Market structure, competition, and pricing in United States international telephone service markets

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MARKET STRUCTURE, COMPETITION, AND PRICING IN UNITED STATES INTERNATIONAL TELEPHONE SERVICE MARKETS

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Abstract—Several national governments argue international telephone prices are high because of asymmetric competition and inefficiencies in the accounting arrangements that govern the telecommunications services trade. This paper develops a model of U.S. international telephone pricing that allows for the accounting rate system and contains market-structure variables for both the U.S. and foreign ends of bilateral markets. Model estimation is on 39 bilateral telephone markets from 1991 through 1994. Parameter estimates reveal that settlement rates, market concentration, competition at either end of the bilateral market, and ownership are significant determinants of prices. These findings support initiatives promoting accounting-rate reductions and increased competition.

I. Introduction

IN THE IMMEDIATE postwar period, the accounting-rate system provided a reasonable basis for international telecommunications carrier pricing and settlements.[1] National monopoly carriers were primarily concerned with maintaining uniform prices and balanced traffic flows within bilateral telephone markets. The environment began to change in the 1970s when several national governments initiated reforms in the telecommunications sector. Such reforms recognized that rapid technological change eroded the natural monopoly arguments for mandated supply, and that competition is more likely to lower prices and provide greater choice (Oum and Zhang (1995)).

Whilst technological advance and market liberalization have substantially reduced the costs of providing international services, the extent of these cost reductions have not been fully reflected in lower prices. Accordingly, international telephone prices (collection rates) have diverged between countries that pursue collection-rate reductions and those that have not. Collection rate reductions by ''low-price'' (competitive) countries have increased their outgoing traffic relative to incoming traffic from ''high-price'' countries. This has occurred directly as users in low-price countries respond to declining collection rates, and, indirectly, as a result of substitution between the higher-price incoming and lower-price outgoing traffic.[2] As such, countries that are efficient in generating outgoing traffic provide high-price countries with an increased settlement payment (Ergas and Patterson (1991), Stanley (1991)). Such payments worsen the low-price country's trade balance and transfer rents to monopoly countries. These rents are determined by the difference between the settlement rate (the originating carrier's payment to access the foreign country's network) and the actual cost incurred by the foreign carrier in terminating the call.

Since the commencement of facilities-based competition in 1985, U.S. carriers have mostly operated in asymmetrically competitive markets.[3] Figure 1 shows that, during this period, a substantial increase in the U.S. traffic deficit has occurred, with net settlement payments from U.S. carriers increasing by 16% per annum. The 1995 net settlement payment of 4,937 million U.S. dollars (USD) accounted for 4.75% of the U.S. trade deficit in goods and services (IMF (1996), FCC (1997)). Callback providers (which allow consumers in foreign countries to ''reoriginate'' calls as if they originated in the U.S.) have eccentuated the traffic deficit in recent years.

This study examines collection-rate pricing on U.S. international telephone markets. An econometric model is estimated that allows consideration of the relationship between collection and settlement rates, and that between collection rates and market structure. Parameter estimates identify the determinants of U.S. collection rates and assist in the evaluation of potential gains from FCC (1996) and WTO (1997) initiatives to reduce collection and settlement rates towards the marginal cost of service provision. Such liberalization has the potential to reduce collection rates for incoming calls to the U.S. and reduce the growing traffic imbalances on U.S. bilateral markets. The paper is organized as follows. Section II develops a theoretical model of U.S. collection-rate pricing. An econometric model and data used for estimation are described in section III. Estimation results are reported in section IV, whilst section V contains conclusions.

II. Theoretical Model

Several studies explore the strategic interaction between carriers in deciding on collection and settlement rates (Hakim and Lu (1993); Cave and Donnelly (1996); Yun, Choi, and Ahn (1997)). They find that increased competition

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[1] The accounting rate is the unit of account from which international settlement payments are made. A country's accounting-rate share is the settlement rate and determines the amount carriers pay to access other country networks (Frieden (1996)).

[2] Larson, Lehman, and Weisman (1990) define substitution of incoming for outgoing calls as call reversion, whilst complementarity is termed *call reciprocity.*

[3] Asymmetric competition is defined as a bilateral market with a monopoly market structure at one end and an oligopoly (or competitive) structure at the other end.

