

# Postal Networks

## Lecture 4b

# Historical Background

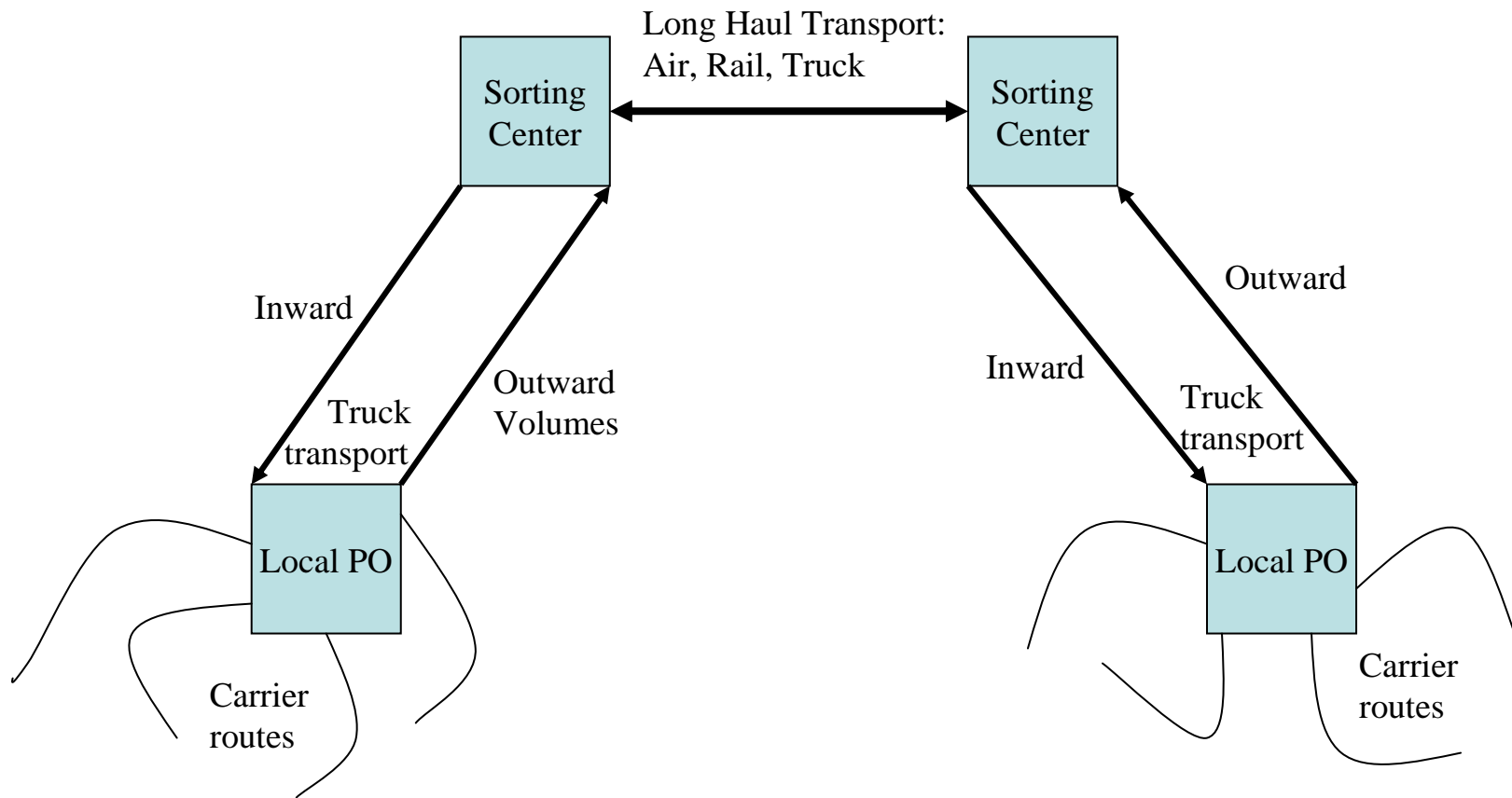
- Postal service dates back thousands of years; e.g., Persian Empire
- Rolland Hill created the modern postal industry with British “penny post” in 1840
  - Sender pays
  - Uniform nationwide rates
- Royal Mail example spread around the world
- International Postal Union organized to facilitate international mail movements

