INTERNATIONAL TELECOM SETTLEMENTS:
GAMING INCENTIVES, CARRIER ALLIANCES,
AND PARETO-SUPERIOR REFORM

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International Telecom Settlements:
Gaming Incentives, Carrier Alliances,
and Pareto-Superior Reform[*]

by

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Liberalized countries that allow competition in international telecommunications favor traffic re-routing practices as arbitrage against foreign monopolists. This view is seriously incomplete. Monopolists, allied with carriers in liberalized countries, can use these practices to reduce termination payments to nonalliance carriers—thereby harming also consumers in liberalized countries —by gaming regulations that require equal termination rates at both ends and 'proportional return' (the monopolist's traffic is allocated among carriers in proportion to their shares of traffic to its country). We also present a simple bilateral settlements reform that eliminates gaming incentives and other proportional-return distortions, yet benefits both countries.

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KEYWORDS: International Telecom, Termination Payments, Alliances

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I.   INTRODUCTION

Historically, all countries had monopolist carriers of international telecommunications. These carriers bilaterally negotiated settlement rates for terminating traffic between their countries; the rates were almost always symmetric on a given route, but differed considerably across routes.[1] After the 1984 breakup of AT&T, the US introduced competition in international telecommunications. However, since international telecommunications require complementary inputs in both countries, an unrestricted foreign monopolist could appropriate much of the gains from US competition (Kwerel [1984, 1994] and Johnson [1991]).[2] The monopolist could respond to the competition-induced reduction in retail margins of US carriers for calls to its country by raising its rate for terminating such traffic; and it would drive the rate it pays for terminating its traffic in the US down to US carriers' marginal cost. To counter these dangers of asymmetric telecom liberalization, the US adopted the International Settlements Policy (ISP).

The ISP requires (1) *uniformity and symmetry*—all US carriers must pay the same rate to terminate in a monopoly country, and this rate must be equal at both ends (maintaining the historical symmetry in the face of US competition); and (2) *proportional return*—traffic from the foreign carrier is allocated among US carriers for US termination in exact proportion to their shares of traffic from the US to that country. By removing discretion to divert traffic from a recalcitrant US carrier, proportional return seeks to prevent a monopolist from pressuring competing US carriers for concessions, such as accepting a higher (symmetric) rate where the US sends more traffic than it receives. While our institutional discussion focuses on the US, the

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[1]The traditional settlements process is known as the Accounting Rate Regime. A carrier pays its foreign correspondent a *settlement rate* per minute of half the 'accounting rate' between their countries on the traffic *imbalance*; this is equivalent to paying the settlement rate on all outbound traffic and being paid the same rate on all inbound traffic. We will use 'settlement rate' and 'termination rate' interchangeably.

[2]We use 'monopolist' broadly, to include dominant carriers that face only weak competition, and will speak of the home countries of such carriers interchangeably as 'monopolistic' or 'closed', as distinct from ones that are 'competitive', 'liberalized', or 'open'.

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analysis also applies to other liberalized countries, including the UK, Finland and Sweden, that have adopted policies similar to the ISP. Moreover, the traffic-manipulation practices we describe for gaming the ISP will be shown to have relevance also in other important telecom settings.

Termination rates between many countries remain well above marginal costs. According to the US Federal Communications Commission (FCC), the traffic-weighted average termination rate paid by US carriers abroad in 1996 was 35¢/minute (FCC [1997a]); foreign carriers' long-run incremental cost of termination was estimated at 'no more than 6-9¢' (FCC [1996]). Since the ISP has kept termination rates symmetric, the rates received by US carriers from many countries also are well above US carriers' marginal costs.[3] The stakes in this industry are high. Accurate data are not publicly available for most foreign carriers; but for US carriers alone, 1996 revenues from international traffic that incurs per-minute charges for termination ('switched traffic') exceeded $14 billion, and their total termination deficit with foreign carriers was $5.4 billion (FCC, 43.61). Despite the growth of traffic that bypasses the settlements process, via private lines or Internet telephony, switched traffic is projected to remain substantial for some time.[4]

One goal of our paper is to highlight the competitive distortions among US carriers

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[3]In 1996 the FCC relaxed its ISP rules towards countries where there is significant competition, allowing US carriers more flexibility to negotiate individual terms. Termination rates between some liberalized countries have fallen dramatically, e.g., to 8¢ between the US and Sweden (FCC [1997a]). Most monopolistic countries, however, have a termination surplus with the US, and have resisted US attempts to lower the settlement rates, notwithstanding the ISP's symmetry requirement. Wright [1999] models symmetric settlement rates as determined through Nash bargaining between a foreign monopolist and US carriers. His model predicts that rates will be above marginal costs, and that the gap increases with the traffic imbalance (arising from exogenous demand factors such as per capita incomes). He finds the pattern of US settlement rates with various countries to be consistent with the model's predictions.

[4]Private lines are leased for a fixed charge regardless of the amount of traffic sent. Internet telephony sends traffic as packets, not through dedicated circuits, and avoids access charges under today's technology and regulatory regimes. Estimates vary widely, but generally project the Internet's share of all international voice and fax traffic several years hence at under 30%.

spawned by the interaction of inflated (though symmetric) settlement rates and the ISP's proportional-return rules. First, proportional return artificially favors smaller over larger carriers in competing for *outbound* traffic. Second, proportional return makes it profitable for US carriers (especially smaller ones) to expand their traffic not only by lowering their US retail prices but also by re-routing through the US traffic that originates abroad, using practices such as callback (discussed below); such practices can easily harm US consumers and can reduce overall US welfare. These distortions have recently been noted by Scanlan [1996, 1998], Einhorn [1997], Galbi [1998], Schwartz [1997], and Vogelsang [1999] and were previously known to some telecom insiders, but they have not been widely appreciated.

Our main purpose, however, is to analyze how *foreign* monopolists allied with US carriers can use traffic re-routing practices to reduce termination payments to non-alliance US carriers—and likely harm also US consumers—while complying with the letter of the ISP. Traffic re-routing practices are ubiquitous and have drawn attention even in the general press (Cairncross, 1997). One such practice is call re-origination (or 'refile')—routing a call from country A to B via a third country C, to make the call appear as having originated in C; another practice is callback—reversing a call from A to B into one that is billed in B and incurs termination charges in A. Liberalized countries generally favor such re-routing schemes as arbitrage against foreign monopolists (see, e.g., OECD [1997], which also provides useful background). Callback is seen as letting callers from monopoly markets pay lower US retail prices, while also increasing US carriers' retail revenues; re-origination is seen as exploiting large differences, which are not cost based, between a destination country's termination rates with various other countries.[5] Our analysis casts serious doubt on this benign view.

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[5]Liberalized countries have recognized the incentives of foreign monopolists to send their traffic into liberalized markets via *private lines*, which bypass the settlements system entirely, while denying comparable bypass opportunities in the other direction. Liberalized countries have restricted such bypass via private lines from countries that do not allow it to their markets. In contrast, traffic re-routing practices, such as callback and re-origination, have been viewed sympathetically.

For two reasons, liberalized countries face a growing threat that traffic re-routing practices, especially callback, will be used by foreign monopolists aided by ally carriers in liberalized countries to game the settlements process. First, the 1997 WTO Agreement on Basic Telecom Services requires any signing country to grant its market-opening commitments equally to all WTO countries. But countries' commitments vary considerably, as will implementation (Frieden [1998] and Oliver [1998]).[6] During the asymmetric transition to competition, carriers from closed markets will increasingly be able to enter or form alliances with carriers in liberalized markets, while preventing competition in their home markets.

Second, the potential for traffic re-routing has grown significantly with recent advances in technology and with increased participation in re-routing schemes by traditional carriers, not only by independent resellers (Blake [1997] and Scheele [1997]). The US-Hong Kong route provides a dramatic illustration. From 1986 to 1992 traffic in both directions grew at about the same rate; from 1992 to 1996 traffic to the US remained essentially flat, while traffic from the US almost quadrupled. The main reason was growth of callback (HKTI [1997] and Lam [1997]). In 1992, US carriers (notably MCI and Sprint) contracted to provide low-priced wholesale minutes from the US to callback operators in Hong Kong; the latter deployed computer technologies that virtually eliminated calling delays and made the service seamless to callers. Callback was used not only to reverse calls from Hong Kong to the US, but also to reach third countries by patching two calls from the US hub—one to the destination country, and a

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[6]The FCC, among others, recognizes that lowering settlement charges through competition will take time even with the WTO Agreement. Despite a groundswell of foreign opposition, the FCC has retained its 1997 Benchmarks Order, which caps the settlement rates US carriers may pay abroad. This FCC policy reduces but does not nullify concerns with gaming the ISP. First, questions remain about the Order's legal status and operational effectiveness (what happens if US carriers refuse to pay above the FCC benchmarks and foreign carriers balk?). Second, the FCC price caps will remain well above cost for several years, especially with developing countries where much of the traffic growth is likely to occur. Moreover, the FCC's policy does not govern the prices that may be paid by non-US carriers.

'callback' to Hong Kong.[7] A major boost to callback was the 1995 entry of three local carriers, which lacked international facilities but offered services to many countries by using the US as a hub and linking to it via callback.

The Hong Kong example vividly demonstrates the power of re-routing schemes. To be sure, the example involves re-routing by competitors, not by a monopolist. But looking ahead, monopolists may turn the tables. In April 1997, the monopolist over international facilities, HongKong Telecommunications International, did just that—it launched its own callback service and regained market share (Pan Asian Telecom [1998]).

The remainder of this paper is organized as follows. Section II discusses competitive distortions from proportional return without manipulation by foreign monopolists. Proportional return induces any US carrier to send more calls to a country so as to increase its entitled share of calls from that country terminated in the US. Because this competition for outbound traffic also redistributes the common pool of inbound termination profit, there are negative externalities among carriers, akin to standard common pool problems (Libecap and Wiggins [1984]). A carrier's perceived marginal cost of terminating its calls abroad is less than the settlement rate because the resulting expansion in that carrier's market share raises its allotted share of inbound traffic; importantly, this proportional-return effect is greater if a carrier's *initial* market share is smaller. (Differences in market shares arise from differences in certain factors which we take as exogenous, such as the brand names and established customer relations of some carriers.) Proportional return therefore stimulates outbound calling, but also distorts competition, since smaller carriers perceive artificially lower marginal costs than larger carriers for sending calls.[8]

A related distortion arises because carriers expand their US-outbound calls not only by

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[7]These third-country calls explain why the surge in US outbound minutes greatly exceeds the fall in inbound minutes. The Hong Kong example is discussed further in Malueg and Schwartz [1998].

[8]The recent landmark settlement of the litigation between forty eight states and the tobacco companies creates an opposite distortion: since a fixed tax bill is allocated annually among companies in proportion to their market shares, smaller companies perceive a *higher* marginal tax rate than larger ones (see Bulow and Klemperer [1998]).

stimulating calls from US consumers but also by re-routing through the US calls that originate abroad. This is profitable due to the ease of re-routing calls and because US-outbound calls are defined for settlement purposes as calls billed in the US, even if originated by foreign callers (it would be very hard for regulators to determine the actual origin). A notable strategy, pursued especially by carriers with lower market shares, is to supply US-outbound minutes at artificially low prices to operators who offer callback from the US. Consumers in the US can easily lose since the increased callback typically raises US carriers' marginal costs of sending all traffic on that route, tending to raise US retail prices. Moreover, even US carriers collectively may lose.

Section III identifies the incentives of a foreign monopolist, allied with a US carrier, to manipulate settlements via traffic re-routing schemes that do not directly affect the US retail market, especially by offering callback from the US to foreign callers. These schemes enable the monopolist to terminate less traffic (at the above-cost settlement rate) with nonalliance US carriers, without violating the ISP rules and without losing retail revenue.[9] Holding other carriers' traffic constant, we present results on the alliance's profit from manipulation as a function of the US ally's market share, the initial inbound and outbound traffic, the settlement rate, and the true cost parameters. Illustrative calculations with US data show that the profit diversion from nonalliance carriers can amount to hundreds of millions of dollars per annum.

Section IV analyzes how such settlements gaming affects *nonalliance* carriers' net marginal costs of sending outbound traffic, evaluated at their pre-gaming traffic levels. The link arises because—under proportional return—a nonalliance carrier's marginal cost of terminating its calls abroad equals (a) the settlement rate *minus* (b) that carrier's gain from increasing its share of US-inbound traffic; the alliance's gaming affects term (b). Surprisingly, a small amount

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[9]The effect on US welfare will be worse than when callback is initiated by independent operators, as discussed earlier. With alliance-initiated callback, there is no arbitrage at the expense of the foreign carrier, arbitrage that otherwise would benefit callback operators (typically US entities) or callers from that country (potentially US companies or traveling nationals). Moreover, since the foreign carrier would actively support such callback to its country, it may be more likely to occur, and on a larger scale.

of gaming can reduce the marginal cost of (only) the largest nonalliance carrier; but we provide fairly weak conditions for alliance gaming to raise the marginal costs of *all* nonalliance carriers.

The likely increase in nonalliance carriers' marginal costs creates a strong presumption that their retail prices for calls from the US will rise. (We cannot be more definitive because we do not model the demand side and retail competition, which are not central for understanding the incentives to game the ISP.) Our finding that—by exacerbating the gaming of settlements—entry by dominant foreign carriers into the US market (through alliances or integration) may raise US retail prices is novel. The potential efficiencies of foreign carriers' entry are well recognized. The standard concerns voiced about such entry—predatory price squeezes or diversion of traffic from potentially more efficient US carriers to the ally (since the ally would base its retail prices on the true marginal cost of foreign termination, while nonalliance carriers pay an inflated rate)—also predict lower prices, at least in the short run. In contrast, traffic gaming under proportional return is likely to raise prices and thereby harm US consumers. We show that gaming can be expected to benefit the alliance despite the induced drop in nonalliance carriers' traffic to the monopolist's country and the monopolist's resulting loss of termination revenue *from* them. We also elaborate on why forming an alliance (or entering the US market directly) may facilitate gaming by a dominant foreign carrier, compared to arm's length contracting with a US carrier.

Section V presents a simple reform of the ISP that eliminates these proportional-return distortions, including gaming incentives by foreign monopolists, yet benefits both countries. This alternative system does not require lump sum transfers or nonlinear pricing. Section VI briefly discusses policy implications for liberalized countries. It also identifies additional areas—beyond the case analyzed here of ISP gaming by monopolists against competitive carriers—where manipulation of telecom traffic flows through similar practices has arisen or may arise in future, in response to termination being priced above marginal cost.

II. COMPETITIVE DISTORTIONS UNDER PROPORTIONAL RETURN

II(i).   *Perceived Net Marginal Costs of Termination*

Consider a competitive domestic country (indexed by d) with multiple carriers of international traffic, indexed by j, and a monopolistic foreign country with a single carrier, m. Let N_I (> 0) and N_O (> 0) denote the total number of minutes inbound to country d and outbound from it, respectively. Carrier j sends n_j outbound minutes and its market share is $s_j = n_j / N_O$. Carriers' market shares are exogenous; they can vary due to factors outside our model, e.g., retailing costs or demand characteristics. Thus, we do not specify a full equilibrium model. Let c_d be the constant marginal cost per minute to any competitive carrier of transporting a call from the meet point with m and completing it in country d; for simplicity, assume that c_d is also the cost of originating a call from country d and transporting it to the meet point. (Thus, c_d includes both international transport and in-country costs; in the US, the latter include access charges paid to local carriers such as the Bells.) Define c_m similarly for the monopolist carrier. The symmetric settlement rate between these countries is r and the competitive country has adopted proportional return. For any competitive carrier j, its total cost of sending n_j minutes is C_j:

$$(1) \qquad C_j = (r + c_d)n_j - (r - c_d)s_j N_I = (r + c_d)n_j - (r - c_d)n_j \frac{N_I}{N_O}.$$

The term $(r + c_d)n_j$ is the cost of sending the outbound minutes, both origination costs and payments to m. The profit from terminating inbound minutes is the margin $(r - c_d)$ multiplied by the number of minutes j terminates, which, under proportional return, is $s_j N_I$.