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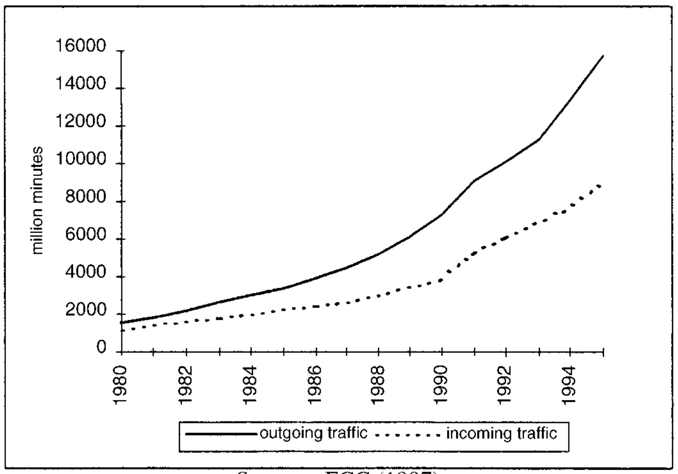
FIGURE 1.—U.S. INTERNATIONAL TELEPHONE TRAFFIC 1980–1995



Source. FCC (1997).

at one end of a bilateral market enhances collection-rate differentials, resulting in unfavorable traffic balances to low-price countries. Such game-theoretical model findings, however, are usually strongly qualified due to their restrictive assumptions. Further, because the models are formulated in an "ideal" world, it is often difficult to directly test model inferences. The approach taken here is to develop a theoretical framework that will provide enough flexibility to allow both cogent empirical estimation and enable examination of the robustness of model results.

Consider an asymmetrically competitive market for international outgoing calls from the U.S. (supplied by n carriers) to a foreign country (with a monopoly carrier). For notational convenience, assume that market share for U.S. outgoing traffic is distributed evenly among the n carriers. The quantity of U.S. carrier j's outgoing traffic output is denoted q_{Oi}, with total output $Q_O = \Sigma_{j=1}^{n} q_{Oj}$. Carrier j's profit function (π_j) is

$$\begin{aligned}\pi_j = {} & q_{Oj} \cdot P_O(Q_O, Q_I, Y_O, \Gamma_O) \\ & - C_{Oj}(q_{Oj}, w_{Oj}, Tech_O) \\ & - sr_O \cdot q_{Oj} + sr_I \cdot q_I - C_{Ij}(q_I, w_{Oj}, Tech_O)\end{aligned} \tag{1}$$

where $P_O(Q_O, Q_I, Y_O, \Gamma_O)$ is the inverse demand function for outgoing calls (Larson, Lehman, and Weisman (1990); Hsiao, Appelbe, and Dineen (1993)),

P_O is the collection rate for outgoing calls,

Q_I is incoming traffic,

Y_O is U.S. income,

Γ_O is a vector of sociodemographic characteristics that influence outgoing call demand,

$C_{Oj}(q_{Oj}, w_j, T)$ is carrier j's outgoing call-handling cost,

w_{Oj} is a vector of input prices for carrier j,

$Tech_O$ is technology,

sr_O is the settlement rate paid to the foreign carrier for terminating outgoing calls,

sr_I is the settlement rate received for terminating incoming calls,

$q_I = Q_I/n$, and

$C_{Ij}(q_I, w_{Oj}, Tech_O)$ is carrier j's cost of handling incoming calls.[4]

Carrier j's price-output decision is represented by a single-shot, two-stage game and is solved by backward induction. In stage one, $n + 1$ carriers (n U.S. and the foreign monopoly) mutually determine the accounting rate (ar) under the 50:50 uniform-settlement rate rule. In stage two, carrier j chooses the quantity of outgoing calls to maximize own profits, given the negotiated accounting rate and 50:50 settlement rate share $\{ar;\ 1/2\}$. The first-order necessary condition for carrier j profit maximization, given $\{ar;\ 1/2\}$, $\Sigma_{k \neq j}^{n} q_{Ok}$, and q_I is