# Current Postal Issues

## (Driven by EU competition policies)

- Liberalization
  - (Some) postal markets must be opened to competitors, both foreign and domestic
  - Sweden and New Zealand are totally open
- Access
  - Competitors must be provided access to incumbent's networks
  - Foreign posts also require access; pay “terminal dues”
- Universal Service
  - Incumbent usually required to maintain a uniform stamp price
- Privatization

# Stylized postal network



# Components of Postal Value Chain (Scale econ. in collection and delivery)

- Collection
  - Mail brought to Local PO from various collection points
- Short haul transport
  - Mail transported from Local PO to Mail Processing Center
- Outward Sortation
  - Mail routed to other MPCs using sorting machines
- Long haul transport
  - Mail transported to destination MPC
- Inward Sortation
  - Mail directed to destination Local PO
- Short haul transport
  - Mail transported to destination Local PO
- Delivery
  - Carriers pick up mail for their routes; sort in route walk order

What do we mean by “contestability” in the case of postal markets?

- The absence of *economically* sunk costs?
- The threat of entry sufficient to eliminate incumbent excess profits?
- Economies of scale *without* barriers to entry?
- “Workable Competition?”

# Postal service is “more contestable” than other infrastructure industries

- Over 80% labor costs  $\Rightarrow$  low sunk costs *for entrants*
  - Sunk pension liabilities born by incumbents
- Economies of scale in delivery do not seem to have prevented entry.
  - Compare to “facilities based entry” in local telecom
- But, unlikely that the *threat* of entry, alone, would force delivery rates to average cost.
- What regulatory policies will make competition “workable” in postal markets?
  - Network issues are key (as they are in the airline industry)

## Outline of argument

- Review of “conventional wisdom” and the resulting policy analysis
- Some observations based upon competitive experiences
- Illustrate the importance of *market definition* for policy
- An alternative view of access pricing and “essential facilities”



# Conventional Wisdom

- Strong economies of scale in delivery
  - Confirmed by empirical studies
    - United States Postal Service
    - La Poste/IDEI
- Constant returns to scale in other components of the value chain
  - An *assumption* of USPS Costing until recently

# Policy implications of this conventional wisdom

- Work-sharing discounts for mail processing and transportation
  - Provide access to delivery function for competitors
  - Regulation of discount rates *may* be desirable
    - But incumbent has profit incentive to draw in efficient entrants
- Owen-Willig “visionary” proposal:
  - Lack of sunk costs may make possible competition *for* the delivery market monopoly

# Some competitive realities

- Substantial volume of work-sharing
  - Especially in U. S.
- But the most attention-getting entry is in collection and delivery:
  - Large urban areas
    - City Mail in Sweden
  - Medium sized urban areas
    - Pete's Post and franchisees in New Zealand
    - Various operations in Germany
- Competition *in the market* despite economies of scale
- How and Why?

# Explaining entry in local delivery

- Lower labor rates
- Uniform stamp price (blame Rolland Hill)
  - But, Deutsche Post could offer nationwide Local/Regional stamp
  - New Zealand Post could even do it city by city!
    - Uniformity not part of their Letter of Understanding!
- Alternative network “technology”
  - Targeting medium sized cities avoids need for large scale sorting machines and facilities
    - Consistent with recent USPS findings of significant economies of scale in Mail Processing

# Policies to promote *efficient* entry

- Re-think uniform pricing, Universal Service policies
- Shift of emphasis from “optimal” regulatory access pricing problem. Instead,
- Borrow from Antitrust/Competition policy principles
  - Market definition issues are very important
    - Geographic: National, Regional
    - Vertical: i.e., wholesale or retail
  - Access to “essential facilities”
  - Prevent “anticompetitive” interconnection behavior