Purely to simplify notation, we focus on $C_j - c_d n_j$, carrier j's costs of terminating its traffic abroad net of profit from inbound termination and excluding origination costs $c_d n_j$. The net *average* cost of termination is equal across carriers and is given by

$$(2) \qquad AC \equiv \frac{(C_j - c_d n_j)}{n_j} = r - (r - c_d)\frac{N_I}{N_O},$$

the settlement rate minus the profit per minute of inbound termination weighted by the industry-wide ratio of inbound to outbound traffic. This construct plays a useful role in later analysis.

A carrier's perceived net *marginal* cost of foreign termination is

(3)
$$\frac{d(C_j - c_d n_j)}{dn_j} = r - (r - c_d)\frac{N_I}{N_O} - (r - c_d)n_j\frac{d}{dn_j}\left(\frac{N_I}{N_O}\right)$$

$$= AC + (r - c_d)\frac{N_I}{N_O}n_j\left(\frac{dN_O/dn_j}{N_O} - \frac{dN_I/dn_j}{N_I}\right),$$

where AC is given in (2), and the derivatives dN_O/dn_j and dN_I/dn_j reflect carrier j's expectations about how a small increase in its traffic will influence total industry outbound and inbound traffic. These expectations will depend, inter alia, on how j attains the increased traffic (e.g., industry-wide price cut or selective discount to a new customer) and on the relationship between inbound and outbound calling (substitutes, complements, independent). In most of our formal analysis we consider the Cournot-like case where any carrier j expects that variations in its outbound traffic will not affect inbound traffic or other carriers' outbound traffic: $dN_I/dn_j = 0$, $dN_O/dn_j = 1$. This corresponds to a situation where inbound and outbound calling are independent and where j generates a new calling minute rather than diverting any business from others (e.g., by giving a selective discount to a new customer). We first note the properties of marginal cost under these assumptions, and then discuss alternative assumptions about expectations.

Substituting $dN_I/dn_j = 0$, $dN_O/dn_j = 1$ in (3) gives carrier j's net marginal cost of terminating its outbound minutes assuming that traffic of other carriers remains constant:

(4) $$MC_j \equiv \frac{\partial(C_j - c_d n_j)}{\partial n_j}\bigg|_{N_I, N_O - n_j} = r - (r - c_d)\frac{N_I}{N_O}\left(1 - \frac{n_j}{N_O}\right) = AC + (r - c_d)\frac{N_I}{N_O}s_j.$$

Examining (2) and (4) reveals several properties. First, both AC_j and MC_j are less than the settlement rate r, because of the profit from proportional return. Their deviation from r increases with the termination margin $(r - c_d)$ and with the ratio of inbound-to-outbound traffic (N_I / N_O).

Second, AC increases with n_j, because total outbound minutes N_O increase with n_j; intuitively, the given total profit from inbound termination—which is what keeps AC below r—is spread over a larger outbound volume. Observe, however, that proportional return equates AC across carriers, regardless of their outbound market shares.

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Third, unlike average cost, marginal cost does depend on a firm's initial market share. For given levels of inbound and outbound traffic, carriers with higher market shares face higher net marginal costs of foreign termination—because the increase in a carrier's market share and, hence, in its allocation of inbound minutes, is smaller the larger is its initial share.[10] Specifically, an increase in carrier j's outbound minutes from n_j to $n_j + t$ raises its market share by Δs_j, where

$$(5) \qquad \Delta s_j = \frac{n_j + t}{N_O + t} - \frac{n_j}{N_O} = \frac{(N_O - n_j)t}{N_O(N_O + t)} = \frac{(1 - s_j)t}{N_O + t}.$$

Thus, Δs_j is linearly *decreasing* in the initial share s_j. Consequently, equal successive increases in carrier j's minutes yield successively smaller gains in its market share and, hence, divert to j fewer additional inbound minutes for profitable termination. As a result MC_j increases with s_j.

Based on (2) and (4), Figure 1 shows average and marginal costs for any carrier j as functions of j's initial market share. Focus on the lowest AC and MC curves, those with vertical intercept $r - (r - c_d)k$, where $k = N_I / N_O$. (The other three curves become relevant in Section IV.) The curves represent 'cross-sectional' comparisons, holding constant the number of inbound minutes N_I and outbound minutes of carriers other than j, and thus also total *initial* industry outbound minutes N_O. (A higher N_O or a lower N_I would imply a higher AC curve.[11]) Average

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[10]The fact that larger carriers face higher marginal costs even though proportional return equalizes average costs is understood as follows. An increase t in outbound minutes by any carrier yields the same increase in average cost, $\Delta AC = AC_1 - AC_0$. The resulting increase in *total* cost for the carrier j that sends the t minutes is $tAC_1 + n_j\Delta AC$, where n_j denotes j's initial outbound minutes. This cost increase is greater the larger is n_j and, thus, the greater is j's initial market share of the given initial industry minutes (N_O).

[11]In Figure 1, the fact that marginal cost is rising and lies above average cost, yet average cost is constant, arises because we represent costs as functions of shares. If costs were written as functions of j's *minutes*, then (still holding constant N_I and other carriers' outbound minutes) marginal cost and average cost would both increase with n_j, marginal cost would exceed average cost, and both functions would approach r in the limit. Marginal cost increases as n_j increases for two reasons, seen in the middle expression in (4): a market share effect—as n_j and N_O increase equally, the term $(1 - n_j/N_O)$ diminishes; and an increase in total industry minutes, N_O, which lowers N_I/N_O (the effect that also increases AC).

cost is unaffected by market share. But marginal cost equals average cost if share is 0, rises linearly with share, and equals r if the share is 1 ($MC_j = r$ if $s_j = 1$ since a monopolist j cannot expand its market share and hence its share of termination profit, so sending an additional outbound minute increases its net termination costs by the full settlement rate r).

—INSERT FIGURE 1 ABOUT HERE—

Alternative Expectations. All that matters qualitatively for our subsequent analysis is that three properties hold: (a) MC is higher for a carrier with higher market share; (b) MC rises as a carrier expands its outbound traffic; and (c) MC rises as the industry-wide traffic ratio N_I/N_O declines. These properties hold in our case (4), which assumes $dN_I/dn_j = 0$, $dN_O/dn_j = 1$. Continuing to assume that N_I is unaffected, the case polar to $dN_O/dn_j = 1$ is $dN_O/dn_j = 0$: instead of pure expansion of industry traffic, carrier j's expansion represents pure diversion from other carriers. Marginal cost in (3) then becomes $r - (r - c_d)(N_I/N_O)$, and properties (a) and (b) no longer hold (though (c) does). Reality is likely to lie somewhere between these extremes, i.e., $dN_O/dn_j \in (0,1)$, so it is reasonable to assume that MC does increase with market share and with a carrier's outbound traffic.[12]

Finally, suppose carrier j creates an additional outbound minute by offering callback that merely displaces an inbound minute: $dN_O/dn_j = 1$ and $dN_I/dn_j = -1$. From (3), marginal cost now becomes $AC + (r - c_d)(N_I/N_O + 1)s_j$, which also increases with s_j. Thus, it is smaller carriers that

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Both effects reduce the proportional-return term $(r - c_d)(1 - n_j/N_O)(N_I/N_O)$ as n_j increases, bringing MC_j closer to r.

[12]For a fuller discussion see 'Marginal Cost under Alternative Expectations' in the Supplemental Materials for this article, located on the *Journal's* web page at <www.stern.nyu.edu/~jindec/>. (This Supplement is included at the end of this discussion paper.)

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have a greater incentive to offer callback, an issue we examine further in Section II(iii).

II(ii). *Bias Against Larger Carriers*

By reducing carriers' perceived net marginal costs of foreign termination below the settlement rate, proportional return is likely to reduce retail prices and benefit US consumers. However, since these marginal costs are artificially lower for carriers with smaller initial market shares, larger carriers are placed at an artificial disadvantage in competing for outbound traffic.[13]

This bias is likely to run opposite to what is needed for efficiency. In non-cooperative oligopoly, larger market shares result from lower marginal costs or advantages in demand (brand names, etc.), and these attributes imply that larger carriers earn higher price-cost margins than do smaller carriers. Since consumers ignore these margins in their purchase decisions (they are guided by retail prices, not margins), larger firms produce too little relative to smaller ones. Proportional return aggravates this bias in the industry's output mix.

Essentially, proportional return amounts to a disproportional subsidy for outbound traffic of smaller carriers financed by taxing the inbound termination profits of larger carriers. Promoting an efficient output mix would typically require subsidizing more heavily the outputs of those firms whose gap between price and marginal cost is greatest—likely to be the larger carriers.[14]

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[13]This poses an interesting contrast with the analysis by Laffont, Rey and Tirole [1998a, 1998b] of competition between domestic carriers, where marginal costs of sending traffic also depend on market shares. They show that if termination rates are symmetrically above costs and any carrier cannot charge different retail prices according to whether calls terminate on its network or on the rival's, then a carrier's average marginal cost of sending calls is *decreasing* in its market share of subscribers—because a larger fraction of its subscribers' calls also terminate on its network, thereby avoiding the rival's termination margin. But in our case, proportional return causes marginal cost to increase with market share.

[14]The fact that net marginal costs of terminating abroad is lower for smaller than for larger carriers only because smaller ones disproportionately divert (inbound) profits from larger ones implies that a larger carrier ordinarily would not gain by breaking itself up into competing entities, as this would entail 'stealing from itself'. Such breakup may be profitable for strategic reasons, following the usual taxonomy

II(iii). *Excessive Callback Incentives*

　　Proportional return also excessively encourages US carriers to supply US-outbound minutes to independent callback operators. Callback contributes to US carriers' deficit on settlements with foreign carriers, which in 1996 totaled $5.4 billion (the FCC estimates at least two thirds of this was payments to foreign carriers above their marginal costs of termination). A common reaction is that US carriers would not offer callback unless their revenue from the US-outbound minutes outweighs their extra termination payments. But this reaction overlooks the critical influence of proportional return on the profitability of callback.

　　Under proportional return, a carrier's gain from increasing its US-outbound traffic by any means, including supply of callback minutes,[15] comes partly from increasing its entitled share of inbound traffic. This share gain, however, is entirely at the expense of other US carriers; hence, inbound termination profits of other carriers fall as any carrier increases its outbound traffic, including for callback to the foreign country. If callback is used to reverse calls to the US from the foreign country (instead of reversing calls from that country to a third country using the US as a hub—see the discussion below and Section I), other carriers suffer not only because their share of inbound traffic is reduced, but also because such callback reduces total US inbound traffic. Yet, in both cases, a small enough US carrier (even if not allied with the foreign carrier) can find it profitable to supply US-outbound minutes for callback at prices so low that profits to US carriers as a whole decline. Moreover, this can also harm US consumers and overall US

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of incentives in two-stage games (Tirole [1988]). [Specifically, if a firm takes the number of rivals as given ('accommodation') and firms' second-stage choice variables are strategic complements, then the firm's incentive in the prior stage is to behave 'soft'—forgoing breakup into competing entities; conversely with strategic substitutes. But if the primary concern is deterrence of entry or of planned expansion, then regardless of the strategic substitutes/complements distinction, the firm will wish to play 'tough'; setting up competing 'divisions' (or outright breakup) can then be profitable (Schwartz and Thompson [1986]).] Such strategic breakup incentives, however, are separate from our central focus—proportional return.

[15]For proportional return purposes, US-outbound minutes sold by callback operators and other resellers are credited to the carrier on whose facilities the calls travel.

welfare.

To illustrate these possibilities, recall from the US-Hong Kong discussion in Section I that callback from the US to another country X is used in two ways: (1) to reverse calls from X destined to a third country Y, by using the US as a hub and connecting two calls from the US, one to X and the other to Y; and (2) to reverse calls from X to the US. Consider case (1), third-country calls, and suppose one minute is reversed. The change in total profit of all US carriers is $(w - c_d - r) + v$, where w is the wholesale price received by US carrier j for supplying the callback minute to X, c_d is j's origination cost, r is the settlement rate with X, and v is the profit from the call to Y. Thus, US carriers collectively lose if $w < r + c_d - v$. Yet carrier j, if its market share to X is small enough, would profit from this strategy even if $v = 0$ and w is well below $r + c_d$, because of the increase in j's share of profitable terminating traffic from X at the expense of the other US carriers. Such occurrences are not uncommon—in the early 1990s wholesale prices for minutes to callback operators from the US to Hong Kong fell to *half* the settlement rate (HKTI, 1997; Malueg and Schwartz, 1998). Also, the increase in minutes from the US to X—which reflects solely calls between non-US consumers in X and Y—reduces the ratio N_I/N_O of total US inbound-to-outbound traffic with X. This typically raises US carriers' perceived net marginal costs of supplying outbound calls to X, since the proportional return gain diminishes (Section IV(i) below). In turn, this tends to raise US retail prices for calls to X and thereby harm US consumers, not only other carriers. Overall US welfare can therefore also decrease.

Now consider case (2), where callback is used to reverse a call originally going from X to the US. Relative to case (1) of third-country reversal, there are two differences: no call to the third country Y (hence the term v is absent), and loss of an inbound minute to the US from X. Notwithstanding this second effect, a US carrier j whose market share to X is sufficiently small will still find it profitable to supply the callback minute at price w if (A) $w \geq r + c_d$, because of the proportional return gain (the loss to j from the decrease in the inbound minute will be arbitrarily small if j's initial share is sufficiently small). Profit to carriers as a whole, however, decline if (B) $w < 2r$ (the additional revenue is w, resource costs are unchanged because total

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traffic is unchanged, but reversing a US-inbound minute into an outbound one increases US settlement costs by $2r$). Provided $r > c_d$, the very condition which the ISP is designed to maintain, there is a range of values for w that satisfy conditions (A) and (B)—callback at w is individually profitable but reduces industry profit.

The potential effects on US consumers are more complex than in scenario (1). Consider one polar case, where US consumers value only calls they originate to country X and derive no utility from calls received from X or from the fact that callers in X pay lower prices. Callback is now likely to harm US consumers, by the same logic as in case (1) above: the decline in the traffic ratio (N_O rises as before, but this time N_I falls as well) typically raises US carriers' marginal costs of outbound calls to X and thereby is likely to raise their prices. Now consider the other polar assumption, that US callers (a) value equally calls they receive from X and calls they send, and (b) value equally price reductions to callers in X (e.g., family members) and price reductions to themselves in the US. It is still possible, but less likely, that callback will now, on balance, harm US consumers. The harm in the US market is still present, but may be outweighed by the benefits (internalized this time by US consumers) from the price cut offered to callers in X by the callback operator to induce the call reversal. But if the requisite price reduction is small, then any countervailing beneficial effects will also be small and dominated by the harm.[16]

In short, proportional return makes it possible for callback to reduce overall US welfare and harm US consumers.[17] Contrary to common perceptions, a foreign monopolist can gain from

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[16]Section III analyzes callback initiated by the foreign monopolist to reverse US-destined calls, without reducing foreign retail prices at all; there are then no countervailing benefits to US consumers.

