJIA returns to proxy for market returns, the coefficient on $R_M{*}D_r$ is significant at the 5.2% level. We also performed the regressions in Table 2 with the inclusion of dividend returns to the ILECs' daily returns. The results were nearly identical to those in Table 2. For the BellSouth, SBC, and Verizon regressions that used the S&P 500 Index to proxy for market returns, the coefficients on $R_M{*}D_r$ were positive and significant statistically. The regression parameter on $R_M{*}D_r$ was also positive and significant statistically for the BellSouth and Verizon regressions that included DJIA returns as a right-hand-side variable. The coefficient on $R_M{*}D_r$ was not significant, either economically or statistically, in the Qwest regressions.

differently, the volatility in Verizon's stock price relative to the S&P 500 Index increased by 44 percent during the recession.[30] Using the DJIA to proxy for the overall market returns, we found that Verizon's β increased from 0.63 during the expansion period to 0.84 during the recession. Hence, the beta regression that uses the DJIA indicates that Verizon's stock was 33 percent more volatile during the recession.[31]

The increased volatility of the ILECs' stock during the recession increased their costs of equity. Equity cost is found by multiplying a firm's β by the market premium, and then adding the return on a risk-free asset.[32] When β increases, one determines the corresponding increase in equity cost by multiplying the change in β by the market return. Table 3 uses the results in Table 2 to determine the changes in equity cost that each ILEC experienced during the recession. To derive these figures, we used a market return of 8.9 percent for the S&P 500 Index and a market return of 8.3 percent for the DJIA, which are the annual returns on those indices since the late 1940s.[33]

30 (0.27/0.62)*100 = 44%.

31 Beta regressions for Qwest Communications, a company with ILEC operations, may be of additional interest. For the Qwest regressions, the coefficient on $R_M * D_r$ is insignificant in both statistical and economic respects. In particular, we cannot reject the null hypothesis that $\hat{\beta}_r = 0$ for Qwest. Also, the estimates of β_r that we obtained for Qwest (-0.01 when using either the S&P 500 Index or the DJIA) are very close to zero. Therefore, we find no evidence that Qwest's beta changed during the recession. Qwest, however, has business operations other than local exchange service provision. For example, Qwest provides long-distance service outside its local exchange areas. *See* QWEST COMMUNICATIONS INT'L INC., 2001 SEC FORM 10-K, at 7 (2002). In addition to providing long-distance service, Qwest also owns an Internet backbone network and provides substantial Internet services as part of its business operations. *See id.* at 2-4. Therefore, the difference between Qwest's business operations and those of BellSouth, SBC, and Verizon during the sample period provides one cogent explanation why the regression results for Qwest deviate from those of the other ILECs.

A comparison of the expansionary betas of Qwest, relative to those of the other ILECs, also confirms this fundamental difference. We estimated Qwest's beta during the expansion to be 1.40 using the S&P 500 Index and 1.26 using the DJIA. The expansionary betas for BellSouth, SBC, and Verizon ranged between 0.45 and 0.77. Clearly, Qwest's business operations, on the whole, fundamentally differ from those of BellSouth, SBC, and Verizon.

32 *See, e.g.*, GRINBLATT & TITMAN, *supra* note 7, at 465.

33 The average yearly return on the S&P 500 Index has been 8.9% since 1949. *See* HISTORICAL RESULTS OF THE 10 UNCOMMON VALUES PORTFOLIO, *at* http://www.lehman.com/equities/10uv/history.htm. The yearly return for the DJIA has been 8.3%, on average, since 1945. *See* DOW JONES AVERAGES, DOW JONES INDEXES, *at* http://www.djindexes.com/jsp/uiHistoricalIndexRep.jsp.

Table 3. The Estimated Change in the ILECs' Equity Costs

	$\beta_{Expansion}$ (A)	$\beta_{Recession}$ (B)	R_M (C) (%)	Risk Premium (%) Expansion (D=A*C)	Risk Premium (%) Recession (E=B*C)	Change Equity Cost (%) (E-D)
S&P 500 Index						
BellSouth	0.45	0.91	8.9	3.98	8.11	4.13
SBC	0.67	0.84	8.9	5.94	7.50	1.57
Verizon	0.62	0.88	8.9	5.49	7.85	2.36
DJIA						
BellSouth	0.59	0.87	8.3	4.87	7.24	2.37
SBC	0.77	0.82	8.3	6.41	6.81	0.39
Verizon	0.63	0.84	8.3	5.22	7.00	1.78