# Understanding access issues requires careful Market Definition

- Delivery entrants do not need interconnection to serve *regional* mail retail market
  - They do need access to Address System and incumbent PO Boxes
  - These are *essential facilities*
- Entrants need interconnection to compete in:
  - *National* retail market and
  - *Regional* collection/delivery wholesale market.
    - At what rate? Remember entrant is *providing* the increasing returns delivery component

# Network economics create opportunities for anticompetitive behavior

- Refusal to interconnect forecloses local delivery entrant from
  - National retail market
  - Collection/delivery wholesale market
- Anticompetitive!
  - *Not* because of essential interconnected national network is an essential facility
  - Because refusal to interconnect at a “reasonable rate” is *predatory*
    - I.e., profitable only if entrant is driven out
  - At what rate?
    - The rate available to other large customers, as per New Zealand Letter of Understanding

# Policy Conclusions

- Postal markets are *readily contested*
  - Even in increasing returns to scale components
- Network effects mean that entry will occur piecemeal
  - Geographic regions
  - Selected service components
- Antitrust/Competition Policy more important than regulatory rate making.
  - Essential facilities play only a limited role
  - Predatory behavior with respect to interconnection may be more of a concern.



# Postal policy issues suitable for economic analysis

- Downstream access
  - Work-sharing discounts
- Private Bag access
- Universal Service Obligation
  - Uniform pricing
- Interconnection
  - Terminal dues

# Postal Access Issues

- Is mandated access required for successful liberalization?
- Are there “monopoly bottlenecks” and essential facilities in postal networks?
- Pros of mandating access (by analogy to telecommunications):
  - Reduce sunk costs of entry
  - Allow entry at small scale
  - Improve network efficiency
- Cons
  - Little sunk costs in postal networks
  - May undermine Universal Service Obligation
- In any event, how should access be priced?

# Example: Downstream access through work-sharing discounts

- Simplified 2 component network:
  - Delivery costs =  $F + rq$
  - Nondelivery unit costs =  $c$
  - Stamp price =  $p$
  - Work-sharing discount  $w$
- Mailers can provide nondelivery component at unit cost  $z \in [0, Z]$  with cdf  $H(z)$ .
- Mailer demand curve:  $D(\min\{p, p-w+z\})$
- Individual mailer's consumers' surplus  $s(\min\{p, p-w+z\})$
- Market demand for work-sharing mail  $W(p, w)$
- Market demand for normal mail  $N(p, w)$
- Market consumers' surplus  $S(p, w)$