[17]If the US retail market is imperfectly competitive, proportional return may increase US welfare by lowering retail prices for outbound calls closer to true marginal costs (Galbi [1998]). However, the implications of proportional return for US welfare are worse when it promotes callback. As noted, the added outbound minutes are not originated by US callers and, indeed, may not involve US consumers at all (case (1) above, reversal of third-country calls); and callback reduces US inbound minutes, and therefore transfers termination profits from US carriers to the monopolist abroad. Observe that callback generally can play pro-competitive roles: to arbitrage differences in retail prices at the two ends of a route; to undercut a monopolist's retail prices to third countries by using two outgoing calls from the US

callback even where callback deprives it of the retail revenue.[18] Moreover, the next section analyzes the incentives of foreign monopolists, allied with US carriers, to use callback and other traffic re-routing schemes to manipulate the settlements system without losing retail revenue.

III. INCENTIVES FOR TRAFFIC MANIPULATION BY CARRIER ALLIANCES

III(i). *Termination Profits under the ISP and Gaming Incentives*

Consider a foreign monopolist carrier, m, that 'enters' a liberalized country: it receives authority and acquires the capability to send calls from that country. For concreteness and brevity we take that country to be the US. Entry could involve various modes, such as establishing new facilities, acquiring ownership in a US carrier, or acquiring ownership in an entity affiliated with a US carrier. We model all these entry modes as an alliance between m and a US partner, carrier a. (Entry by m entirely through its own new facilities corresponds to the special case in which m's US 'ally' is entirely controlled by m and initially has zero US outbound traffic to m's country.) For now, assume that the objective of carriers m and a is to maximize their combined profit. This assumption is most appropriate if entry is through complete integration, but it may also be reasonable for other entry modes (see Section III(v)).

We focus on settlement payments between the monopolist m and nonalliance US carriers. Henceforth, 'outbound' traffic is from the US to m's country, and 'inbound' is into the US from

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hub (Section I); and to provide advanced services not offered by incumbents. But the profitability of such strategies does not hinge on proportional return, whereas the willingness to sell callback minutes below cost (e.g., below the settlement rate) is driven by proportional return.

[18]Let p_m denote the monopolist's retail price. If a minute of callback leaves total traffic unchanged (merely reverses the direction), the monopolist's change in profit is $2r - p_m = (r - c_m) - (p_m - c_m - r)$, the termination margin on the additional inbound call minus the retail margin on the lost outbound call. Thus, a sufficient condition for the monopolist to gain is $2r > p_m$. Incorporating the fact that callback may increase calling volume by lowering the price to foreign callers, and hence increase the monopolist's profit from termination, Scanlan [1998] shows that the monopolist can benefit even if $2r < p_m$.

m's country. Thus, N_I now denotes the total number of US inbound minutes sent by m from its country (subject to settlement at the symmetric rate between these countries, r). Let n_a denote a's outbound minutes. US carriers other than a ('nonalliance' or 'other' carriers) are denoted by $j = 1, 2, \ldots, T$, and their total outbound traffic is $n = \Sigma_{j \geq 1} n_j$. The total number of outbound minutes of all US carriers to m's country is therefore $N_O \equiv n + n_a$.

Recall that the cost of sending traffic for any US carrier j (net of j's profit from inbound termination), C_j, is given by (1). In particular, for the alliance partner a,

$$(6) \qquad C_a = (r + c_d)n_a - (r - c_d)s_a N_I = (r + c_d)n_a - (r - c_d)n_a \frac{N_I}{N_O}.$$

The foreign monopolist m earns profit on terminating all the US-outbound minutes, N_O, and incurs costs in sending the US-inbound minutes N_I; its total cost of termination is therefore

$$(7) \qquad C_m = (r + c_m)N_I - (r - c_m)N_O.$$

The alliance A of carriers a and m therefore incurs total termination cost $C_A = C_a + C_m$, or

$$(8) \qquad C_A = (c_m + c_d)(n_a + N_I) + (r - c_d)(1 - s_a)N_I - (r - c_m)n,$$

where $(c_m + c_d)(n_a + N_I)$ is the true resource cost of sending and terminating the alliance's calls in both directions (any payment of r is just a transfer within the alliance); $(r - c_d)(1 - s_a)N_I$ is the additional payment m incurs because, instead of terminating all its calls in the US at marginal cost c_d with its partner a, it pays an additional markup $(r - c_d)$ on the $(1 - s_a)N_I$ minutes that it must terminate with nonalliance carriers under proportional return; and $(r - c_m)n$ is A's profit on calls from nonalliance carriers to m.

The incentives and ways to game the ISP can be grasped by examining (8), holding constant the number of outbound minutes of nonalliance carriers, n. Although gaming will affect n in equilibrium, holding n constant is a natural starting point, since the settlement gaming schemes discussed below do not affect the retail market directly (indirect effects are explored in Section IV). The alliance aims to reduce the 'surcharge' paid to nonalliance carriers, $(r - c_d)(1 - s_a)N_I$. The next two subsections consider two strategies: *call inflation*, which raises s_a; and *call turnaround*, which both raises s_a and lowers N_I, while keeping $n_a + N_I$ constant. The

alliance's retail revenue will not be directly affected by either strategy.

III(ii). *Call Inflation by the Alliance*

We use *call inflation* to denote an increase in the calls sent by the US ally but not emanating from US consumers. Its purpose is to boost the ally's *share* of US-outbound minutes and, hence, under proportional return, the share of the monopolist's traffic to the US that may be terminated with the ally. We first address call inflation that creates new useless (e.g., computer generated) minutes.[19] Later we discuss call inflation via re-origination of calls through the US.

Throughout the remainder of Section III, we hold constant carrier a's initial (pre-gaming) outbound minutes (n_a), total outbound minutes of all other carriers (n), and initial inbound minutes (N_I). These traffic levels reflect the non-gaming equilibrium. Suppose carrier a increases its outbound minutes to m's country from n_a to $n_a + t$, raising a's market share by Δs_a, as given in (5) (with carrier j now taken to be the alliance partner a). The alliance's net termination cost becomes

$$\left. C_A \right|_{\text{inflation}} = (c_m + c_d)(n_a + t + N_I) + (r - c_d)(1 - s_a - \Delta s_a)N_I - (r - c_m)n$$

(9)
$$= (c_m + c_d)(n_a + N_I) + (r - c_d)(1 - s_a)N_I - (r - c_m)n$$

$$- \left[(r - c_d)N_I \Delta s_a - (c_m + c_d)t \right],$$

where the final term in brackets depicts the profitability of call inflation. The alliance's cost of call inflation is the resource cost of sending and terminating the t minutes, $(c_m + c_d)t$. (Other cost assumptions are discussed after Proposition 1.) The benefit $(r - c_d)N_I \Delta s_a$ arises because, under proportional return, the expansion in a's outbound market share by Δs_a diverts $N_I \Delta s_a$ inbound minutes from nonalliance carriers to a, and on each diverted minute the alliance saves $(r - c_d)$.

It is also instructive to examine the alliance's *marginal* cost and benefit of call inflation.

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[19]Industry insiders report that computer-generated minutes have indeed been used. A clear advantage of this over simply misreporting the minutes sent is that the foreign carrier tracks the number of minutes into its country. See also Ryan [2000] for similar issues among local carriers in the US.

The marginal cost is simply $(c_m + c_d)$. Using (5) and (9), the marginal benefit is

$$(10) \quad MB\Big|_{\text{inflation}} = (r - c_d)N_I \frac{\partial \Delta s_a}{\partial t} = (r - c_d)N_I \frac{n}{(N_O + t)^2} = (r - c_d)(1 - s_a)\frac{N_O N_I}{(N_O + t)^2}.$$

Marginal benefit diminishes because equal increases in a's minutes yield successively smaller increases in a's market share and hence in the number of inbound minutes diverted to a.

Proposition 1 *(Incentives for Call Inflation):*

(A) A given amount of call inflation becomes more profitable for the alliance as:

  (A.1) the ally has a smaller initial share (s_a) of the given outbound traffic (N_O);

  (A.2) the level of inbound traffic (N_I) is higher, or the level of outbound traffic (N_O) is lower, given firm a's share (s_a);

  (A.3) termination costs (both c_d and c_m) are lower or the settlement rate (r) is higher.

(B) Some call inflation ($t > 0$) is profitable for the alliance if and only if

$$(r - c_d)(1 - s_a) > \left(\frac{N_O}{N_I}\right)(c_m + c_d).$$

(C) If the condition in (B) is met, the alliance's optimal level of call inflation is t^*, where

$$\frac{t^*}{N_O} = \sqrt{(1 - s_a)\left(\frac{N_I}{N_O}\right)\left(\frac{r - c_d}{c_d + c_m}\right)} - 1.$$

<p align="center">**—INSERT FIGURE 2 ABOUT HERE—**</p>

Part (A) follows by recalling (5) and examining the term in square brackets of (9). Figure 2 illustrates parts (B) and (C); call inflation becomes profitable if and only if the vertical intercept of *MB* exceeds $c_m + c_d$, a condition equivalent to that in (B). When call inflation is profitable, the profit-maximizing level, reported in (C), is found where *MB* from (11) equals the marginal cost of inflation, $c_m + c_d$.

Proposition 1 presumes that call inflation occurs by generating new (but useless) US minutes. Another method is *re-origination*—taking calls from third countries destined to the monopolist's country and routing them via the US ally. The results of Proposition 1 must then be modified as follows. The *total* number of minutes terminating in m's country does not increase, so m avoids the cost tc_m. But one must add the costs of re-routing the call via the US and subtract any reduced termination revenue to m if its settlement rate with the US is lower than with the country where the call originated. [20] Of course, if m is orchestrating re-origination to maximize alliance profit, it will seek to re-originate (through the US) from countries with which its settlement rates are *lower* than its rate with the US. This contrasts with cases where re-origination of calls into the monopolist's country is driven by third-party arbitrage of differences in the monopolist's settlement rates with different countries.

Observe that call inflation will increase the alliance's outbound minutes and appear as a pro-competitive expansion of US output. But this is illusory, as the 'expansion' does not represent useful minutes for US consumers. Note also that incentives for call inflation hinge on proportional return.[21] But incentives for call turnaround arise more generally, as shown next.

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[20]Note that these cost-side modifications do not affect the comparative statics results established for $1 - s_a$, r, or N_O / N_I, which depend only on the marginal benefit. Note also that the cost of call inflation also may be lower than $c_d + c_m$ (the level assumed in Proposition 1) not only with reorigination but also for new calls that are generated *off-peak*, when marginal costs are negligible.

[21]The incentives created by this regulatory linkage across markets—of the allocation of inbound-minutes to outbound shares—are analogous to the incentives of a firm subject to cost-of-service regulation in one market to cross-subsidize an unregulated affiliate provided some costs can be misattributed to the regulated market; one likely consequence is an artificial expansion in the firm's output in the unregulated market (Brennan [1990]).

III(iii). *Call Turnaround by the Alliance*

     Call turnaround by the alliance entails taking a call from *m*'s country to the US and reversing it for settlements purposes into a call sent from the US by the ally.[22] Unlike callback sponsored by independent operators, here the foreign carrier retains the retail revenue: it charges the same retail price to its customer, but the call is labeled a 'callback'.[23] The alliance benefits for two reasons. The ally's US-outbound market share increases, allowing it to terminate a greater share of inbound traffic; this effect is analogous to call inflation. But, in addition, US-inbound traffic decreases (having been converted into outbound traffic for settlements purposes).

     Suppose the alliance turns around a call of *t* minutes from *m*'s country to the US into a call of *t* minutes completed by carrier *a* from the US to the foreign caller. Now examine the

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[22]Early callback methods relied on making a short call, and requesting a return call. Later methods relied on 'uncompleted call signaling' from the foreign country: a subscriber would dial a subscriber-specific US number and hang up, and the US computer would recognize the hang-up and initiate a callback to the subscriber's pre-determined number in the foreign country. Modern technologies are even more sophisticated. They employ out-of-band signaling, whereby the information pertaining to the desired call (e.g., destination number, caller's account) travels independently from the call itself (e.g., over data networks, the Internet, or private lines). Thus, the callback switch in the US would process the signaling information, and rapidly provide the necessary link(s) from the US with little noticeable difference as compared to a direct call. We prefer 'turnaround' over 'callback' since 'turnaround' connotes that the call direction is reversed for billing (and hence, settlement) purposes and that the methods used go beyond literal callback. But following industry practice, we shall use the terms interchangeably.

[23]Recall that the direction of a call for settlements purposes traditionally is determined by where the call is billed. In our example, the US ally carrier *a* bills its foreign partner *m* for providing callback minutes from the US and pays settlement charges to *m*. To reduce the scheme's transparency, the parties could instead contract through a callback provider, *y*. Carrier *m* signals initially to *y*, instructing *y* to purchase a callback from *a*. Thus, *m* pays *y*, and *y* pays *a*. Carrier *a* records the transaction as a sale of outbound minutes to a callback operator. If they wished to prevent such a scheme, regulators would have to identify a callback operator's ultimate customers—a foreign carrier or 'ordinary' end users. The extra step of going through a callback operator (or, if need be, having that operator also bill the retail customer and rebate this amount to carrier *m*) should not significantly reduce the profitability of the scheme to the alliance, given competition among callback operators (or ownership of the operator by *a* or *m*).

alliance's termination account. Unlike the call inflation addressed in Proposition 1, turnaround does not increase the total number of minutes and therefore avoids the extra costs $(c_m + c_d)t$ of inflation. Instead, signaling costs (see fn. 22) are incurred to initiate the call reversal. Signaling costs vary mainly with the number of calls not minutes—because a cost is incurred only in setting up a call. As an approximation, however, we represent the cost of signaling as a constant x per minute, by averaging the signaling cost over the expected duration of a call. One justification for this averaging is that call duration is not known ex ante, when the alliance must decide whether the benefits from turnaround will cover the fixed cost of signaling.

The alliance's new termination cost is found from (8) as follows: recompute C_A to reflect the increase in a's outbound minutes from n_a to $n_a + t$ and the decrease in inbound minutes from N_I to $N_I - t$, and then subtract the signaling costs xt. As before, hold constant n, the outbound minutes of nonalliance carriers, and let Δs_a from (5) denote the increase in a's market share from sending the t additional outbound minutes. The alliance's termination cost is therefore

$$C_A\big|_{\text{turnaround}} = (c_m + c_d)(n_a + N_I) + (r - c_d)(1 - s_a - \Delta s_a)(N_I - t) + tx - (r - c_m)n$$

(11)
$$= (c_m + c_d)(n_a + N_I) + (r - c_d)(1 - s_a)N_I - (r - c_m)n$$

$$- \big[(r - c_d)N_I \Delta s_a + (r - c_d)(1 - s_a - \Delta s_a)t - tx\big].$$

The profit from call turnaround is depicted in the final term of (11), which can be decomposed into a diversion effect, $(r - c_d)N_I \Delta s_a$; a replacement effect, $(r - c_d)(1 - s_a - \Delta s_a)t$; and the signaling cost, tx. The diversion and replacement effects are understood as follows. Think of turnaround as first increasing a's outbound minutes, then reducing total inbound minutes. Under proportional return, the increase in a's outbound share lets m divert $N_I \Delta s_a$ inbound minutes from nonalliance carriers and terminate them instead with a, saving the alliance $(r - c_d)N_I \Delta s_a$. This diversion benefit is equivalent to that from call inflation. Now consider replacement. For settlement purposes, turnaround converts t inbound minutes into t outbound ones. Of these, $(1 - s_a - \Delta s_a)t$ would have terminated with nonalliance carriers under proportional return, since $(1 - s_a - \Delta s_a)$ is their collective outbound market share following the

increase in a's outbound minutes and hence market share. Thus, for $(1 - s_a - \Delta s_a)t$ minutes, turnaround replaces US termination with nonalliance carriers by foreign termination; on each such minute, the alliance again saves the profit margin charged by nonalliance carriers, $r - c_d$ (c_d is still incurred, as turnaround only changes the direction of calling, and we have assumed that the costs of originating from and terminating in a given country are equal).