The results in Table 3 indicate that Verizon's equity costs rose by 2.36 percentage points when the S&P 500 Index was used to proxy for R_M and by 1.78 percentage points when the DJIA was used instead. Similarly, BellSouth's equity costs increased by 4.13 percentage points using the S&P 500 Index and by 2.37 percentage points using the DJIA. Because Verizon's and BellSouth's beta estimates during the recession were statistically different from those during the expansion period, we can conclude that the rise in equity costs for these two firms are statistically significant. Table 3 also indicates that SBC's costs of equity rose by between 0.39 percentage points and 1.57 percentage points. Neither of these estimates is statistically significant at the 5 percent level of confidence, however. Thus, the cost of equity for BellSouth, SBC, and Verizon increased during the recession, and the equity cost increase for two of those firms was statistically significant. Therefore, our statistical analysis supports the Jorde-Sidak-Teece hypothesis.

To determine whether our results in Tables 2 and 3 are robust, we now repeat the analysis using an extended timeframe. Table 4 displays results from the least-squares beta regressions for the four ILECs when the sample is extended to include daily returns between March 1, 1998 and December 31, 2002.

Table 4. Regression Estimates for the ILECs' Daily Returns, March 1, 1998-December 31, 2002

	BellSouth		SBC		Verizon	
Variable	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
S&P 500 Index						
R_M	0.47	7.64	0.69	11.08	0.60	10.11
$R_M{*}D_r$	0.44	4.77	0.15	1.67	0.28	3.16
D_r	-0.07	-0.52	-0.08	-0.61	0.00	0.00
Const.	0.06	0.75	0.05	0.59	0.03	0.44
R^2	0.17		0.19		0.19	
Obs	1213		1213		1213	
DJIA						
R_M	0.53	7.92	0.74	10.90	0.59	8.97
$R_M{*}D_r$	0.34	3.54	0.08	0.88	0.26	2.77
D_r	-0.09	-0.67	-0.10	-0.74	-0.02	-0.17
Const.	0.06	0.70	0.04	0.54	0.03	0.41
R^2	0.16		0.18		0.17	
Obs	1213		1213		1213	

The results in Table 4 are similar to those in Table 2. A beta regression using the S&P 500 Index indicates that Verizon's beta rose from 0.60 to 0.88, and BellSouth's beta rose from 0.47 to 0.91. Both of these increases are statistically significant at the 5 percent level of confidence. SBC's beta rose from 0.69 to 0.84, an increase that is statistically significant at the 10 percent level of confidence. Using the returns from the DJIA to proxy for R_M, one finds that Verizon's beta increased significantly from 0.59 to 0.85, and BellSouth's beta increased from 0.53 to 0.87, and those increases are statistically significant. Finally, the beta for SBC increased by a small amount, and that increase was not statistically significant.

III. Comments on the Empirical Findings by Ekelund and Ford

Empirical research by Ekelund and Ford conflicts with our statistical findings. The authors found that the betas for BellSouth, SBC, and Verizon were lower during the recession than during the economic expansion.[34] However, an examination of their estimates reveals that their results could be inaccurate for the following three reasons. First, the authors misconstrued the Jorde-Sidak-Teece hypothesis. Second, Ekelund and Ford used weekly returns rather than daily returns. Third, they did not use a full recession cycle in their estimation. After discussing these three

34 *See* Ekelund & Ford, *supra* note 12, at 386.

problems with the Ekelund-Ford study, we show why their regression results seem unreasonable given recent stock market events.

A. *Problems with the Ekelund-Ford Study*

Ekelund and Ford incorrectly interpreted the Jorde-Sidak-Teece hypothesis. Jorde, Sidak, and Teece argued that mandatory unbundling of network elements at prices that are not compensatory will subject the ILECs to greater risk, and therefore increase their costs of equity.[35] Ekelund-Ford, however, do not mention TELRIC pricing in their explanation of the Jorde-Sidak-Teece hypothesis.[36] Even though this error cannot explain the divergence of the empirical findings in Ekelund-Ford from the results presented here, it is critical to distinguish the implications to the ILECs of mandatory unbundling under both TELRIC and compensatory pricing. If the prices of UNEs fully compensated the ILECs for the real option value of their networks, their risk exposure from mandatory unbundling would be insignificant. Alternatively, the ILECs' risk exposure increases when UNEs are leased at TELRIC prices and with greater intensity—a phenomenon that would occur during a recession. Only because ILECs are compensated for UNE-P arrangements at TELRIC prices should one expect mandatory unbundling to increase their costs of capital during a recession.