$$\begin{aligned} & P_O + q_{Oj}\left(\frac{\partial P_O}{\partial q_{Oj}} + \sum_{k \neq j}^{n} \frac{\partial P_O}{\partial q_{Ok}} \cdot \frac{\partial q_{Ok}}{\partial q_{Oj}} + \frac{\partial P_O}{\partial q_I} \cdot \frac{\partial q_I}{\partial q_{Oj}}\right) \\ & \quad - MC_{Oj}(q_{Oj}, w_{Oj}, Tech_O) - sr + sr \cdot \frac{\partial q_I}{\partial q_O} \\ & \quad - MC_{Ij}(q_I, w_{Oj}, Tech_O) \cdot \frac{\partial q_I}{\partial q_O} = 0 \end{aligned} \tag{2}$$

where $MC_{Oj}(q_{Oj}, w_{Oj}, Tech_O) = \partial C_{Oj}/\partial q_{Oj}$, and $MC_{Ij}(q_I, w_{Oj}, Tech_O) = \partial C_{Ij}/\partial q_{Ij}$. The term in the parenthesis captures strategic behavior and indicates how carrier j output directly affects the collection rate, and how variations in own output affect the collection rate through its effect on the output decisions of the other U.S. carriers and the foreign carrier.

Assuming the costs of handling incoming and outgoing calls are identical, equation (2) becomes[5]

$$\begin{aligned} & P_O + q_{Oj}\left(\frac{\partial P_O}{\partial q_{Oj}} + \sum_{k \neq j}^{n} \frac{\partial P_O}{\partial q_{Ok}} \cdot \frac{\partial q_{Ok}}{\partial q_{Oj}} + \frac{\partial P_O}{\partial q_I} \cdot \frac{\partial q_I}{\partial q_{Oj}}\right) \\ & \quad = MC_{Oj}^{s}(q_{Oj}, w_{Oj}, Tech_O, sr) \end{aligned} \tag{3}$$

where $MC_{Oj}^{s} = [(1 + (\partial q_I/\partial q_{Oj})) \cdot MC_{Oj}(q_{Oj}, w_{Oj}, Tech_O) + (1 - (\partial q_I/\partial q_{Oj})) \cdot sr]$ is the shadow marginal cost of carrier j. When there is no reversion or reciprocity $((\partial q_I/\partial q_{Oj}) = 0)$, MC_{Oj}^{s} equals the cost of handling the outgoing call plus the settlement rate. Should reversion exist $((\partial q_I/\partial q_{Oj}) < 0)$, the marginal cost of calling falls with the decrease in the cost of handling an incoming call but rises due to the associated decline in incoming-call settlement-rate revenue. When reciprocity exists $((\partial q_I/\partial q_{Oj}) > 0)$, the marginal cost rises

[4] Equation (1) assumes competitors are obliged to accept a uniform settlement rate ($sr = sr_O = sr_I$).

[5] Aside from billing and marketing costs, the costs of handling outgoing and incoming calls should be the same, because transmission costs do not change with the direction of traffic (Alleman and Sorce (1997)).

with the increase in the cost of handling an incoming call and is offset by increased incoming-call settlement-rate revenue.

Outside the perfectly competitive model, price-quantity-setting conduct follows more-general supply relations that allow nonprice-taking conduct (Bresnahan (1989)). Because market conduct affects carrier j pricing and profitability, it is convenient to express its supply relation (3) as

$$P_O - \tau_{Oj} \cdot q_{Oj} = MC^s_{Oj}(q_{Oj}, w_{Oj}, Tech_O, sr) \tag{4}$$

where $\tau_{Oj} = [P_O - MC^s_{Oj}(q_{Oj}, w_{Oj}, Tech_O, sr)]/q_{Oj}$ is the ratio of price-cost markup to quantity and measures the degree of oligopolistic competition.

Borenstein (1989) and Cowling and Waterson (1976) express competition as a function of industry characteristics. Here, the relationship between incoming and outgoing traffic, dq_I/dq_{Oj}, implies that carrier j may consider the conduct of foreign monopoly carrier(s), as well as the conduct of other U.S. carriers when pricing international services:

$$\tau_{Oj} = \tau_{Oj}(MCI_O, Comp, Priv) \tag{5}$$

where MCI_O is an index of market concentration for outgoing telephone traffic,

Comp is a measure of competition at both ends of a bilateral market, and

Priv is the extent of private ownership of carriers operating at both ends of a bilateral market.