Comparing (11) with the alliance's termination cost under call inflation from (9) shows

(12) $$C_A\big|_{\text{turnaround}} = C_A\big|_{\text{inflation}} - (r - c_d)(1 - s_a - \Delta s_a)t - (c_d + c_m - x)t.$$

Call turnaround is therefore more profitable than inflation because of the added replacement benefit (middle term), and the cost savings (last term—recall that the cost of signaling to set up a call reversal, x, is likely to be low relative to the costs of actually generating a new call, $c_d + c_m$). We can also compare the *marginal* cost and benefit of turnaround, to obtain Proposition 2 below. The marginal cost is simply x. The marginal benefit is

(13) $$MB\big|_{\text{turnaround}} = MB\big|_{\text{inflation}} + \frac{\partial}{\partial t}\big[(r - c_d)(1 - s_a - \Delta s_a)t\big]$$

$$= \frac{N_O(N_I + N_O)}{(N_O + t)^2}(1 - s_a)(r - c_d),$$

using expression (5) for Δs_a. Using equations (11) and (13), Proposition 2 provides results for call turnaround analogous to those in Proposition 1 for call inflation.

***Proposition 2** (Incentives for Call Turnaround):*

(A) A given amount of call turnaround becomes more profitable for the alliance as:

   (A.1)   the US ally has a smaller initial share (s_a) of the given outbound traffic (N_O);

   (A.2)   the level of inbound traffic (N_I) is higher, or the level of outbound traffic (N_O) is lower, given firm a's share (s_a);

   (A.3)   the domestic termination cost (c_d) and the signaling cost (x) are smaller or the settlement rate (r) is larger.

(B) Some call turnaround ($t > 0$) is profitable for the alliance if and only if

$$(r - c_d)(1 - s_a) > \left(\frac{N_O}{N_O + N_I} \right) x.$$

(C) Turnaround of *all* inbound traffic ($t = N_I$) is optimal for the alliance if and only if

$$(r - c_d)(1 - s_a) \geq \left(\frac{N_O + N_I}{N_O} \right) x.$$

(D) If some, but not all, turnaround of inbound traffic is optimal, then the alliance's optimal level of call turnaround, t^*, satisfies

$$\frac{t^*}{N_I} = \sqrt{(1 - s_a)\left(\frac{N_O}{N_I} \right)\left(1 + \frac{N_O}{N_I} \right)\left(\frac{r - c_d}{x} \right)} - \frac{N_O}{N_I}.$$

In short, where callback is initiated by the alliance, there is no arbitrage of retail pricing between the two countries, and the alliance necessarily gains (if the signaling cost x is low). Foreign carriers are catching on; as noted, in 1997 HKTI launched its own callback operation.

Call turnaround is profitable to the alliance under more general conditions than is call inflation, since it yields the same diversion benefit (and at lower cost) but in addition replaces inbound minutes with outbound ones. Because of this replacement effect, incentives for call turnaround (unlike those for call inflation) do not hinge on the linkage induced by proportional return between shares of outbound traffic and of inbound termination. For example, call turnaround incentives exist also under the following alternative to proportional return that still denies the monopolist discretion over which US carriers terminate its traffic.

Proposition 3 *(Turnaround Incentives with Fixed-Share Allocations)*:

Suppose there is no proportional return, but the foreign monopolist *m* is required to terminate *fixed* shares $\{z_i\}_i$ of its minutes with the various US carriers. Holding constant the outbound minutes of nonalliance carriers, the alliance of *m* and *a* maximizes profit by turning around *all* US inbound minutes N_I if $(r - c_d)(1 - z_a) > x$, and zero minutes otherwise. Thus, if turnaround occurs, the alliance's profit is $N_I\big[(r - c_d)(1 - z_a) - x\big]$.

The above analysis cautions against viewing monopolists' alliances with small US carriers as automatically pro-competitive. A monopolist maximizes its potential gain from reducing its termination payments to US carriers by allying with the carrier that initially terminates the least traffic from the monopolist (provided the ally has, or can rapidly acquire, capacity to expand its traffic); under proportional return, this is the carrier with the smallest outbound market share.[24] Therefore, the risk that the alliance will be used to divert termination profits from other carriers by gaming the ISP is greater when the monopolist partners with a small US carrier. (We address efficiency motives for alliances in subsection IV(iii).)

III(iv). *Empirical Magnitudes*

Table I reports on eight countries accounting for significant shares of US-inbound traffic and whose settlement rates exceed 20¢/minute. For each route, we consider an alliance between the dominant foreign carrier and a US carrier with no initial traffic on that route ($s_a = 0$); this overstates only modestly the alliance's gain relative to partnering instead with the smallest of the major US carriers (AT&T, MCI, Sprint, and WorldCom) active on that route, since the smallest such carrier (Sprint to India, WorldCom elsewhere) always had a market share below 10%. The last four columns report the alliance's preferred call inflation as a percent of initial outbound minutes, $(t^*/N_O)\cdot 100$, and the resulting profit diversion from nonalliance carriers, $(r - c_d)N_I\Delta s_a$, under two assumptions about domestic and foreign origination and termination costs.

—INSERT TABLE I ABOUT HERE—

The first case has $c_d = 7$¢/min, $c_m = 8$¢/min. The 7¢ figure is based on AT&T's 1996 estimate that its cost of terminating calls in the US was 7.5¢ (FCC [1997a]) and noting that access charges paid by international US carriers to local US phone companies, included in the 7.5¢ figure, have declined since then. The 8¢ figure is in the 6¢-9¢ range of the FCC's [1996]

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[24]A similar pattern would hold in the no-proportional-return case of Proposition 3, if the exogenous allocation of inbound minutes were positively correlated with carriers' initial outbound shares.

estimate of termination costs abroad (the US and Sweden, for example, have a *settlement* rate of only 8¢, suggesting that the cost is even lower; however, the figure could be higher in less developed countries). Table I shows that to all countries except China and Israel, call inflation that entails creating new minutes, and thus incurs costs of $c_d + c_m$ per minute, is unprofitable. A major reason is that the US already receives from these countries far fewer minutes than it sends (N_I/N_O is well below 1; see Proposition 1(B)). The second case shown in Table I, $c_m = 0$, approximates the scenario where call inflation increases the ally's US-outbound minutes by letting it re-originate existing third-country traffic destined to the monopolist's country; there is no increase in the total traffic terminated by the monopolist in its country and, hence, no increase in the monopolist's associated costs. Call inflation is then profitable to all countries but Hong Kong, and the total diversion of termination profit from nonalliance US carriers is $135 million.

Table II considers the same eight countries as in Table I (and, as before, an ally carrier with $s_a = 0$), but reports profit diversion, $(r - c_d)(N_I \Delta s_a + t(1 - s_a - \Delta s_a))$, from various amounts t of call turnaround; t is set at 10%, 20%, 30%, 40%, or 100% of the initial inbound minutes N_I. The last column reports the highest signaling cost x^* for which the alliance would prefer 100% turnaround (see Proposition 2 (C)). In all cases, the value of x^* exceeds plausible estimates of x (of only a few cents). Thus, left unconstrained, the alliance would turn around all US inbound traffic, thereby reducing nonalliance carriers' termination profits by over half a billion dollars annually. The other columns show what happens if the alliance is constrained—perhaps by fear of regulatory reaction—to lower percentages of turnaround. Even if only 30% of US inbound minutes are turned around, the annual harm to nonalliance carriers exceeds $200 million.[25]

<center>**—INSERT TABLE II ABOUT HERE—**</center>

Comparing Tables 1 and 2 shows that call turnaround is a more significant issue than call

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[25]The profit diversion increases less than proportionately with the percentage of inbound minutes turned around because the call inflation component of turnaround exhibits diminishing returns (from the standpoint of the ally carrier), as does any call inflation (see Section III(ii)).

inflation; even with inflation through re-origination, which avoids added foreign termination costs, the profit diversion under the alliance's preferred degree of call inflation is less than one quarter of the profit diversion that obtains under the preferred degree (100%) of turnaround.

III(v). *How Alliance Relationships Can Facilitate Settlements Manipulation*

So far we assumed that cooperation between carriers *m* and *a* is tight enough that their alliance acts to maximize their joint profit. Joint maximization is not necessary for our results. But some arrangement that enables profit sharing or transfers will often be needed, since traffic manipulation may well increase the carriers' combined profit but harm one of them.

The need for compensation. Consider first a case where the direction of compensation would be from the US ally *a* to the foreign monopolist *m*. Suppose that call inflation by *a* takes the form of *re-originating* through the US some traffic from a third country, X, destined to *m*. Suppose that *m*'s (symmetric) termination rate is higher with X than with the US. Provided the difference in rates is not too great (and the extra transport cost of re-routing is not too high), the alliance as a whole can gain from re-originating some such traffic through the US—by increasing *a*'s share of the traffic from *m* at the expense of nonalliance carriers. However, *m* would lose from such re-routing, since the termination rate from the US is lower than from X. In such a case, *m* supports the re-origination only if it can share in *a*'s increased profit.

Now consider three examples where compensation would be needed from *m* to *a*. First, modify the previous example of call inflation through re-origination, by assuming that *m*'s termination rate with country X is lower than with the US. As before, call inflation diverts termination profit from nonalliance carriers to *a*, thus raising the alliance's overall profit. But now *m* benefits, while *a* may lose despite the diversion—because it incurs the differential between the higher termination rate from the US than from country X. (The differential is what matters, because under reorigination the carrier in X would be liable for only the termination payments for a direct call from X to *m*.) If so, re-origination becomes mutually profitable only if *m* compensates *a*.

Second, consider call inflation through a net expansion of useless (e.g., computer

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generated) minutes. The alliance as a whole can benefit (Proposition 1); but, for $N_I < N_O$, a loses unless compensated for the increased termination payments it makes to m for the additional minutes.

The third and probably most important example where compensation would be needed from m to a involves call turnaround. Suppose $t > 0$ minutes are turned around and added to a's outbound minutes. We investigate the need for compensation by exploring the limits of linear contracts between m and a. Suppose that m offers a only a linear price (for each of the t minutes) equal to a's origination cost (c_d) plus a's net marginal cost of termination from (4), evaluated at a's higher, post-turnaround level of minutes.[26] Would a accept the offer?

The tradeoff facing a can be visualized as follows: (i) the drop in inbound minutes harms a by shifting up its marginal cost function of sending outbound minutes; but (ii) a benefits by sending the additional minutes, because its new MC function—which incorporates both the effect of fewer inbound minutes and the proportional return gain from expanding a's outbound minutes—is rising, and for the t minutes a receives a price equal to its higher marginal cost, $MC_a(n_a + t; N_I - t)$. The arrangement will be profitable to a if its initial outbound share (s_a) is sufficiently small: a's loss from the drop in inbound minutes, effect (i), is $(r - c_d)t s_a$, which goes to zero for any t as s_a goes to 0 (carriers other than a terminated most of the lost minutes). But the scheme is clearly unprofitable to a if a's initial share is sufficiently large. The loss $(r - c_d)t s_a$ is then large. In contrast, the gain, effect (ii), becomes arbitrarily small as s_a approaches 1.[27] How large can s_a be before a rejects any call turnaround under the proposed linear compensation?

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[26]This experiment assumes that all carriers continue to supply the same number of outbound minutes in the retail (i.e., non-turnaround) market.

[27]Because marginal cost is continuously increasing, the gain (ii) is no bigger than t multiplied by the change in marginal cost; since marginal cost increases *continuously* and equals r for $s_a = 1$, this change in marginal cost goes to zero as a's market share approaches 1. Intuitively, a's maximal gain from diverting inbound minutes from other carriers is small if it is already getting most of these minutes on account of its initially high share.

Proposition 4 *(Turnaround Incentives Without Compensation):*

Suppose that turnaround reverses t inbound minutes into t outbound ones sent by the US ally carrier a, and m pays a for each of the t minutes a price equal to a's marginal cost of sending outbound minutes evaluated at a's post turnaround level of minutes. Then carrier a prefers zero turnaround ($t = 0$) over any positive amount if its initial market share s_a exceeds $s_{max}^* = \left[N_I / (2N_O + N_I) \right]^2$. In particular, if initially outbound traffic exceeds inbound ($N_O \geq N_I$), then under the hypothesized linear pricing arrangement, carrier a would find turnaround of any minutes unprofitable if its initial market share is above 1/9 or approximately 11%.[28]

Two comments are in order. First, the threshold market share s_{max}^* will be even lower than 1/9 if initially N_O strictly exceeds N_I, as is the case between the US and most countries. For example, between the US and Mexico $N_O = 2.4 N_I$, so s_{max}^* is only 3%. Second, if a's initial share exceeds s_{max}^* then, under the linear pricing scheme, a would reject *any* turnaround; but even for $s_a < s_{max}^*$, a would reject turnaround above a certain fraction of inbound traffic.

Possible alliance roles. Alliance relations could help to harmonize incentives by offering a vehicle for direct profit sharing or one where financial transfers can be made in a manner less detectable to regulators. For example, the carriers could share the gaming profit through co-ownership of a joint venture; or they could use such a venture to disguise transfers by having one carrier undertake a disproportional contribution towards the venture's marketing or other costs.

In addition, a joint venture formed ostensibly for legitimate purposes such as joint marketing (indeed, efficiency and gaming motives can coexist) could help to disguise traffic manipulation, where the legality of manipulation is a gray area. For example, a spike in the US outbound minutes of the ally carrier due to call inflation or call turnaround might be attributed to increased marketing and promotion by the alliance that boost 'legitimate' minutes.

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[28]See 'Proof of Proposition 4' in the Supplemental Materials for this article on the *Journal's* web page at <www.stern.nyu.edu/~jindec/>. Proofs of Propositions 5 and 6 are in the Appendix to this article. (This Supplement is included at the end of this discussion paper.)

IV.   OUTPUT EFFECTS OF GAMING, AND RETAIL MARKET EXTENSIONS

IV(i).   *Effect on Marginal Costs of Nonalliance Carriers*

We now consider the effect of the alliance's settlements gaming on the net marginal costs of termination faced by nonalliance carriers, evaluated throughout at their pre-gaming traffic levels. The change in marginal costs will affect carriers' retail prices to US consumers. Call inflation of t minutes increases N_O by t minutes; call turnaround of t minutes does likewise, and reduces N_I by t minutes. Thus, both practices reduce N_I / N_O. Figure 1 illustrates inflation or turnaround that cuts N_I / N_O from an initial level k to a lower level k'. As N_I / N_O drops, AC shifts up in parallel to AC' (in this paper 'primes' do *not* denote derivatives); MC rotates clockwise—it remains at r for $s_j = 1$, and rises towards r at all $s_j < 1$.