The empirical analysis in Ekelund-Ford relies on weekly returns data. However, Monte Carlo studies have found that beta estimation using daily returns is superior to an analysis that uses weekly returns.[37] The efficiency gain in econometric estimation from using daily returns results from the larger sample size. Increasing the number of observations in the regression sample decreases the standard errors of the regression estimates, and it thus allows one to take advantage of large-sample properties of the least-squares estimator.[38] Consequently, the regressions in the Ekelund-Ford study could have been estimated with greater precision had the authors used daily returns in their analysis.[39] Table 5 reproduces the three-year

35 Jorde, Sidak & Teece, *supra* note 3, at 19-20, 36.

36 Ekelund & Ford, *supra* note 12, at 383-85 (explaining the Jorde-Sidak-Teece hypothesis).

37 *See, e.g.*, Daves, Ehrhardt & Kunkel, *supra* note 22, at 12.

38 *See, e.g.*, DAMODAR N. GUJARATI, BASIC ECONOMETRICS 781-84 (3d ed. 1995) (giving an elementary explanation of how the regression estimator improves as the sample size grows); GEORGE G. JUDGE, W. E. GRIFFITHS, R. CARTER HILL, HELMUT LUTKEPOHL & TSOUGH-CHAO LEE, INTRODUCTION TO THE THEORY AND PRACTICE OF ECONOMETRICS 264-70 (2d ed. 1988) (deriving the asymptotic properties of the least-squares estimator).

39 Research by Amado Peiro concluded that the use of weekly returns data in financial analysis may be superior to daily returns data because weekly returns are more likely than daily returns to be normally distributed. *See* Amado Peiro, *Skewness in Individual Stocks at Different Investment Horizons*, 2 QUANTITATIVE FIN. 139, 139, 145 (2002). Also, Peiro finds slight evidence that daily returns data exhibit some asymmetries, while weekly returns data tend to be symmetric. *See id*. at 145. Finally, Peiro qualifies his finding by stating that "asymmetry does not seem to be a stylized fact

return regressions in Ekelund-Ford using daily rather than weekly returns data. We also include empirical results that use the DJIA Index to proxy for the market return. Comparing the S&P 500 Index regressions to those that use the DJIA gives an additional robustness test that Ekelund-Ford omitted.

Table 5. Regression Estimates for the ILECs' Daily Returns, March 1, 1998-June 17, 2002

	BellSouth		SBC		Verizon		ILEC Index	
Variable	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
S&P 500 Index								
R_M	0.47	7.01	0.69	10.78	0.60	10.04	0.59	10.84
$R_M{*}D_r$	0.19	1.44	-0.06	-0.31	0.18	1.15	0.10	0.71
D_r	-0.12	-0.58	-0.23	-0.82	0.09	0.42	-0.09	-0.46
Const.	0.06	0.73	0.05	0.58	0.03	0.42	0.05	0.72
R^2	0.08		0.14		0.12		0.16	
Obs	832		832		832		832	
DJIA								
R_M	0.53	7.45	0.74	10.66	0.59	8.93	0.62	11.07
$R_M{*}D_r$	0.25	1.75	0.01	0.07	0.27	1.60	0.18	1.09
D_r	-0.15	-0.75	-0.25	-0.92	0.05	0.26	-0.12	-0.64
Const.	0.06	0.68	0.04	0.53	0.03	0.39	0.04	0.67
R^2	0.09		0.14		0.11		0.16	
Obs	832		832		832		832	

Note: In Table 5 we report White-Huber robust t-statistics in the BellSouth, Verizon, and ILEC Index regressions.

The regression results in Table 5 indicate that the findings in the Ekelund-Ford study are misleading. Using daily returns over the same return interval—March 1, 1998 to June 17, 2002—we find that the betas of BellSouth and Verizon did not decrease between March 1, 2001 and June