Accordingly, carrier j's supply relation (4) is

$$P_O = MC^s_{Oj}(q_{Oj}, w_{Oj}, Tech_O, sr) + \tau_{Oj}(MCI_O, Comp, Priv) \cdot q_{Oj} \tag{6}$$

As carrier-specific data is generally not available, equation (2) is rewritten in aggregate form, and equation (6) is interpreted as the supply relation for the average U.S. carrier. The parameter τ_O is industry average conduct, and $\tau_O = 0$ implies no market power is present. As τ_O moves away from zero, average carrier conduct is less competitive (Cowling and Waterson (1976), Porter (1983), Bresnahan (1989)).

III. Econometric Model and Data

To enable consistent estimation of equation (6), the endogeneity of price and quantity is recognized. Accordingly, a system of equations comprising outgoing and incoming supply relations (equation (7) and (8), respectively) and outgoing and incoming demand equations (equation (9) and (10), respectively) is specified.

The log-linear system, for bilateral market i at time t, is

$$\begin{aligned} P_{Oit} = {} & \pi_1 + \pi_2 Q_{Oit} + \pi_3 w_{Ot} + \pi_4 Tech_{Ot} + \pi_5 D_i \\ & + \pi_6 sr_{Oit} + \pi_7 (MCI_{Oit} \cdot Q_{Oit}) \\ & + \pi_8 (Comp_{it} \cdot Q_{Oit}) + \pi_9 (Priv_{it} \cdot Q_{Oit}) \\ & + \epsilon_{Oit} \end{aligned} \tag{7}$$

$$\begin{aligned} P_{Iit} = {} & \phi_1 + \phi_2 Q_{Iit} + \phi_3 w_{Iit} + \phi_4 Tech_{Iit} + \phi_5 D_i \\ & + \phi_6 sr_{Iit} + \phi_7 (MCI_{Iit} \cdot Q_{Iit}) \\ & + \phi_8 (Comp_{it} \cdot Q_{Iit}) + \phi_9 (Priv_{it} \cdot Q_{Iit}) + \epsilon_{Iit} \end{aligned} \tag{8}$$

$$\begin{aligned} Q_{Oit} = {} & \alpha_1 + \alpha_2 P_{Oit} + \alpha_3 Y_{Ot} + \alpha_4 Q_{Iit} + \alpha_5 Trade_{it} \\ & + \alpha_6 Trav_{Oit} + \alpha_7 Size_{it} + u_{Oit} \end{aligned} \tag{9}$$

$$\begin{aligned} Q_{Iit} = {} & \beta_1 + \beta_2 P_{Iit} + \beta_3 Y_{Iit} + \beta_4 Q_{Oit} + \beta_5 Trade_{it} \\ & + \beta_6 Trav_{Iit} + \beta_7 Size_{it} + u_{Iit} \end{aligned} \tag{10}$$

where ϵ_O, ϵ_I, u_O, and u_I are additive disturbance terms. Definitions, sample means, and standard deviations for all variables in equation (7) through (10) are provided in table 1.

The nonnegative derivative $\partial P/\partial Q \geq 0$ reveals carrier willingness to increase supply in response to collection-rate increases. Collection rates are not expected to increase with labor productivity improvements, namely $\partial P/\partial w \leq 0$. Greater digitization suggests lower collection rates through increased efficiency; however, digitization may lead to improved service quality and higher collection rates. Accordingly, the sign of $\partial P/\partial Tech$ is indeterminate.[6] D is included in the supply relations to account for the distance-based cost components of collection rates (that is, $\partial P/\partial D \geq 0$). Carrier access to international networks is a primary production input, and $\partial P/\partial sr \geq 0$ should hold. The ability of carriers to set collection rates above cost is assumed positively related to market concentration, or $\partial P/\partial(MCI \cdot Q) \geq 0$. When U.S. and foreign carriers compete for U.S.-originating traffic, increased rivalry at either end of the market may reduce outgoing and/or incoming collection rates, with $\partial P/\partial(Comp \cdot Q) \leq 0$.[7] Greater foreign-carrier private ownership may result in lower outgoing and/or incoming collection rates, and $\partial P/\partial(Priv \cdot Q) \leq 0$.[8] Finally, the assumption that outgoing and incoming call-transmission costs are equal implies the restrictions $\partial P_O/\partial sr_O + \partial Q_I/\partial Q_O = 1$ and $\partial P_I/\partial sr_I + \partial Q_O/\partial Q_I = 1$.