Alliance gaming therefore unambiguously increases the (common) average cost of nonalliance carriers. The effects on marginal costs are more complex. There are two opposing forces, seen in expression (4): (a) the drop in N_I / N_O increases any carrier's marginal cost at its initial market share; but (b) for any nonalliance carrier, market share decreases (since its minutes are held constant while the ally carrier's minutes increase due to gaming), an effect which lowers marginal cost. In Figure 1, effect (a) is the rotation of MC about the right intercept r, while (b) is a move down along the new curve. Surprisingly, (b) can dominate; hence, a nonalliance carrier's marginal cost can decrease at its initial outbound minutes. This occurs in Figure 1 if the carrier's share falls from s_j to s_j'. The following example demonstrates that such a case indeed can occur.

Example: call turnaround can reduce marginal cost. Suppose there are only two US carriers, a and 1, and initially $N_I = 50$, $n_a = 10$, $n_1 = 90$. Then $s_1 = 0.9$, so $MC_1 = r - (r{-}c_d)(.1)(.5) = .95r + .05c_d$, from (4). The alliance of m and a then turns around 20 minutes, yielding $N_I = 30$, $n_a = 30$, $n_1 = 90$. Carrier 1's share of outbound traffic falls to $s_1 = 0.75$ and its marginal cost, at 90 minutes, becomes $MC_1 = .9375r + .0625c_d$. Therefore, $\Delta MC_1 = -.0125r + .0125c_d < 0$, given $r > c_d$; that is, call turnaround can cause a large nonalliance carrier's marginal cost to fall. It follows that marginal cost can fall also with call inflation, because call inflation of t minutes

yields the same change in market share as turnaround of t minutes, but leaves N_I unchanged and thus lowers N_I/N_O by less (and the drop in N_I/N_O is the source of upward pressure on costs.)

A priori, therefore, the impact of alliance traffic manipulation on other carriers' marginal costs is uncertain. The following proposition addresses the effects more systematically.

Proposition 5 *(Impact of Gaming on Nonalliance Carriers' Marginal Costs):*

(A) A large enough amount of call inflation or of call turnaround will raise the marginal cost of any nonalliance carrier j if j's initial market share is less than one.

(B) Any amount of call inflation will raise the marginal cost of any nonalliance carrier j *if and only if* the sum of j's initial and new market shares is less than one ($s_j + s_j' < 1$).

(C) Any amount of call inflation *or call turnaround* will raise the marginal cost of any nonalliance carrier j *if* any of the following conditions applies:

(C.1) the sum of j's initial and new market shares is less than one ($s_j + s_j' < 1$); or

(C.2) j's initial market share is less than one half ($s_j < 1/2$); or

(C.3) j does not have the largest initial market share.

Because ISP gaming by the alliance typically increases the marginal costs of nonalliance carriers for sending outbound calls (evaluated at their initial traffic levels) such gaming creates upward pressure on carriers' retail prices for outbound calls. Obtaining more definite predictions would require imposing considerably more structure, both in specifying costs and demands and the oligopoly interaction—since a carrier's marginal cost under proportional return depends also on others' traffic, and since a carrier's pricing will depend not only on its marginal cost function but also on others' retail prices. Nevertheless, Proposition 5 strongly suggests that ISP manipulation will raise nonalliance carriers' prices, thereby harming consumers.

IV(ii). *Profitability of Manipulation Despite an Induced Drop in Nonalliance Carriers' Traffic*

Expressions (9) and (11) showed the alliance's gain from call inflation and turnaround, due to lowering m's termination payments *to* nonalliance carriers, holding constant their total

outbound minutes, n. The rise in nonalliance carriers' marginal costs (except, perhaps, for the largest carrier) implies, however, that n is likely to fall, thus reducing m's profit from terminating traffic in its country, the term $(r - c_m)n$ in (8). The following revealed preference argument indicates that gaming will likely remain profitable despite the drop in nonalliance traffic.

Most monopolist carriers would raise their (symmetric) settlement rates with the US, but for FCC pressures and the need to bargain with US carriers. For example, in the 1997 round of negotiations, the Mexican incumbent Telmex requested a 25% *increase* in settlement rates, from 39.5¢ to around 50¢; and a host of foreign carriers have objected strongly to the FCC's [1997a] Benchmarks Order that aims to reduce settlement rates. That is, a foreign monopolist m typically expects that raising r would increase its termination revenue on the remaining US traffic by enough to outweigh its loss from both (a) the induced drop in US outbound traffic and from (b) the rise in the price for terminating its traffic in the US. Now instead of (i) m increasing r by a given Δr, consider an alternative experiment (ii) where the alliance games the ISP to the following degree: at the initial traffic levels N_I (from m to the US) and n (from US nonalliance carriers to m), gaming increases nonalliance carriers' average cost, AC in (2), by the same amount as would Δr.

For a given n, both schemes yield the same increase in net termination payments by US nonalliance carriers since, by construction, both yield the same increase in their AC (only the channel differs—raising r forces nonalliance carriers to pay more to m on the unchanged traffic imbalance; ISP gaming lets m pay them less because of the reduction in its traffic terminated with them). However, relative to raising r, ISP gaming is likely to cause a smaller drop in nonalliance carriers' outbound minutes, n (and, thus, in termination profit abroad), because the increase in *marginal* cost of *any* nonalliance carrier, at its initial outbound minutes, will be less.

The intuition can be grasped from Figure 1, where k denotes the initial ratio N_I / N_O across all carriers and k' denotes another level, where N_I has been reduced or N_O has been increased (thus, $k' < k$). The MC curve for case (i), i.e., inflation or turnaround, is indicated by k' (middle curve) and lies below that for case (ii), denoted by the higher settlement rate r'. Thus, for a given initial market share, a nonalliance carrier's marginal cost rises less (relative to the bottom curve)

in (i). Moreover, market shares remain constant in (ii), but in (i) carrier *a*'s share rises (with inflation or turnaround), so the share of any nonalliance carrier falls—implying a move left and down along the middle *MC* curve. For both reasons, marginal cost evaluated at a carrier's initial number of outbound *minutes* rises by less in case (i).

Thus, compared to raising *r*, gaming the ISP is likely to yield a superior tradeoff between increased termination profits on nonalliance carriers' remaining traffic and the loss from the drop in their traffic. Moreover, unlike raising the symmetric *r*, gaming does not increase the price paid by the monopolist for terminating its traffic in the US. Finally, gaming via the alliance has added advantages over raising *r*, due to the ally's participation in the retail market as discussed below. The sole disadvantage of ISP gaming versus raising *r* is the cost of implementing inflation or turnaround; but this cost is relatively low, especially for turnaround (which requires only minor signaling costs). Therefore, if raising *r* is profitable to the monopolist (as suggested by revealed preference), then some settlements gaming will be profitable to the monopolist's alliance.

IV(iii). *Retail Market Extensions*

The main issue for our purposes is whether retail market effects dampen the alliance's gains from call inflation or turnaround compared with expressions (9) and (11), which hold constant the retail prices and nonalliance carriers' outbound minutes. There are conflicting forces. As noted, gaming raises nonalliance carriers' marginal costs, tending to raise their prices and lower their traffic terminating abroad, which lowers the alliance's gain. However, raising nonalliance carriers' marginal costs also diverts retail market profits to the ally.[29] A priori, these

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[29]This effect in the retail market for US-outbound calls is reminiscent of raising rivals' costs (Salop and Scheffman [1983]). But there are two wrinkles: the perpetrator loses as input supplier—of foreign termination to the nonalliance carriers; however, the 'investment' in raising rivals' costs, which can render usual RRC strategies unprofitable, directly increases profit (by reducing the termination payments to nonalliance carriers for US-inbound calls). Indeed, in our paper, the purpose of manipulating the ISP is to reduce these termination payments; the impact on nonalliance carriers' marginal costs of outbound calls arises as an indirect consequence, due to the linkage created by proportional return.

retail market effects could decrease *or increase* the alliance's gains from settlements gaming.

Similarly, incorporating the alliance's role in retail market competition has two opposing effects on retail prices, relative to focusing only on the rise in marginal costs of nonalliance carriers induced by the alliance's gaming of settlements. A force pushing prices lower is removal of double marginalization: the ally carrier internalizes the fact that lowering its price will typically increase industry outbound minutes, and thus its partner's termination profit abroad. But there is an opposing effect. Assuming that retail prices are strategic complements, the ally's preferred retail price is likely to rise as nonalliance carriers increase their price in response to the increase in their marginal costs caused by alliance gaming of settlements.[30]

V. A PARETO-SUPERIOR SETTLEMENTS SYSTEM

There are good reasons to reform the ISP, both because of the incentives it breeds for gaming by monopolist carriers abroad and because of distortions created by proportional return even absent such gaming. As an alternative to the ISP, which mandates equal settlement rates, we identify an *asymmetric* system that benefits both countries and eliminates all distortions from proportional return. Later, we identify an entire class of such asymmetric systems, that mitigate (though not eliminate) proportional-return distortions and benefit both countries.

Suppose the competitive country d maintains proportional return towards a monopoly country, and a symmetric settlement rate r above its carriers' marginal cost of termination, $r > c_d$ (if $r = c_d$ nothing is lost by dropping the ISP). Denote the associated ISP traffic levels by $\bar{N}_I$ and $\{\bar{n}_j\}_j$, where j indexes carriers in the competitive country, and $\bar{N}_O = \sum_j \bar{n}_j$. Our asymmetric settlements system cuts the settlement rate in the competitive country (r_d) to marginal cost; and cuts the other country's rate (r_m) to the net average termination cost paid by competitive carriers under proportional return, given in (2), at the associated traffic levels:

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[30]Raising the retail price to US callers can be profitable as a substitute for raising the foreign termination rate r, which is capped by the FCC.

(14)   Asymmetric Settlements System: $r_d = c_d$ and $r_m = r - (r - c_d)(\overline{N}_I / \overline{N}_O)$.

Proposition 6 *(An Alternative Settlements System):*

Compared to the ISP, the Asymmetric Settlements System in (14) has the following properties:

(A) at the ISP's traffic levels ($\overline{N}_I$ and $\{\overline{n}_j\}_j$) it is profit-neutral for *all* carriers;

(B) it reduces each carrier's marginal cost of terminating in the other country, evaluated at the following traffic levels: for carrier m, at any traffic level; and for any competitive carrier j, at traffic levels no lower than j's ISP level ($n_j \geq \overline{n}_j$), holding other carriers' traffic at their ISP levels ($\overline{N}_I$ and $\{\overline{n}_i\}_{i \neq j}$);

(C) it eliminates all distortions from proportional return in the competitive country: bias against larger carriers, excessive incentive to supply discounted outbound minutes for callback, and incentives for gaming the ISP by monopolist carriers from other countries.

The basic idea behind the asymmetric system (14) is to deliver the same net payment from competitive carriers to the monopolist, $r(\overline{N}_O - \overline{N}_I)$, in a less distorting manner. The ensuing discussion assumes that (14) yields $r_m > c_m$, as is empirically likely.[31] Whereas a

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[31]We describe later an alternative reform in cases where (14) would imply $r_m < c_m$. However, we can expect (14) to yield $r_m > c_m$ for the US with virtually all monopoly countries by the following logic. Those countries typically send much less traffic to the US than they receive (e.g., for the eight countries in Tables 1 and 2, N_I/N_o ranges from a high of 0.4 for Mexico, to a low of 0.12 with India). Expressing r_m as the weighted average $(1 - N_I/N_O)r + (N_I/N_O)c_d$ shows that a low weight N_I/N_O implies that r_m will be closer to r than to c_d. Actual values of r for the US with most countries are several times larger than c_d (the latter is estimated at under 10¢, while the traffic-weighted global average rate paid by US carriers in 1996 was 35¢, and the rates were higher to most monopoly countries), and this gap is significantly greater than the gap (if any) between marginal cost of terminating in various foreign countries and in the US ($c_m - c_d$). Thus, since r_m is likely to be closer to r than to c_d (because of the typically low N_I/N_O), r_m is also likely to exceed c_m in most cases. To illustrate, consider the eight countries in Tables 1 and 2. Using the 1996 data on their settlement rates and traffic levels with the US, the values for r_m implied by (14) range from 26¢ (Mexico) to 72¢ (China), with most values clustered around 30¢. These comfortably exceed plausible estimates of marginal cost of termination in those countries (c_m).

symmetric rate yields profit only on the traffic imbalance, our system would let the monopolist carrier earn profit on all traffic it terminates $\overline{N}_O$, while paying only the marginal cost to terminate its traffic in the competitive country; this permits reducing the monopolist's rate to the aforementioned r_m while preserving the same profit inflow at initial traffic levels. Essentially, by raising the tax base (all traffic to the monopolist, instead of just the imbalance) a given revenue can be preserved while lowering the tax rate (settlement rate charged by the monopolist).

The resulting efficiency advantages over the ISP can be grouped into two categories. First, lowering the settlement rates will reduce the marginal costs of sending traffic (Proposition 6.B) and therefore should stimulate traffic in both directions. Second, the distortions induced by proportional return will be eliminated (Proposition 6.C): a) Our system ends the ISP's bias against larger carriers, since all will face the same net (constant) marginal cost of foreign termination—the new foreign settlement rate.[32] b) By eliminating the profit margin on traffic termination in the competitive country, our system also eliminates incentives of (smaller) carriers in that country to supply below-cost minutes for callback (Section II(iii)), as well as incentives for gaming by foreign monopolist carriers—thereby economizing on the resource costs of traffic re-routing.[33] c) Finally, eliminating inbound termination profit renders proportional return obsolete, and therefore permits savings of regulatory costs by discarding this policy.

Now consider distributional effects. In the competitive country, overall welfare should

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[32]To illustrate the impact on US carriers of replacing the ISP with system (14), consider traffic in 1996 between the US and Mexico. AT&T had the largest share and thus perceived the highest net marginal cost of terminating in Mexico—34¢ compared to 27¢ for WorldCom, a 21% difference. Adopting system (14) would have reduced *all* US carriers' marginal costs to the *same* constant level, equal to the then-prevailing average cost of 26¢ (Malueg and Schwartz [1998, Table 3]).

[33]Incentives would remain for carriers in the competitive country to turn around or re-originate calls destined to the other country. Our model abstracted from these incentives by assuming a foreign monopolist with complete control over termination into and callback out of its country. However, stepping beyond the model, the asymmetric system reduces gaming incentives for carriers in the competitive country as well, since it also cuts the settlement rate abroad.

rise: at initial traffic levels that country is no worse off, and it gains from the likely expansion in output, from improved allocation of output among its carriers, and from savings on regulatory costs. Individual carriers may lose, particularly ones with small initial traffic shares to the other country, because our system reduces their marginal costs less than for larger carriers on that route. However, since marginal costs fall for *all* carriers, the expected result is lower retail prices, benefiting consumers in the liberalized country. The monopolist's marginal cost of terminating its calls in the liberalized country also falls, from r to c_d, inducing it to cut prices for calls from its country (since the monopoly price increases with marginal cost; Samuelson, 1947) and thereby benefiting its customers. The foreign carrier also benefits. Its profit is unchanged at initial traffic levels given the asymmetrically lower settlement rates of system (14); however, the monopolist gains from being able to send increased traffic at a lower rate ($c_d < r$), and from the expansion of traffic to its country, on which it earns a positive termination margin ($r_m > c_m$).