characteristic of daily returns." *See id.* The applicability of Peiro's research to the Jorde-Sidak-Teece hypothesis is questionable, because Peiro studies only a sample of twenty-five firms, none of which provide local exchange service. *See id.* at 143. An analysis of weekly returns used in the Ekelund-Ford paper indicates that those data are neither normally distributed nor symmetric. In particular, a skewness-kurtosis test for normality rejects the null hypotheses that the weekly returns of BellSouth, SBC, S&P 500 Index, or Verizon are normally distributed. In addition, but for the three-year sample of weekly returns for Verizon, the skewness-kurtosis test rejects the null hypothesis that these returns are symmetric. Furthermore, a Shapiro-Wilkinson test for normality rejects the null hypotheses that the weekly returns data are distributed according to the normal density function. Only for the three-year sample of Verizon returns does the p-value for the normality test exceed 0.05—it is 0.06 in that case. Therefore, the weekly returns data in the Ekelund-Ford paper do not exhibit the characteristics that they claim justify the use of those data over daily returns. *See* Ekelund & Ford, *supra* note 12, at 385 n.9 (citing the results in Peiro as justification of using weekly returns data). Consequently, one must question the author's decision to forgo the opportunity to improve the efficiency of their estimates by using daily returns data.

17, 2002. In particular, the estimated coefficients on the $R_M{*}D_r$ variable are positive in the BellSouth, Verizon, and ILEC Index[40] regressions. Also, the regression parameter on $R_M{*}D_r$ is significant statistically in the BellSouth regression that uses the DJIA as the market index. Had Ekelund and Ford taken steps to increase the efficiency of their regression results, and therefore used daily rather than weekly returns, they would have been forced to conclude that the ILECs' risk exposure increased between March 1, 2001 and June 17, 2002.

The recession period in the Ekelund-Ford study contained weekly returns between March 2001 and June 17, 2002.[41] As of February 2003, NBER had yet to declare that the recession had ended.[42] Consequently, the results in the Ekelund-Ford study do not necessarily contain a full business cycle. A proper analysis of the Jorde-Sidak-Teece hypothesis would be constructed once the full business cycle, or even multiple business cycles, had been declared. Hence, the regressions in the Ekelund-Ford study use a smaller return interval than, and are therefore less efficient than, the regressions that we present here.[43]

B. *The Implausibility of the Ekelund-Ford Results in Light of Stock-Market Reactions to the FCC's Possible Elimination of UNE-P*

Recent events in the stock market cast serious doubt on the plausibility of the Ekelund-Ford results. On January 6, 2003, certain telecommunications stocks rallied sharply in response to a front-page story in the *Wall Street Journal* reporting that FCC Chairman Michael Powell would effectively end UNE-P by reducing the number of network elements that the ILECs must offer for lease to competitors on an unbundled basis at TELRIC prices.[44] The economic significance of UNE-P is evident from Table 6, which shows the percentage of CLEC lines over time that rely on UNE-P rather than resale, partial use of facilities-based entry, or total use of facilities-based entry.[45] CLECs have clearly taken advantage of the

40 The ILEC Index is the average of the separate daily returns for BellSouth, SBC, and Verizon, which is analogous to Ekelund-Ford's weekly ILEC index. *See* Ekelund & Ford, *supra* note 12, at 386.

41 *See* Ekelund & Ford, *supra* note 12, at 385 n.10.

42 NAT'L BUREAU OF ECON. RESEARCH, *supra* note 11, at 1.

43 In fairness to Ekelund and Ford, their regressions were performed during June 2002. Consequently, they did not have the advantage of data between June 18, 2002 and December 31, 2002. Therefore, a future test of the Jorde-Sidak-Teece hypothesis should be produced once NBER has concluded that the current recession has ended. Our expectation, however, is that the findings of that future test would not materially differ from those reported here.

44 Dreazen & Young, *supra* note 9.

45 *See* FED. COMMUNICATIONS COMM'N, LOCAL TELEPHONE COMPETITION: STATUS AS OF JUNE 30, 2002 tbl.4 (2002).

regulatory arbitrage that UNE-P offers, and have abandoned resale in the process.

Table 6. Composition of CLEC End-User Switched Access Lines, December 1999-June 2002

Date	Resold (%)	On-Net UNE (%)	UNE-P (%)	Facilities-Based (%)
Dec-99	51.6	11.5	5.6	31.3
Jun-00	40.9	13.6	13.0	32.5
Dec-00	33.9	15.3	17.9	32.9
Jun-01	24.4	17.4	26.3	31.9
Dec-01	20.5	18.8	29.6	31.1
Jun-02	16.4	19.1	35.2	29.3

Source: Fed. Communications Comm'n, Local Competition Report (Dec. 2002).