[6] An anonymous referee correctly observes that the vast majority of U.S. digital switches are in the local network. Therefore, the estimate of $\partial P_O/\partial Tech_O$ may be overstated.

[7] Alternatively, increased competition at the foreign end of a market may result in a lower settlement rate, which indirectly leads to a lower collection rate.

[8] Consumer theory implies a priori signs for equation (9) and (10). Demand-equation estimates are not provided as the focus of this study concerns pricing and market structure variables contained in table 2.

TABLE 1.—VARIABLE DESCRIPTION AND SAMPLE STATISTICS 1991–1994

Variable	Definition	Mean	Std Dev
P_O	real per-minute peak outgoing collection rate (USD)	1.16	0.23
P_I	real per-minute peak incoming collection rate (USD)	1.52	0.99
Q_O	minutes of outgoing U.S. traffic (millions)	220	431
Q_I	minutes of incoming traffic (millions)	122	273
w_O	U.S. mainlines per employee (an input cost proxy)	218	17
w_I	foreign country mainlines per employee	145	67
$Tech_O$	U.S. network digitization (a technology proxy) (%)	62	7.55
$Tech_I$	foreign country digitization (%)	58	22
D	distance from Washington, D.C., to the foreign country capital city (km)	8023	3679
sr_O	real per-minute settlement rate for outgoing traffic (USD)	0.65	0.21
sr_I	real per-minute settlement rate for incoming traffic (USD)	0.57	0.24
MCI_O	dominant U.S. carrier share of outgoing traffic (%)	65	8.4
MCI_I	foreign dominant carrier share of traffic terminating in the U.S. (%)	96	10
$Comp$	U.S. and foreign facilities-based carriers in the bilateral market	5.32	0.81
$Priv$	one plus the private ownership share of the dominant foreign carrier	1.26	0.38
Y_O	U.S. real GDP (billion USD)	5922	220
Y_I	foreign country real GDP (billion USD)	356	707
$Trav_O$	foreign residents traveling to the U.S. (million)	1.14	3.06
$Trav_I$	U.S. residents traveling to the foreign country (million)	1.08	3.17
$Trade$	U.S.-foreign country real exports and imports (million USD)	23758	41721
$Size$	product of U.S. and foreign country population (billion)	14189	36086

Source. FCC (1991–1995); TeleGeography, Inc. (1995); IMF (1996); ITU (1996a, 1996b); Bali Online (1997); World Bank (1997); World Tourism Organization (1997).

Note; (a) As market-specific traffic data are unavailable for many foreign countries, country *f* dominant carrier's share of world outgoing traffic is used to proxy the share of outgoing traffic to the U.S.

(b) Base year 1991.

The system (7) through (10) is estimated on annual data for 39 bilateral markets for the period 1991 through 1994. Of the 39 foreign countries contained in the sample, ten are Asian-Pacific, one is African, eighteen are European, two are Middle Eastern, and eight are from the western hemisphere.[9] Real collection rates are, on average, 24% lower in the U.S. Average U.S. outgoing telephone traffic per country averages 220 million minutes per annum, compared to 122 million incoming minutes. The average U.S. international traffic deficit is equivalent to 29% of two-way (↔) traffic for each bilateral market. Market structure data reveal U.S. bilateral telephone markets are mostly asymmetrically competitive. The average market share of the dominant U.S. and foreign country carriers are 65% and 96%, respectively. On average, four carriers compete at the U.S. end, whilst 1.32 carriers compete at the foreign end. Because the dominant U.S. carrier is privately owned, *Priv* indicates a typical foreign dominant carrier is 74% publicly owned.

IV. Estimation Results

The system (7) through (10) is estimated by 3SLS, with appropriate corrections for single-equation, first-order autocorrelation and heteroskedasticity, and allowance for contemporaneous residual covariance across equations.[10] The estimating equations contain region-specific intercepts for Africa, Asia-Pacific, Europe, and the Middle East. Country-specific intercepts for Australia and Sweden are also included as Australia ↔ US and Sweden ↔ US telephone traffic is approximately balanced over the sample period.[11] A Wald test does not reject the restriction that outgoing and incoming call-transmission costs are equal at the 5%-level ($\chi^2 = 0.2843$). Coefficient estimates and *t*-ratios for the supply relations are reported in table 2.