In the unlikely event that (14) would imply $r_m < c_m$, one could still benefit both countries relative to the ISP by cutting the liberalized country's settlement rate but leaving it above marginal cost ($r_d > c_d$). Consider setting $r_m = c_m$ and $r_d = r - (r - c_m)(\overline{N}_O / \overline{N}_I)$, or indeed any pair (r_d^*, r_m^*) in the following set:

$$(15) \quad \{ (r_d^*, r_m^*) \mid r > r_d^* > c_d \text{ and } r_m^* = r - (r - r_d^*)(\overline{N}_I / \overline{N}_O) \},$$

where, again, care should be taken not to lower r_d so far that the implied r_m falls below c_m. Any such pair preserves profit neutrality at initial traffic, as does (14), and cuts the price paid by the monopolist for terminating in the competitive country. Moreover, if the competitive country retains proportional return (given that $r_d > c_d$), then at *any* traffic levels the marginal cost for any carrier j is lower than it would have been at those levels under the initially symmetric rates equal to r. At rates (r_d^*, r_m^*) defined in (15), firm j's marginal cost equals

$$MC_j = r - (r - c_d)\frac{N_I}{N_O} + (r_d^* - c_d)\frac{N_I}{N_O} s_j.$$

Comparison with (4) shows the new marginal cost is lower than under the initial ISP regime. Finally, while distortions from proportional return will not be eliminated (since unlike (14), there

now remains a positive termination margin in the competitive country, $r_d^* > c_d$), these distortions are reduced, since their magnitude is monotonic in the margin $(r_d - c_d)$ and (15) cuts this margin (r_d drops from r to r_d^*). For example, adoption of any such pair (r_d^*, r_m^*) reduces the *slope* of a carrier's marginal cost curve (compare with (4)), thereby reducing the bias against large carriers.

Our asymmetric system (14) is not first best, as it generally leaves the monopolist's settlement rate above cost, $r_m^* > c_m$. However, it has the practical advantage that both countries are likely to benefit. Moreover, it requires no lump-sum transfers, only a uniform linear settlement rate to all carriers in the competitive country, thereby treating them all equally.[34]

One can certainly question the normative merits of whether settlement reform should benefit both countries (and the monopolist carrier), as does (14).[35] Nevertheless, benefiting both countries is likely to be of practical significance, because it can soften resistance to reform. Consider the FCC's Benchmarks Order (FCC [1997a] and Cowhey [1998]), which imposes caps on the symmetric settlement rates between the US and various countries. The Order can potentially increase overall welfare more than can our system, by lowering rates abroad closer to marginal costs (we are assuming, as is likely, that (14) would leave r_m well above c_m; see fn. 31). But it is likely to reduce profits to monopolist carriers that terminate more traffic from the US

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[34]The foreign pricing distortion could be eliminated, without reducing foreign profit, by replacing the uniform rate r charged to US carriers with a sliding scale where the rate drops to foreign marginal cost for all traffic beyond a certain threshold. The threshold would be carrier-specific, not industry wide, to avoid a race-to-be-last among US carriers (each waiting for others to send the high-priced traffic, and trigger the lower rate for all). The first part of the sliding scale would serve as a fixed fee that transfers profit to m without distorting marginal decisions by US carriers. For example, a sliding scale system might differ from (14) only in charging a US carrier r_m per minute up to its initial level of traffic n_j, and marginal cost c_m for additional traffic. A potentially thorny issue, however, is choosing the thresholds for various carriers, especially as carriers' market shares change over time and new carriers enter; each carrier will clamor for a lower threshold at which it becomes eligible for the lower foreign settlement rate. System (14) avoids this problem, by setting the new linear rate r_m to all US carriers at all traffic levels.

[35]For example, Wallsten [forthcoming] presents evidence against the claim that inflated international rates are used to finance development of telecom infrastructure.

than they send, and many governments and their carriers have vociferously protested the Order. In cases where the FCC cannot implement its specified benchmarks (because of legal challenges, resistance by carriers abroad, or other reasons), our reform may still be acceptable because, starting from the ISP rate and traffic levels, both countries will benefit. In such cases, our system can be a substitute to the Order, by attaining at least some of the efficiency gains. In other cases, where a benchmark rate is accepted, our system can be a valuable complement to the Order: both countries benefit if, starting at the traffic levels that would prevail at the symmetric benchmark rate, this rate is replaced with our asymmetric rates specified in (14).

VI. CONCLUSIONS

In the past, innovative traffic re-routing practices, such as callback and re-origination, were used largely against telecom monopolists in many countries. A central message of our paper is that liberalized countries should not rely on re-routing practices to discipline foreign monopolists in the future; once monopolists adjust, re-routing practices may well favor them.

Observe first the limits of re-routing practices when used against monopolists. Callback from a liberalized country L to the monopolist's country M can pressure retail prices of calls from M to L; but callback incurs termination charges, and hence does not discipline the monopolist's termination rate in M. Call re-origination can arbitrage differences between a monopolist's termination rates with various countries. However, the monopolist could foil such arbitrage by setting a uniform intermediate rate—lowering some rates but raising others; if re-origination (or its threat) induces such an outcome, the resulting effect on global welfare is ambiguous.[36]

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[36]This tracks the general welfare ambiguity of third-degree price discrimination relative to uniform pricing by a monopolist. Malueg and Schwartz [1994] illustrate this ambiguity in analyzing the effects of gray market ('parallel') imports. A difference in international telecom is that a carrier typically cannot raise its settlement rate unilaterally, since it negotiates rates with foreign correspondent carriers. If a monopolist subject to re-origination arbitrage cannot raise the lower of its settlement rate(s), arbitrage indeed will push prices systematically lower. This outcome, however, depends on the monopolist's

Furthermore, we showed how these same re-routing practices can be used by monopolists against carriers in liberalized countries, especially if the monopolists are allied with other carriers in such countries. Through call turnaround, a monopolist could retain the retail revenue from calls originating in its country and destined to country L, but reverse the calls for settlement purposes into calls from L carried by its ally. Opportunities for call turnaround are likely to be very unequal. A monopolist can choose among competing carriers in a liberalized country vying to be its partner; but turnaround opportunities from its country will be more limited because, by assumption, the monopolist controls outbound facilities from, and termination into, its country.

Now consider re-origination. In our analysis, this was a method of call inflation, not of arbitrage. Re-originating calls through a liberalized country L will artificially boost the ally's traffic from L and, hence, the share of the monopolist's traffic to L that the ally may terminate under proportional return. Stepping beyond our model, however, re-origination also can be used for arbitrage, but disproportionately by monopolists. First, as the sole provider of termination in its country, the monopolist may be able to pressure carriers abroad not to re-originate traffic into its country; in contrast, it can exploit the presence of competing carriers abroad to accept re-originated traffic into their country. Second, a monopolist is immune to inbound arbitrage if its termination rates with all countries are uniformly high. In contrast, if liberalized countries adopt uniformly high (symmetric) rates with a monopolist but low rates among themselves, the monopolist may be able to route its traffic into one liberalized country through another, to which it pays only a small transit fee, and exploit their lower bilateral rate. This could become a serious issue for EU countries, for example, as they reduce settlement rates for intra-EU traffic towards costs but retain high rates with less liberalized countries.

Asymmetric re-routing opportunities can, by enabling monopolists to disproportionately avoid paying high termination charges for their traffic, defeat liberalized countries' regulatory measures meant to equalize termination rates on a route. Liberalized countries thus lose

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assumed inability to raise its lower rate(s). And in the absence of policy intervention by liberalized countries, carriers from monopoly markets would be in a strong position to dictate settlement rates.

termination profit on inbound traffic. In addition, they risk paying more to terminate their traffic in monopoly countries, because a monopolist's ability to avoid paying high rates in liberalized countries will prompt it to seek higher rates, even if rates are *nominally* symmetric.

We identified a reform of the ISP that eliminates gaming incentives, removes the other distortions induced by proportional return, and benefits both countries. The proposed reform cuts the rate in the liberalized country to marginal cost, and cuts the foreign rate to equal the *average* cost of foreign termination (net of inbound termination profit) perceived by all carriers in the liberalized country under the ISP's traffic levels.

If such a reform is not adopted and settlement rates between liberalized countries and monopoly countries remain inflated, monopolists will have strong incentives to game the system through re-routing practices. The risk of this occurring on a large scale increases if monopolists can acquire facilities or ally with carriers in liberalized countries. Since regulatory policing of re-routing practices is difficult, a more promising path is to reduce incentives for gaming. Cutting the settlement rate between two countries will reduce such incentives, as well as mitigate the harm from any gaming that does occur. Thus, a case can be made for conditioning approval of 'entry' by a dominant foreign carrier into a liberalized market (directly or through an alliance) on its accepting a lower settlement rate between the two countries.

There are, however, opposing considerations. First, foreign carriers' entry can also be motivated by efficiencies. Second, actions by liberalized countries individually may be ineffective. Suppose the US restricts participation by a foreign monopolist m but another liberalized country, L, does not. If traffic can move at low cost between the US and L (through private lines or low bilateral settlement rates), then m can use L as a hub from which to turn around its US-destined traffic or to re-file its traffic into the US. While there are no easy solutions to the traffic gaming issue once incentives for gaming are created, our paper warns against assuming that traffic re-routing patterns systematically favor liberalized countries.

We conclude with brief additional remarks on the empirical implications and relevance of our analysis. One implication is that a monopolist carrier would seek to ally with a *small* carrier in liberalized country L if the purpose is to divert profit from other carriers in L. In contrast, if

the alliance's main purpose is to reduce double marginalization, then the preferred partner in L is likely to be a large carrier, which would be able to directly offer a price reduction to more consumers in L (such ability is relevant, for example, if consumers view carriers' services as imperfect substitutes). The 1997 proposed alliance between Telmex and Sprint in the US fits this prediction, since Sprint was the smallest of the major US carriers on the US-Mexico route, although that venture has since been abandoned for reasons unknown to us. One might also expect monopolist carriers to target their alliances towards liberalized countries that have adopted ISP-like rules towards those monopolists. Attempting a comprehensive test of alliance patterns, however, is beyond the scope of this paper.

Turning to additional evidence of potential traffic gaming, one illustration is Mexico. In recent years, Mexico has allowed competition in international telecom services and adopted proportional return for allocating inbound traffic. Mindful of the scope for gaming, it instituted an elaborate regulatory structure, including monthly audits of carriers (Cofetel [1996]). Recent agreements between Telmex and its international-services competitors, Alestra and Avantel (affiliated with AT&T and WorldCom, respectively), have included financial settlements to resolve a range of outstanding disputes (Associated Press [2001]). While the full details were not made public, industry sources in Mexico confirm that the resolved issues included differing interpretations of the proportional return rules and compensating adjustments for disputed past practices.

Another illustration involves termination of traffic between local carriers in the US. The termination rates exceed marginal costs, and this has induced carriers to try to maximize the amount of traffic they terminate from other networks. A well known tactic pursued by new carriers has been to focus on hosting Internet Service Providers, which typically receive more incoming calls (mainly from subscribers of the incumbent) than they send. While lawful, such targeting has been controversial. Moreover, consider the following episode (Ryan [2000] and NCUC [2000]), which is remarkably similar to our discussion in Section III(ii) of 'computer-generated minutes'. In April 2000, the North Carolina Utilities Commission ruled that BellSouth did not have to pay a competing local carrier, US LEC, over $150 million in

termination fees ('reciprocal compensation') for traffic that originated from a particular

BellSouth corporate customer, Metacomm. The Commission found that US LEC had 'induced'

Metacomm to maintain its transmission facilities, leased from BellSouth for a fixed monthly fee,

connected on a near-continuous basis to computers (routers) on US LEC's network. The 'empty

connections' carried no traffic; their sole purpose was to generate recorded 'minutes' from

BellSouth to US LEC and therefore large termination payments from BellSouth. The

Commission further noted that US LEC agreed to pay Metacomm 40% of the revenue generated

from BellSouth due to Metcacomm's traffic, and that US LEC's chairman owned a controlling

interest in Metacomm.[37]

Given carriers' obvious interest in maintaining secrecy about gaming, examples such as

those above are likely to represent only the tip of the iceberg. The relative ease of manipulating

telecommunications flows suggests that any arrangement that sets termination rates significantly

above marginal cost may be prone to serious gaming. This is likely to be true with a vengeance

for internet traffic, since the content of packets is often unobservable to the carriers and the

direction and magnitude of traffic are especially conducive to manipulation. The scope for such

abuse may explain why financial arrangements for delivering internet traffic have essentially

fallen into two categories: a customer/provider relation, whereby the customer (which may be a

smaller ISP) pays its providing carrier regardless of the direction of traffic between them; and

settlement-free exchange of traffic ('peering') between certain carriers (Huston [1999]). The

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[37]In its colorful account, the NCUC noted that Metacomm 'established connections by having routers
[computers] connected to circuits purchased from BellSouth call routers connected to circuits provided by
US LEC'. The routers were programmed 'to disconnect and immediately reconnect … every 23 hours and
59 minutes, so that US LEC's switches could create the record which US LEC needed to bill
BellSouth…' (¶4). Testimony showed that the scheme was based on 'having circuits operational with no
data or content. … the circuits are being turned up and no traffic traverses the circuits'. (p. 15). One of
Metacomm's purported 'customers' was Charlie Horse Farm, whose business was boarding horses.
Metacomm installed facilities at the horse barn and originated connections from there to a terminating
router for approximately one year; the barn owner testified that over that period he had never even
attempted to use Metacomm's network (p. 24).

analysis also suggests that introducing settlements charges between internet carriers may be fraught with peril unless charges are set quite close to marginal cost.

APPENDIX

Proof of Proposition 5:

(A) A large enough amount of call inflation or call turnaround will drive the ratio N_I/N_O arbitrarily close to 0, raising each nonalliance carrier's marginal cost arbitrarily close to r, which exceeds the marginal cost of any carrier with initial share less than one.

(B) Suppose the alliance generates t additional minutes of outbound traffic. For any nonalliance firm j, let MC_j and MC_j' denote firm j's marginal cost before and after call inflation, respectively. Let $k = N_I/N_O$, $k' = N_I/(N_O+t)$, $s_j = n_j/N_O$, and $s_j' = n_j/(N_O+t)$. First it is easily verified that $s_j - s_j' = (n_j/N_I)(k - k')$. This relationship and routine algebra establish

$$MC_j' - MC_j = \left(r - (r - c_d)k'(1 - s_j')\right) - \left(r - (r - c_d)k(1 - s_j)\right)$$
$$= (r - c_d)(k - k')(1 - s_j - s_j').$$

Because call inflation implies $k > k'$, it follows that $MC_j' > MC_j \iff 1 > s_j + s_j'$.

(C) Recall that turnaround of t minutes is equivalent to (a) inflation of t minutes plus (b) a loss of t inbound minutes, and that effect (b) unambiguously raises marginal costs; thus, if t minutes of call inflation raise j's marginal cost, so do t minutes of call turnaround. Next, observe that both inflation and turnaround reduce the outbound market share of any nonalliance carrier j, $s_j' < s_j$. (C.1) now follows immediately from (B). (C.2) follows from (C.1) since $s_j < 1/2$ ensures $s_j' + s_j < 1$. (C.3) follows since $s_j < 1/2$ if j does not have the largest initial market share. *Q.E.D.*

Proof of Proposition 6:

(A) Under (14), at ISP traffic levels, the reduction in payments from m to carrier j equals $(r - c_d)\overline{N}_I(\overline{n}_j/\overline{N}_O)$ and the reduction in payments from carrier j to m is $(r - r_m)\overline{n}_j$. The definition of r_m in (14) guarantees these quantities are then equal.