# Ramsey analysis of optimal work-sharing discounts

$$W(p, w) = \int_0^w D(p - w + z) dH$$

$$N(p, w) = \int_w^Z D(p) dH = D(p)[1 - H(w)]$$

$$S(p, w) = \int_0^w s(p - w + z) dH + s(p)[1 - H(w)]$$

$$\pi(p, w) = (p - c - r)N(p, w) + (p - w - r)W(p, w) - F$$

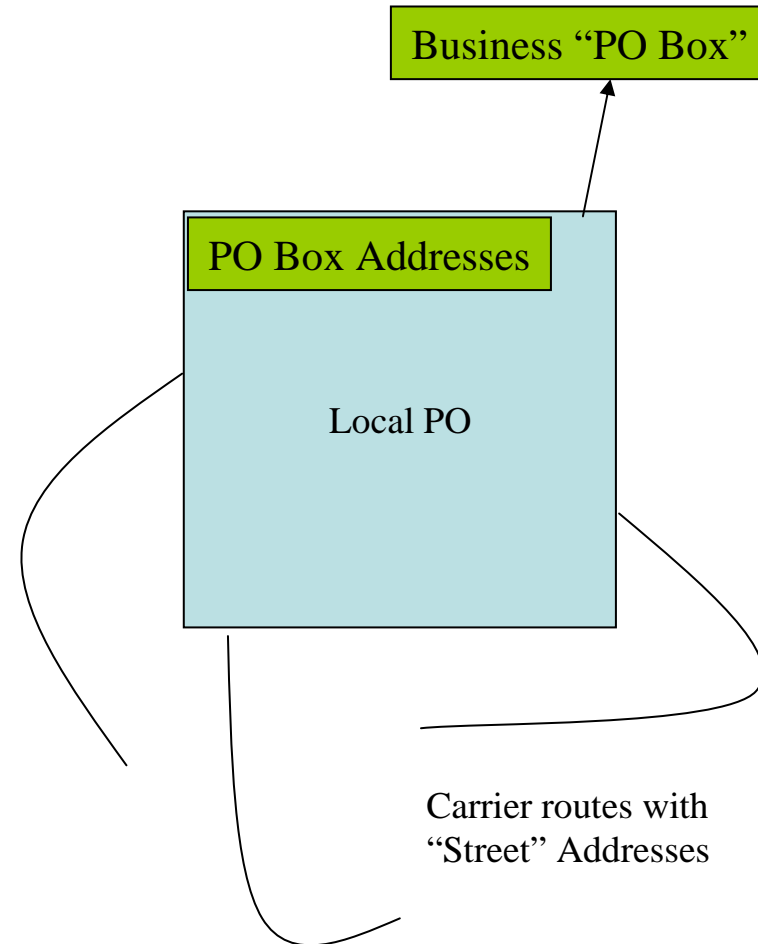
$$L = S(p, w) + (1 + \lambda)\pi(p, w)$$

# Post Office Boxes

- PO Boxes are facilities rented out to subscribers for the secure reception of mail.
  - Usually on the premises of the incumbent postal provider.
  - Mail Boxes, Etc. is a competitive provider of PO Box services in US.
- The share of PO Box addresses varies greatly by country, but accounts for a significant proportion of both businesses and individuals.
- Delivery entrants in any region find a significant volume of mail addressed to PO Boxes.
  - Delivering this mail may be their only contact with the incumbent.
  - Entrants offer to “do it themselves,” but incumbents reluctant to “let them in.”

# PO Box Addresses and “Street” Addresses

- Mail addressed to PO Boxes never leaves the Local PO
  - To deliver to PO Box Addresses, a competitor must gain *access* to Local PO.
- “PO Boxes” of commercial subscribers may be at their own locations, but no physical address is available for delivery.
  - Competitors must still turn over such mail to Local PO.



# Access to PO Boxes

- Even those (like me) skeptical of “essential facilities” arguments in postal networks agree that competitors should be granted to incumbent’s PO Box addresses.
- But, again, how to price to ensure that there is no leveraging of “dominant position” in PO Box market to delivery market.
  - Incumbent’s advocate ECPR
    - retains the incumbent’s full contribution, even though entrant does nearly all of the work!
  - Entrants (and Postal Regulators) favor cost-based rates
    - which can be very low.
  - Notice that this comes up in the presence of *delivery* competition (bypass), so this is actually an *interconnection* issue.
    - suggests “Bill and Keep” as an option

# PO Boxes as a 2-Sided Market

- PO Box operator provides services to:
  - Recipients of mail, who value secure, perhaps anonymous, delivery
  - Postal operators, who are obligated to deliver mail addressed to PO Box subscribers.
    - Postal operators “pass through” the demand of *senders of mail*, who, since Rolland Hill, pay for the volumes sent.
- PO Box operator can charge:
  - Recipients a monthly fee  $m$  and/or a per piece charge  $r$
  - Postal operators an access fee  $a$  per piece delivered.