All cost and market-structure estimated coefficients in equation (7) are signed according to a priori expectations and are inelastic. Of particular interest is the estimated sign for settlement rates (sr_O) which is positive and supports the Hakim and Lu (1993) conjecture. The U.S. collection-rate elasticity with respect to the settlement rate is smaller than the corresponding elasticity reported for the incoming supply relation (8). The estimate implies a percent reduction in the settlement rate reduces outgoing collection rates by 0.25%. As expected, the coefficient for distance is inelastic, because technological change has seen the historically determined "distance-based component" of pricing become less relevant. It is not clear how to interpret the reported positive coefficient for digitization ($Tech_O$). Digitization measures U.S. network sophistication. An increase in digitization is expected to lower collection rates in the long run through productivity improvements. A positive estimate

[9] Asian-Pacific: Australia, Hong Kong, India, Japan, New Zealand, Philippines, Singapore, South Korea, Taiwan, and Thailand; Africa: Nigeria; European: Austria, Belgium, Denmark, France, Finland, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Switzerland, Sweden, Turkey, and the United Kingdom; Middle-East: Egypt and Israel; western hemisphere: Brazil, Canada, Chile, Costa Rica, Honduras, Equador, Mexico, and Venezuela.

[10] Significant Durbin-Watson and Breusch-Pagan statistics indicate the presence of first-order autocorrelation and heteroskedastcity in all equations estimated by 2SLS. Following Acton and Vogelsang (1992), the sample observations are weighted by the U.S. share of U.S. ↔ foreign country traffic to allow for heteroskedastcity.

[11] The U.S. had a traffic surplus in only one of the 156 sample markets, U.S. ↔ Sweden in 1991. Although the U.S. was in deficit with Australia from 1991 to 1994, the market has the most balanced distribution of two-way traffic, with 52% of total traffic originating from the U.S.

TABLE 2.—3SLS ESTIMATES FOR SUPPLY RELATIONS

Outgoing Call Supply Relation (7)			Incoming Call Supply Relation (8)		
Independent Variables	Estimated Coefficient	*t*-Ratio	Independent Variables	Estimated Coefficient	*t*-Ratio
Cost			*Cost*		
Q_O	0.046[a]	3.590	Q_I	−0.528[a]	−3.972
w_O	−0.565[a]	−6.012	w_I	−0.225[a]	−3.349
$Tech_O$	0.684[a]	5.627	$Tech_I$	−0.023	−0.388
D	0.205[a]	10.81	D	0.192[b]	1.793
sr_O	0.249[a]	10.72	sr_I	0.786[a]	25.10
Market structure			Market structure		
$MCI_O \cdot Q_O$	0.153[a]	3.162	$MCI_I \cdot Q_I$	0.747[a]	6.817
$Comp \cdot Q_O$	−0.149[a]	−3.208	$Comp \cdot Q_I$	−0.104	−1.076
$Priv \cdot Q_O$	−0.011[a]	−3.596	$Priv \cdot Q_I$	−0.020[b]	−1.742
Region/country			Region/country		
Africa	0.066	0.960	Africa	−1.106[a]	−2.902
Asia-Pacific	0.041	0.923	Asian-Pacific	−0.644[a]	−2.553
Europe	−0.040	−1.270	Europe	−0.860[a]	−4.873
Middle East	−0.048	−0.977	Middle East	−0.846[a]	−3.061
Australia	0.030	0.327	Australia	−1.172[a]	−3.520
Sweden	0.100	1.634	Sweden	0.024	0.077
Constant	1.029	1.478	Constant	2.011	1.266

Note: (a) denotes significance at the 5% level.
(b) denotes significance at the 10% level.

suggests that carriers may be pricing according to improved quality of service.