(B) For the foreign monopolist, marginal cost of sending calls clearly falls since the termination rate in the competitive country falls from r to c_d. Next consider any carrier j. Under (14), j's net marginal cost of termination is constant and equal to r_m. From (4) and (14) we see that, for $n_j \geq \overline{n}_j$, carrier j's marginal cost under the ISP would equal

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$$MC_j\Big|_{\overline{N}_I, \{\overline{n}_i\}_{i\neq j}} = r - (r - c_d)\frac{\overline{N}_I}{n_j + \sum_{i\neq j}\overline{n}_i} + s_j(r - c_d)\frac{\overline{N}_I}{n_j + \sum_{i\neq j}\overline{n}_i} \geq r - (r - c_d)\frac{\overline{N}_I}{n_j + \sum_{i\neq j}\overline{n}_i}$$

$$\geq r - (r - c_d)\frac{\overline{N}_I}{\overline{n}_j + \sum_{i\neq j}\overline{n}_i} = r_m.$$

(C) Under (14), all domestic carriers have equal and constant marginal costs of termination, eliminating the bias against large carriers. Moreover, because the profit on domestic termination is eliminated by setting $r_d = c_d$, the distorted incentives of competitive carriers to supply callback minutes or the incentives of monopolists abroad to game the ISP are also eliminated. *Q.E.D.*

REFERENCES

Associated Press, 2001, 'Mexico Phone Cos. Reach Agreement', January 2.

Blake, P., 1996, 'King of the Callbacks', *Telephony*, May, 21 (8), pp. 20-22.

Brennan, T., 1990, 'Cross-Subsidization and Cost Misallocation by Regulated Monopolists', *Journal of Regulatory Economics*, 2, pp. 37-51.

Bulow, J. and Klemperer, P., 1998, 'The Tobacco Deal', in *Brookings Papers on Economic Activity*: *Microeconomics*, M. N. Baily, P. C. Reiss and C. Winston, eds., pp. 323-394 (Brookings Institution, Washington DC).

Cairncross, F., 1997, 'Telecommunications Survey: A Connected World', *The Economist*, September 13, pp. 3-34.

Cheong, K. and Mullins, M., 1991, 'International Telephone Service Imbalances: Accounting Rates and Regulatory Policy', *Telecommunications Policy*, April, 20 (10), pp. 107-118.

Cofetel, 1996, *International Long Distance Rules*, Comision Federal de Telecomunicaciones (Cofetel), December 4, Mexico City.

Cowhey, P., 1998, 'FCC Benchmarks and the Reform of the International Telecommunications Market', *Telecommunications Policy*, 22 (11), pp. 899-911.

Einhorn, M. A., 1997, 'International Accounting and Settlements: A Review of the Literature', Mimeo, Broadcast Music, Inc., New York, NY.

FCC, 43.61, *Section 43.61 International Telecommunications Data*, various years, Federal Communications Commission (FCC), Washington, DC.

FCC, 1996, *International Settlement Rates*, Notice of Proposed Rulemaking, IB Docket No. 96-261, FCC, rel. December 16.

FCC, 1997a, *International Settlement Rates*, Report and Order ('Benchmarks Order'), IB Docket No. 96-261, Federal Communications Commission, rel. August 18.

FCC, 1997b, *Rules and Policies on Foreign Participation in the U.S. Telecommunications Market*, IB Docket No. 97-142, and *Market Entry and Regulation of Foreign-Affiliated Entities*, IB Docket No. 95-22, Report and Order and Order on Reconsideration ('Foreign Entry Order'), FCC, rel. November 26.

Frieden, R., 1998, 'Falling Through the Cracks: International Accounting Rate Reform at the ITU and WTO', *Telecommunications Policy*, 22 (11), pp. 963-975.

Galbi, D. A., 1998, 'Cross-Border Rent Shifting in International Telecommunications', *Information Economics and Policy*, 10, pp. 515-536.

Huston, G., 1999, 'Interconnection, Peering, and Settlements', paper presented at the 9th Annual Conference of the Internet Society, San Jose, http://www.isoc.org/inet99/1e/1e_1.htm.

HKTI, 1997, Comments of HongKong Telecom International, *In the Matter of International Settlement Rates*, IB Docket No. 96-261, FCC, February 2.

Johnson, L. L., 1991, 'Dealing with Monopoly in International Telephone Service: A U.S. Perspective', *Information Economics and Policy*, 4, pp. 225-47.

Kwerel, E., 1984, 'Promoting Competition Piecemeal in International Telecommunications', OPP Working Paper 13, Office of Plans and Policy, FCC, Washington DC, December.

———, 1994, 'Reconciling Competition and Monopoly in the Supply of International Telecommunications Services: A U.S. Perspective', in E. M. Noam and G. Pogorel, eds., *Asymmetric Deregulation: The Dynamics of Telecommunications Policy in Europe and the United States*, pp. 75-106 (Abex Publishing Company, Norwood, NJ).

Laffont, J-J, Rey, P., and Tirole, J., 1998a, 'Network Competition: I. Overview and Nondiscriminatory Pricing', *RAND Journal of Economics*, 29, pp. 1-37.

———, 1998b, 'Network Competition: II. Price Discrimination', *RAND Journal of Economics*, 29, pp. 38-56.

Lam, P.-L., 1997, 'Erosion of Monopoly Power by Call-Back: Lessons from Hong Kong', *Telecommunications Policy*, 21 (8), pp. 693–95.

Libecap, G. D. and Wiggins, S. N., 1984, 'Contractual Responses to the Common Pool Problem: Prorationing of Crude Oil Production', *American Economic Review*, March, 74 (1), pp. 87-98.

Malueg, D. A. and Schwartz, M., 1994, 'Parallel Imports, Demand Dispersion, and International Price Discrimination', *Journal of International Economics*, 37, pp. 167-95.

———, 1998, 'Where Have All the Minutes Gone? Asymmetric Telecom Liberalization, Carrier Alliances, and Gaming of International Settlements', Working Paper 98-08, Georgetown University, Washington DC, August.

———, 2001, 'Marginal Cost under Alternative Expectations' in the Supplemental Materials for this article, located on the *Journal's* web page at <www.stern.nyu.edu/~jindec/>.

NCUC, 2000, *In the Matter of BellSouth Telecommunications, Inc. v. US LEC of North Carolina Inc.*, North Carolina Utilities Commission (NCUC), Docket No. P-561, Sub 10, Order Denying Reciprocal Compensation, Raleigh, NC, issued March 30.

OECD, 1997, *New Technologies and their Impact on the Accounting Rate System*, OECD Working Papers Vol. V, No. 11, Paris.

Oliver, C. M., 1998, 'WTO Agreement on Basic Telecommunications Services and FCC Implementation', *Communications Lawyer*, Winter, pp. 13-19.

Pan Asian Telecom, 1998, 'Singapore Telecom Readies for Competition', April 7, 2 (1), p.1.

Ryan, V., 2000, 'Draining the Incumbent: US LEC's Reciprocal Comp Charges Deemed Illegal', *Telephony*, April, 10, p. 25.

Salop, S. C. and Scheffman, D. T., 1983, 'Raising Rivals' Costs', *American Economic Review*, May, 73 (2), pp. 267–271.

Samuelson, P. A., 1947, *Foundations of Economic Analysis.* Cambridge, MA: Harvard University Press.

Scanlan, M., 1996, 'Why Is the International Accounting Rate System in Terminal Decline and What Might Be the Consequences?' *Telecommunications Policy*, 20 (10), pp. 739–753.

———, 1998, 'Using Call-back to Demonstrate the Discriminatory Nature of the Proportionate Return Rule', *Telecommunications Policy*, 22 (11), pp. 913-930.

Scheele, M.J. & Associates, 1997, *1997 Fall International Callback Market Analysis*, San Francisco, CA: December.

Schwartz, M., 1997, 'Competitive Concerns with Gaming of the International Settlements Process under Asymmetric Liberalization of International Telecommunications and Above-Cost Settlement Rates', affidavit on behalf of AT&T, submitted to the FCC in *Rules and Policies on Foreign Participation in the U.S. Telecommunications Market*, IB 97-142, November 18.

Schwartz, M. and Thompson, E. A., 1986, 'Divisionalization and Entry Deterrence', *Quarterly Journal of Economics*, May, 101 (2), pp. 307-321.

Tirole, J., 1988, *The Theory of Industrial Organization,* Cambridge, MA:, MIT Press.

Vogelsang, I., 1999, 'The Arcane World of International Telecommunications', paper presented at AICGS Conference on Building a Transatlantic Marketplace, Washington DC, November.

Wallsten, S., 'Telecommunications Investment and Traffic in Developing Countries: The Effects of International Settlement Rate Reforms', *Journal of Regulatory Economics*, forthcoming.

Wright, J., 1999, 'International Telecommunications, Settlement Rates, and the FCC', *Journal of Regulatory Economics*, 15, pp. 267-291.

average cost,
marginal cost

r'

$MC\big|_{r',\,k}$

$MC\big|_{r,\,k'}$

r

$MC\big|_{r,\,k}$

$r' - (r' - c_d)k$
$= r - (r - c_d)k'$

AC'

AC

$r - (r - c_d)k$

0 s_j' s_j 1

s_j

firm j's share of outbound minutes
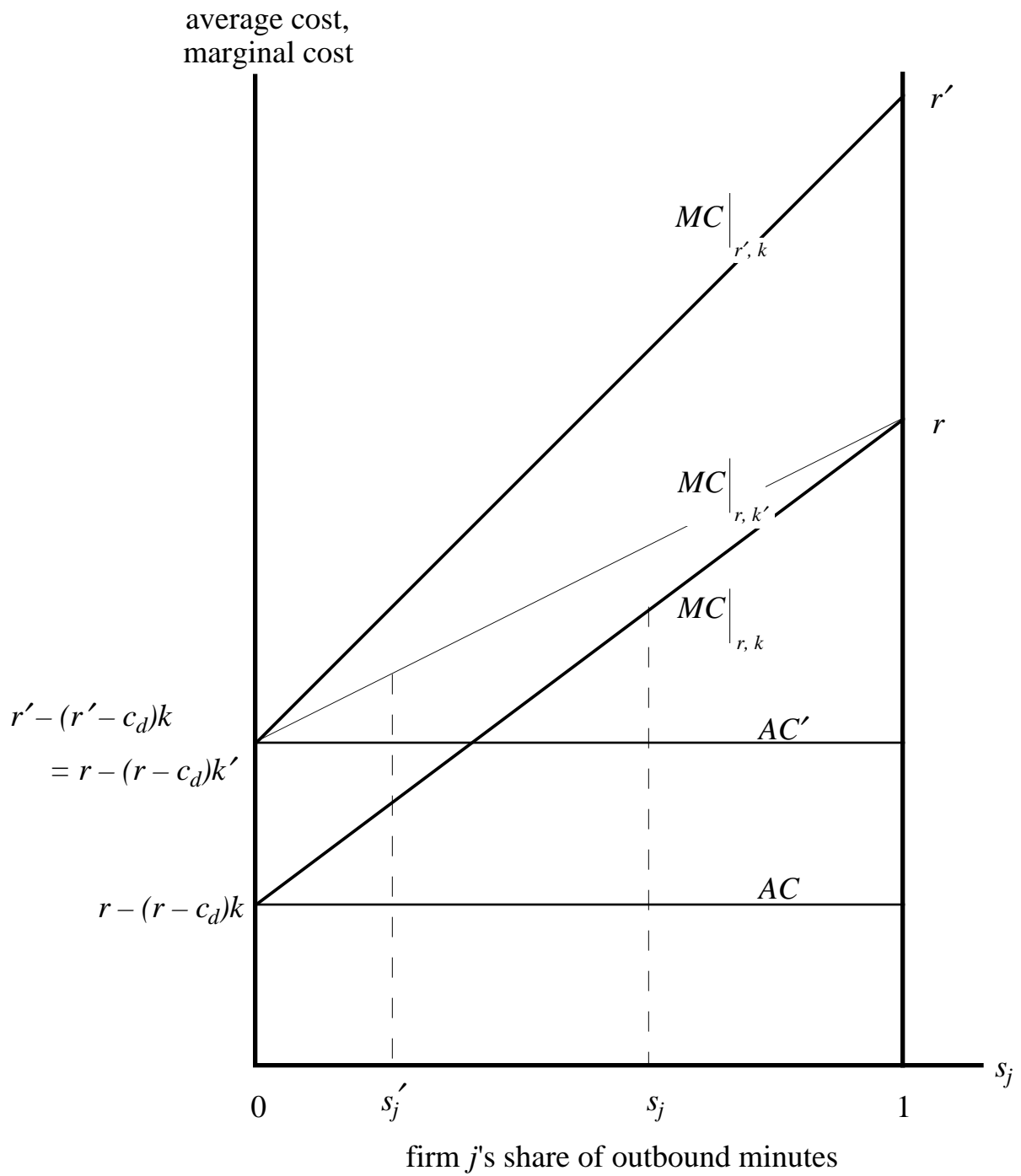
Figure 1. Average and Marginal Costs of Termination

$$\dfrac{N_I}{N_O}(1 - s_a)(r - c_d)$$

$$MB = \dfrac{N_I\, n}{(N_O + t)^2}(r - c_d) = \dfrac{N_I N_O}{(N_O + t)^2}(1 - s_a)(r - c_d)$$