Even though the rally was tempered when analysts cautioned that state regulatory commissions would fight the FCC to preserve UNE-P,[46] both the ILECs' stock prices and the stock prices for the telecommunications equipment manufacturers rose dramatically. A value-weighted index[47] of stock for BellSouth, Qwest, SBC, and Verizon rose 8.4 percent on January 6, 2003.[48] These stock price movements totaled $18.8 billion. The stocks of the telecommunications equipment manufacturers also improved. A value-weighted index consisting of the stocks of JDS Uniphase, Lucent Technology, Nortel Network, and Tellabs increased 8.3 percent on January 6, 2003.[49] Their combined market value increased $1.5 billion.

We now present a more rigorous event-study analysis of the market's reaction to the news concerning UNE-P. Focusing on the abnormal returns of the ILECs only would be ambiguous.[50] One can hypothesize that the ILECs experienced positive abnormal returns for either of two reasons: (1) investors expected that the ILECs would avoid losses associated with their compulsory leasing of unbundled network elements at uncompensatory prices under UNE-P, or (2) investors expected that the ILECs would be relieved of the CLECs as serious competitors, since the CLECs had come

46 Tom Locke, *Analysts Warn Investors To Temper Baby Bell Enthusiasm*, D.J. NEWSWIRES, Jan. 6, 2003, at 1.

47 Value-weighting refers to the act of multiplying the stock prices in the index by the shares outstanding for each respective company to determine portfolio weights. *See, e.g.*, GRINBLATT & TITMAN, *supra* note 7, at 167.

48 Stock price data were downloaded at http://finance.yahoo.com/.

49 *Id.*

50 Abnormal returns are the returns of a stock index that cannot be explained by movement in the market index. Put differently, abnormal returns for an index equal the difference between the actual returns on that index and the predicted returns that are derived from an estimated return equation (such as Equation 6 above). *See, e.g.*, ZVI BODIE, ALEX KANE & ALAN J. MARCUS, INVESTMENTS 368 (2d ed. 1993).

to rely disproportionately on UNE-P as an entry strategy. The first hypothesis would be consistent with increased sales of telecommunications equipment, whereas the second would be consistent with decreased sales of such equipment (on the rationale that the output of local telecommunications services would decline if the ILECs faced less competition from CLECs, and thus the industry's derived demand for telecommunications equipment would decline). Thus, the abnormal returns of telecommunications equipment manufacturers on and around January 6, 2003 are highly probative of whether mandatory unbundling at TELRIC prices—epitomized in its most extreme form by UNE-P—is thought by the capital markets to increase or decrease investment in the network infrastructure required for local telephony.

To perform our event study, we calculated the abnormal returns for the ILECs and the equipment manufacturers on January 6, 2003. We used both the DJIA and the S&P 500 Index as market indexes in the analysis. Table 7 reports the findings of the event study.

Table 7. Abnormal Returns of ILECs and Telecommunications Equipment Manufacturers on January 6, 2003

	ILECs		Equipment Manufacturers	
Index	Abnormal Return	Z Stat	Abnormal Return	Z Stat
DJIA	6.16**	3.14	5.55*	1.28
S&P 500	5.82**	3.05	4.82	1.12

Note: * indicates statistical significance at 10%, ** indicates statistical significance at 1%.

Table 7 indicates that the abnormal returns for the ILECs and equipment manufacturers on January 6, 2003 were positive and statistically significant. The returns for the ILECs were 6.16 percent higher than normal returns explained by the DJIA and 5.82 percent higher than normal returns as explained by the S&P 500 Index. Those returns were statistically significant at the 1 percent level. Also, the positive returns for the telecommunications equipment manufacturers exceeded by approximately 5 percent the return that the market could explain. Using the DJIA to measure normal returns, the abnormal returns of the telecommunications equipment manufacturers were significant at the 10 percent level of confidence.[51] If mandatory unbundling of network elements at TELRIC

51 The abnormal return in an event study, which is the predicted residual from a least-squares regression, is asymptotically normal. *See, e.g.*, *id.* at 339 (discussing the calculation of abnormal returns from a least-squares regression); JUDGE, GRIFFITHS, HILL, LUTKEPOHL & LEE, *supra* note 38, at 264-70 (deriving the asymptotic distribution of the least-squares estimator and the residuals from the least-squares regression). Dividing a normally distributed random variable by its standard deviation yields a variable with a "standard normal distribution." *See, e.g.*, RICHARD J. LARSEN &

prices actually encouraged investment in local telecommunications infrastructure (as the Ekelund-Ford study implies by its finding of lower equity costs for ILECs), then the abnormal returns to the telecommunications equipment manufacturers would have been negative on January 6, 2003. Instead, the positive abnormal returns to JDS Uniphase, Lucent, Nortel, and Tellabs reflected an expectation of the capital markets that these firms would have increased net cash flows, which would result from greater (not lesser) sales of telecommunications equipment.[52]

In short, the findings of the Ekelund-Ford study are inconsistent with this positive reaction of the capital markets to news that the FCC might substantially reduce the attractiveness of UNE-P as a business model for CLECs.