The coefficient for $MCI_O \cdot Q_O$ is positive and indicates that collection rates are higher the more concentrated is the U.S. outgoing-call market. A percent decrease in concentration in the U.S. outgoing-call market is estimated to reduce U.S. collection rates by 0.15%. To obtain clearer interpretation of this result, the U.S. → Hong Kong and U.S. → Honduras markets are considered.[12] The U.S. → Hong Kong market is least concentrated (53%) and is the competitive benchmark, whilst the U.S. → Honduras market is the most concentrated (79%). Should the U.S. dominant carrier's market share fall to the benchmark level, U.S. → Honduras collection rates would decline by approximately 5%. The reported negative coefficient for competition ($Comp \cdot Q_O$) indicates that the conduct of the average U.S. carrier responds to the number of carriers operating at the foreign end. The more numerous are foreign carriers, the closer the bilateral market is to being symmetrically competitive, and the average U.S. carrier is likely to be more price competitive. The estimated coefficient on ($Priv \cdot Q_O$) implies outgoing collection rates are approximately 1% lower in bilateral markets when the foreign end is served by a fully privately owned carrier.

The estimated incoming supply relation (8) shows all coefficients other than incoming traffic are signed according to a priori expectations. This negative coefficient for Q_I implies the average foreign carrier's supply relation curve is negatively sloped. The estimated coefficient for incoming settlement rates (sr_I) implies a percent reduction in the incoming settlement rate leads to a 0.786% reduction in collection rates for incoming calls. As is the case for outgoing calls, incoming collection rates are positively related to distance, and the relationship is similar in magnitude to that reported in the outgoing supply relation.

Market concentration ($MCI_I \cdot Q_I$) has a positive impact on incoming collection rates; namely, collection rates are higher in more-concentrated markets. The relative size of the estimated coefficients for $MCI_O \cdot Q_O$ and $MCI_I \cdot Q_I$ suggests market power is stronger at the foreign end of the bilateral market.[13] This result is not surprising as the foreign end of U.S. bilateral telephone markets is typically operated by a publicly -owned monopoly which can support substantially higher incoming collection rates. The competition variable ($Comp \cdot Q_I$) is insignificant. Because the foreign end of the average bilateral market is typically operated by a monopoly carrier, a reduction in market concentration closely tracks the commencement of competition. Hence, it is not possible to isolate the independent impact that *Comp* has on incoming collection rates.

V. Conclusions

The U.S. has been experiencing substantial growth in its international telephone-traffic deficit. Several commentators argue that the deficit is caused by lower U.S. prices (due to market liberalization) and an inefficient accounting-rate system. This study quantifies determinants of U.S. collection rates, and, in doing so, provides a justification for telecommunications reforms suggested by the FCC and the WTO.

[12] Market share data for all U.S. outgoing markets, for the period 1991 through 1994, show the U.S. → Hong Kong market has the lowest average concentration, whilst the U.S. → Honduras market has the highest average concentration.

[13] An anonymous referee suggested the interpretation of table 2 estimates in terms of competitive conduct implied by equation (4). Following Sullivan (1985), reduced-form estimates of $\epsilon_{P_O sr_O}$ (the elasticity of P_O with respect to sr_O), $\epsilon_{Q_O sr_O}$, $\epsilon_{P_I sr_I}$, and $\epsilon_{P_I sr_I}$ are used to calculate the equivalent number of carriers playing a quantity Cournot game (n^*). Lower-bound estimates of $n_O^* = 4.52$ and $n_I^* = 3.17$ confirm that industry average conduct is more competitive for U.S. carriers than foreign-country carriers (qualitatively similar estimates of n_o^* and n_I^* were obtained using the exogenous input cost (w) variable as a proxy for marginal cost).

Model estimates indicate that traffic volume, labor productivity, digitization, settlement rates, and market structure are important determinants of collection rates. These findings suggest that the average U.S. carrier may consider the market conduct of foreign and other U.S. carriers when pricing international services. In particular, model estimates imply that, as bilateral markets become symmetric in competition and private ownership, collection rates fall.

The study finds empirical support for institutional reforms that force settlement and collection rates towards the marginal cost of service provision. Such reforms suggest several desirable outcomes. Although international-call demand depends on socioeconomic and demographic factors, lower foreign-country collection rates may stimulate incoming traffic to the U.S. and reduce the growing U.S. traffic imbalance. A lower traffic deficit, along with settlement-rate pricing that better reflects marginal cost, will reduce the flow of rents from the U.S. to monopoly-provider countries. The removal of distortions in international traffic flows and settlement payments will provide appropriate signals for carrier investment and promote further efficiency gains.

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