¢/min

$c_d + c_m$ — MC

0

t^*

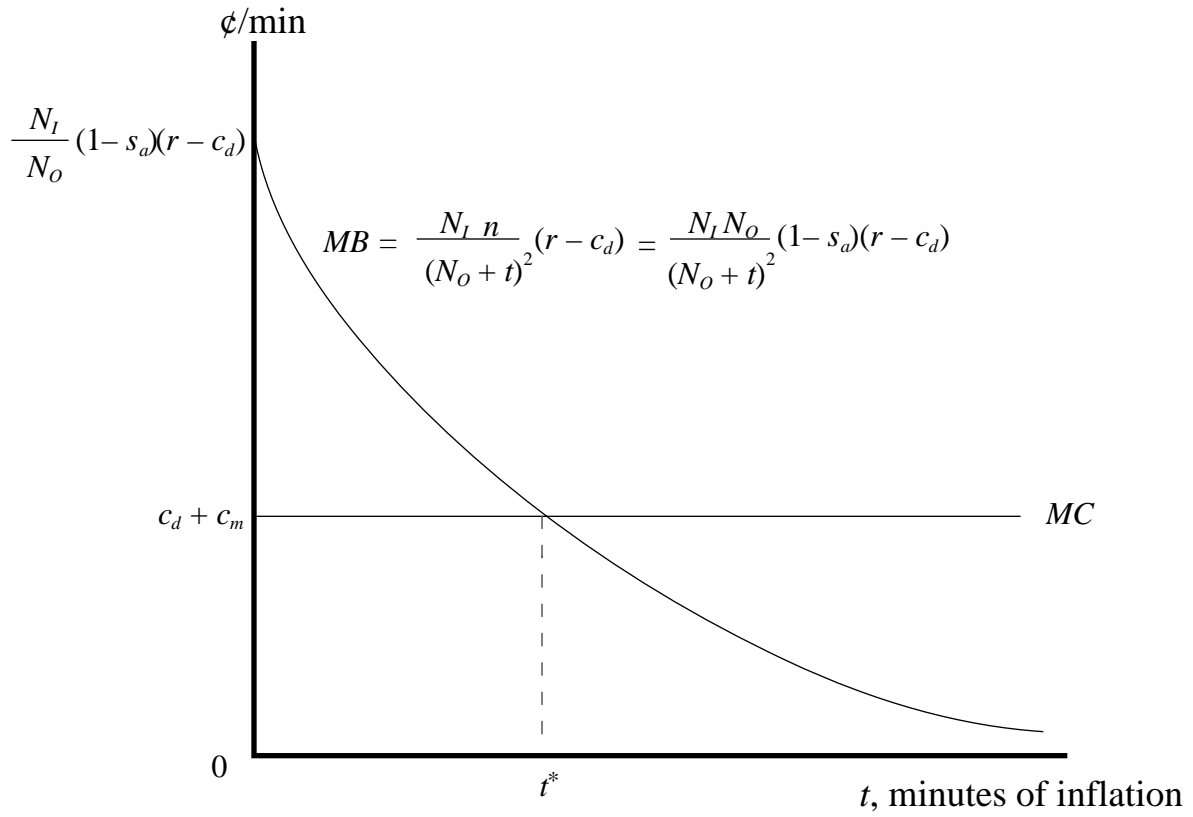t, minutes of inflation

Figure 2. The Marginal Benefit and Marginal Cost of Call Inflation

Table I: Call Inflation

Country	Settlement Rate r ($¢$/min.)	US Inbound min. N_I (million)	In/Out min. N_I/N_O	Cost Assumptions ($¢$/min.) $c_d = 7, c_m = 8$		Cost Assumptions ($¢$/min.) $c_d = 7, c_m = 0$	
				t^*/N_O as %	Diverted Profit ($ million)	t^*/N_O as %	Diverted Profit ($ million)
Mexico	39.5	948.1	0.40	0.00%	$0.0	35.97%	$81.5
Brazil	42.5	123.5	0.33	0.00%	$0.0	29.88%	$10.1
Dom. Rep.	40.0	112.9	0.27	0.00%	$0.0	13.05%	$4.3
Hong Kong	39.3	96.3	0.18	0.00%	$0.0	0.00%	$0.0
Israel	59.0	78.9	0.33	7.12%	$2.7	56.81%	$14.9
China	88.6	58.3	0.20	3.14%	$1.4	50.98%	$16.1
Singapore	42.0	53.5	0.36	0.00%	$0.0	34.13%	$4.8
India	79.0	49.1	0.12	0.00%	$0.0	10.41%	$3.3
TOTAL	n.a.	n.a	n.a	n.a.	$4.1	n.a.	$135.0

Notes: 1) Traffic data and settlement rates are for 1996 (FCC, 43.61 Reports).
2) Assuming the US ally carrier has zero initial market share to that country ($s_a = 0$).
3) t^*/N_O is the alliance's preferred level of inflation, from Proposition 1, which assumes inflation is via creating new minutes (not re-originating existing ones).
4) The case $c_f = 0$ approximates inflation through re-origination (where total minutes terminating abroad do not increase).

Table II: Call Turnaround

Country	Settlement Rate r (¢/min.)	US Inbound min. N_I (million)	In/Out min. N_I/N_O	Profit Diversion From Various % of Call Turnaround ($ million)					x^* (¢/min.)
				10%	20%	30%	40%	100%	
Mexico	39.5	948.1	0.40	$41.4	$79.8	$115.5	$148.7	$308.1	23.2
Brazil	42.5	123.5	0.33	$5.7	$11.0	$15.9	$20.6	$43.8	26.6
Dom. Rep.	40.0	112.9	0.27	$4.6	$9.0	$13.1	$17.1	$37.2	26.0
Hong Kong	39.3	96.3	0.18	$3.6	$7.1	$10.4	$13.7	$31.1	27.4
Israel	59.0	78.9	0.33	$5.3	$10.2	$14.9	$19.3	$41.0	39.1
China	88.6	58.3	0.20	$5.6	$10.9	$16.1	$21.1	$47.5	68.3
Singapore	42.0	53.5	0.36	$2.5	$4.7	$6.9	$8.9	$18.7	25.7
India	79.0	49.1	0.12	$3.9	$7.7	$11.5	$15.1	$35.4	64.4
TOTAL	n.a	n.a.	n.a.	$72.6	$140.4	$204.3	$264.5	$562.8	n.a.

Notes: 1) Traffic data and settlement rates are for 1996 (FCC, 43.61 Reports).
2) $c_d = 7$¢/min.
3) Assuming the US ally carrier has zero initial market share to that country ($s_a = 0$).
4) For any value of the signalling cost x below the value of x^* above, the alliance prefers complete (100%) turnaround (see Proposition 2 (C)).

Supplemental Materials for David A. Malueg and Marius Schwartz, "International Telecom Settlements: Gaming Incentives, Carrier Alliances, and Pareto-Superior Reform," *The Journal of Industrial Economics* VOLUME (ISSUE), MONTH YEAR, pp. XXX–YYY.

Marginal Cost under Alternative Expectations

Recall the generalized expression for marginal cost:

$$(3) \qquad \frac{d(C_j - c_d n_j)}{dn_j} = AC + (r - c_d) \frac{N_I}{N_O} n_j \left(\frac{dN_O/dn_j}{N_O} - \frac{dN_I/dn_j}{N_I} \right).$$

Properties (a), (b) and (c) of *MC* described in the text will hold if (not only if) in (3) the expected term

$$\frac{dN_O/dn_j}{N_O} - \frac{dN_I/dn_j}{N_I}$$

is the same across carriers and is positive. Suppose that outbound traffic does not affect inbound traffic: $dN_I/dn_j = 0$. Then if each carrier j expects $dN_O/dn_j = 0$, carriers' marginal costs will *not* depend on their initial market shares. This case of pure output diversion, $dN_O/dn_j = 0$, however, is extreme. For example, if carriers' products are differentiated and carrier j offers a price cut to all customers while others' prices are constant (as under Bertrand competition), a more likely expectation is some mix of diversion and industry expansion, $0 < dN_O/dn_j < 1$. If this expectation is the same across carriers (e.g., for linear differentiated demands and different intercepts but symmetric cross partials), then—continuing to assume N_I constant—properties (a) through (c) would hold.[1]

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[1] To the extent carriers might expect different ratios of diversion to expansion when they increase their outputs, the expected dN_O/dn_j arguably should be greater for larger than for smaller carriers, because a lesser portion of their expansion is likely to come from diversion (since larger carriers face a smaller

To understand why the pure diversion case is special, suppose that as any firm j expands traffic by t, total outbound traffic changes by ΔN_O (instead of by t as in (5)). The change in j's share of traffic can be written as

$$\Delta s_j \;=\; \frac{n_j + t}{N_O + \Delta N_O} \;-\; \frac{n_j}{N_O} \;=\; \frac{t}{N_O} - \left(\frac{1}{N_O} - \frac{1}{N_O + \Delta N_O} \right)\!\left(n_j + t\right).$$

The term t/N_O is the increase in share that would have resulted if the t minutes were diverted from other carriers, so total outbound traffic remained unchanged. But after total traffic increases, one minute represents a market share of $1/(N_O + \Delta N_O)$ instead of $1/N_O$. This discount equal to $1/N_O - 1/(N_O + \Delta N_O)$ in the "share value" of an outbound minute must be applied to all of j's traffic at the new level, $n_j + t$, to arrive at the actual change in j's share; hence the resulting increase in share is smaller the larger is the initial n_j. This effect disappears in the case of pure diversion because there is then no expansion in industry output, hence no discount effect.

We do not mean to push this discussion of expectations too far, but only to suggest that the properties of our base case (4) (other than the linearity of marginal cost in shares) are fairly robust to alternative assumptions about expectations: as can be shown from (3), our properties hold if $d(N_O/N_I)/dn_j$ is positive and is non-decreasing across carriers the larger is a carrier's initial share. The above discussion suggests that these conditions are plausible.

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customer pool from which to divert business). This would preserve property (a), that marginal cost increases with share (although the relation will now be strictly convex rather than linear).

Proof of Proposition 4

Recall from (1) that the cost to carrier a of terminating its traffic abroad net of profit from inbound termination is equal to

$$C_a(n_a, N_I) = (r + c_d)n_a - (r - c_d)n_a \frac{N_I}{N_O}.$$

Carrier a's marginal cost of terminating these additional minutes abroad is equal to

(A1) $\quad MC_a(n_a, N_I) \equiv \frac{\partial C_a}{\partial n_a} = (r + c_d) - (r - c_d)n \frac{N_I}{N_O^2}.$

(Note: MC_a is *not* "net" of origination costs, as assumed in (3), and therefore is not identical to (3).) Now suppose carriers f and a arrange to turn around t inbound minutes into an equal number of outbound minutes carried by a. This reduces total inbound minutes to $N_I - t$ and increases a's outbound minutes to $n_a + t$. With the reduction in inbound minutes, a's marginal cost function, given other firms' minutes, is $MC_a(n_a, N_I - t)$ (recall that this marginal cost curve incorporates the effect that increasing output has in increasing a firm's share of inbound minutes). The change in a's termination cost is given by

$$
\begin{aligned}
C_a(n_a + t, N_I - t) - C_a(n_a, N_I) &= C_a(n_a + t, N_I) - C_a(n_a, N_I - t) \\
&\quad + C_a(n_a, N_I - t) - C_a(n_a, N_I) \\
&= \int_{n_a}^{n_a + t} MC_a(x, N_I - t)\, dx
\end{aligned}
$$

(A.2)
$$
\begin{aligned}
&\quad + \left((r + c_d)n_a - (r - c_d)n_a \frac{N_I - t}{N_O} \right) \\
&\quad - \left((r + c_d)n_a - (r - c_d)n_a \frac{N_I}{N_O} \right) \\
&= \int_{n_a}^{n_a + t} MC_a(x, N_I - t)\, dx + (r - c_d)\frac{n_a}{N_O} t.
\end{aligned}
$$

In the last line of (A.2), $(r - c_d)t(n_a/N_O)$ represents a's lost profits from the reduction in total inbound minutes ($\Delta N_I = -t < 0$), which caused a to lose inbound minutes in proportion to its initial market share of outbound minutes ($s_a = n_a/N_O$). The first term corresponds to the area under the new marginal cost curve (shifted up by the decrease in inbound minutes) between a's old and new levels of outbound minutes. This integral term in (A.2) can be rewritten as follows:

$$\int_{n_a}^{n_a+t} MC_a(x, N_I - t)\, dx = \int_{n_a}^{n_a+t} \left((r + c_d) - (r - c_d)(N_I - t)n(n + x)^{-2} \right) dx$$

$$= \left((r + c_d)x + (r - c_d)(N_I - t)n(n + x)^{-1} \right) \Big|_{n_a}^{n_a+t}$$

$$= \left((r + c_d)t + (r - c_d)(N_I - t)n\left(\frac{1}{n + n_a + t} - \frac{1}{n + n_a} \right) \right)$$

$$= \left((r + c_d)t + (r - c_d)(N_I - t)n\left(\frac{1}{N_O + t} - \frac{1}{N_O} \right) \right)$$

(A.3)

$$= \left((r + c_d)t + (r - c_d)(N_I - t)n\left(\frac{t}{(N_O + t)N_O} \right) \right)$$

$$= \left((r + c_d) + (r - c_d)\left(\frac{(N_I - t)n}{(N_O + t)N_O} \right) \right)t$$

$$= \left((r + c_d) + (r - c_d)\left(\frac{(N_I - t)n}{(N_O + t)N_O} \right) \right)t$$

$$= \left((r + c_d) + (r - c_d)\frac{(N_I - t)}{(N_O + t)N_O}(1 - s_a) \right)t.$$

In our experiment, for each of the t additional outbound minutes that a carries due to the turnaround, a is paid by f a price equal to a's new marginal cost of foreign termination. Thus, a receives

$$\text{(A.4)} \quad MC(n_a + t, N_I - t) \times t = \left[(r + c_d) - (r - c_d) \frac{n(N_I - t)}{(N_O + t)^2} \right] t.$$

Substituting (A.3) into (A.2) to obtain the increase in a's termination costs, and using (A.4), we can now express the change in a's net revenues from this arrangement as follows:

$$\Delta(\text{net revenue}) = \text{payment received} - \text{increased costs}$$

$$= \left[(r + c_d) - (r - c_d) \frac{n(N_I - t)}{(N_O + t)^2} \right] t$$

$$- \left\{ \left[(r + c_d) - (r - c_d) \frac{n(N_I - t)}{N_O(N_O + t)} \right] t + (r - c_d) \left(\frac{n_a}{N_O} \right) t \right\}$$

$$= (r - c_d) \left(\frac{n(N_I - t)}{(N_O + t)} \right) \left(\frac{1}{N_O} - \frac{1}{(N_O + t)} \right) t - (r - c_d) s_a t$$

$$\text{(A.5)} \qquad\qquad = (r - c_d) \left(\frac{n(N_I - t)}{(N_O + t)} \right) \left(\frac{t}{N_O(N_O + t)} \right) t - (r - c_d) s_a t$$

$$= (r - c_d) \left(\frac{n(N_I - t)t}{N_O(N_O + t)^2} \right) t - (r - c_d) s_a t$$

$$= (r - c_d) \left((1 - s_a) \frac{(N_I - t)t}{(N_O + t)^2} \right) t - (r - c_d) s_a t$$

$$= (r - c_d) t \left[\left(\frac{N_I - t}{N_O + t} \right) \left(\frac{t}{N_O + t} \right) - s_a \left(1 + \left(\frac{(N_I - t)t}{(N_O + t)^2} \right) \right) \right]$$

$$= (r - c_d) \left[y - s_a (1 + y) \right] t,$$

where $y = \dfrac{(N_I - t)t}{(N_O + t)^2}.$

Expression (A.5) implies that, for given levels of initial traffic and for given turnaround, t, the profitability to carrier a is decreasing linearly in its initial market share of outbound minutes, s_a. It also demonstrates the properties argued informally earlier in the text, that under the hypothesized payment (price equal to the new marginal cost), turnaround will be profitable for a small carrier but not for a large one. For example, for $s_a = 0$, we have $\Delta(\text{net revenue}) = (r - c_d)yt > 0$; but for $s_a = 1$, we have $\Delta(\text{net revenue}) = -(r - c_d)t < 0$. (By similar logic, it is not profitable under the hypothesized payments to turn around all of the minutes, which is seen by noting that such complete turnaround makes $y = 0$, and, hence, $\Delta(\text{net revenue}) = -(r - c_d)s_a t < 0$.)

From (A.5) the critical initial share above which turnaround of t minutes is *not* profitable under the hypothesized reimbursement scheme is

$$s^* = \frac{y}{1+y} = \frac{(N_I - t)t}{(N_O + t)^2 + (N_I - t)t} = \frac{\left(1 - \dfrac{t}{N_I}\right)\dfrac{t}{N_I}}{\left(\dfrac{N_O}{N_I} + \dfrac{t}{N_I}\right)^2 + \left(1 - \dfrac{t}{N_I}\right)\dfrac{t}{N_I}}.$$

For given N_O and N_I, the largest value of s^* is found when $t = \dfrac{N_O N_I}{2N_O + N_I}$, which implies

$$s^*_{\max} = \left(\frac{N_I}{2N_O + N_I}\right)^2.$$

Observe that if $N_O \geq N_P$ then $s^*_{\max} \leq 1/9 \approx 11\%$, as reported in Proposition 4. *Q.E.D.*