Conclusion

We have tested the hypothesis that mandatory unbundling would increase the volatility of the ILECs' stock returns during times of recession and therefore increase the ILECs' equity costs. Different time periods and market indexes were used in the analysis to confirm that the results were robust. We find that BellSouth and Verizon experienced statistically significant increases in their equity costs during the recession. BellSouth's costs of equity rose by between 2.37 and 4.13 percentage points, while

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MORRIS L. MARX, AN INTRODUCTION TO MATHEMATICAL STATISTICS AND ITS APPLICATIONS 215-16 (2d ed. 1986). A Z-statistic refers to a particular value along the horizontal axis of the standard normal distribution. There exists a ten percent probability that a point greater than 1.28 will be drawn from a standard normal distribution. *See, e.g.*, *id.* at 576-77. Similarly, there exists a five percent probability that a value greater than 1.64 will be drawn from the standard normal. *See, e.g.*, *id.* Therefore, a Z-score between 1.28 and 1.64 implies statistical significance at the ten percent level of confidence. A Z-score that exceeds 1.64 indicates statistical significance at the five percent level of precision or beyond.

52 On February 20, 2003, the FCC announced its decision in the Triennial Review of unbundling, which removed only high-capacity switches (principally used to serve business customers) from the list of UNEs subject to mandatory unbundling at TELRIC prices. *See* Press Release, Fed. Communications Comm'n, FCC Adopts New Rules for Network Unbundling Obligations of Incumbent Local Phone Carriers (Feb. 20, 2003), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-231344A1.doc; Commissioner Kevin J. Martin's Press Statement on the Triennial Review, at 2 (Feb. 20, 2003), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-231344A7.doc. Furthermore, the FCC, in effect, placed UNE-P regulation in the hands of the state public utility commissions. *See, e.g.*, Marc Wigfield, *FCC Vote Shifts More Control of Telecom Deregulation to States*, D.J. NEWSWIRES, Feb. 20, 2003. The stock prices of both the ILECs and the telecommunications equipment manufacturers responded negatively to this news. On February 20, 2003, the return to the ILEC index was 5.7% lower than the normal return explained by the S&P 500 Index. The ILECs' abnormal returns were -5.5% using the DJIA as the market index. These negative abnormal returns were statistically significant at the one percent level of confidence. Also, the returns to the telecommunications equipment manufacturers were 3.3% below the normal return that the S&P 500 Index could explain and 3.2% below the normal return explained by the DJIA. Although these abnormal returns were not statistically significant at the ten percent level, the fact that they were negative further highlights the implausibility of the empirical findings in the Ekelund-Ford study.

Verizon's equity cost increased by between 1.78 and 2.36 percentage points. The analysis also indicates that SBC's equity costs rose by as much as 1.59 percentage points, but that this increase was not generally significant in a statistical sense. These empirical findings support the Jorde-Sidak-Teece hypothesis that mandatory unbundling at TELRIC prices has decreased the ILECs' incentives to invest in their own networks.

We also tested the impact that recent news of the FCC's intent to rewrite UNE-P legislation had on the stock prices of the ILECs and telecommunications equipment manufacturers. Our analysis found that the stock prices of both the ILECs and telecommunications equipment manufacturers responded positively to the prospect that the FCC would eliminate UNE-P as a mandatory offering by ILECs. Furthermore, the stock price increases of both the ILECs and equipment manufacturers were not explained by covariance with the DJIA or the S&P 500 Index. If the findings in the Ekelund-Ford study were correct, then the FCC's elimination of UNE-P as a viable CLEC strategy would deter investment in telecommunications equipment and therefore cause financial markets to devalue the stocks of such companies. The fact that the stocks of equipment manufacturers instead rallied on January 6, 2003 is additional evidence that, as the Jorde-Sidak-Teece hypothesis maintains, mandatory unbundling at TELRIC rates deters the ILECs from investing in the telecommunications network.