# Heterogeneous mail recipients

- Mail recipients are indexed by two parameters  $(s,t)$  distributed according to joint density  $f(s,t)$ .
- $t \in [0,T]$  reflects preference for PO Box subscription.
- $s \in [0,1]$  indexes the amount mail he receives.
- The mail volume sent to recipient of type  $s$ ,  $v(p,s)$ , also depends upon the price paid by mailers:
  - Mailers may pay different prices depending upon whether mail is addressed to PO Boxes ( $p_B$ ) or street addresses ( $p_S$ ).
  - Simplify analysis by assuming mailers have equal demand elasticities for each type of recipient:  $v(p,s) = sv(p)$ .
- Recipient *net* utility:
  - For PO Box subscribers  $U_B = t + (\alpha-r)sv(p_B) - m$
  - For non subscribers  $U_0 = \alpha_s sv(p_S)$

# Recipients' subscription decisions determine mix of mail volumes

- The marginal recipient type  $t^*$  equates the net utility of subscribing and non subscribing:  $t^* = m - (\alpha - r)sv(p_B) + \alpha_S sv(p_S)$
- Total number of PO Box subscribers is  $B(m, r, p_B, p_S)$ .
- Total mail volumes delivered to PO Box subscribers is  $V(m, r, p_B, p_S)$ .
- Total volume of mail delivered to street addresses is  $V_S(m, r, p_B, p_S)$ .

$$B(p_S, p_B, m, r) = \int_0^1 \int_{t^*}^T f(s, t) dt ds$$

$$V(p_S, p_B, m, r) = v(p_B) \int_0^1 \int_{t^*}^T sf(s, t) dt ds \equiv v(p_B) Z$$

$$V^S(p_S, p_B, m, r) = v(p_S) \int_0^1 \int_0^{t^*} sf(s, t) dt ds \equiv v(p_S) Z^S$$

# Mailers' behavior and welfare

- The behavior of mailers sending mail to recipients of type  $s$  is assumed to be captured by their Marshallian demand functions
- Their utility functions are assumed to be quasi-linear, so that Mailer welfare  $M$  is captured by their Marshallian consumers' surplus:  $sS(p)$ .
  - Note that this specification assumes that the demands for mail sent to two different mailer types are *independent*.
- Recipient welfare  $R$  is summed over PO Box subscribers and non subscribers

$$M = S(p_S) \int_0^1 \int_0^{t^*} sf(s, t) dt ds + S(p_B) \int_0^1 \int_{t^*}^T sf(s, t) dt ds$$

$$R = \int_0^1 \int_0^{t^*} \alpha_S v(p_S) sf(s, t) dt ds + \int_0^1 \int_{t^*}^T [(\alpha - r)sv(p_B) - m] f(s, t) dt ds$$

# Postal and PO Box services as integrated system of 2-sided markets

- Postal service not usually modeled as a 2-sided market under “sender pays”.
  - As in telecom, explicit 2-sided modeling is not required with a single service provider.
  - Access and interconnection issues make 2-sided interactions explicit.
- Optimal pricing in integrated system provides useful benchmark for access pricing policy in multi-firm situations.
- Cost assumptions (no “institutional” costs):
  - Postal costs of delivery to PO Box =  $c_B$ .
  - Postal costs of delivery to street address =  $c_S$ .
  - Fixed cost per PO Box =  $b$
  - PO Box cost per piece received =  $c$

## Optimal pricing by integrated provider: mail rates reflect reception externality

- Proposition 1: The optimal mailing rates for both PO Box addressed and street addressed mail are equal to their respective end-to-end marginal costs less the associated reception benefit:

$$p_B^* = c_B + c - \alpha$$

$$p_S^* = c_S - \alpha_S$$

# Optimal PO Box subscription charge is cost based, reception charge reflects externalities.

- Proposition 2: The optimal PO Box fixed subscription charge is set equal to the per subscriber fixed cost of operating and maintaining it: i.e.,  $m^* = b$ .
- Proposition 3: The optimal PO Box acceptance charge is equal to the difference between the PO Box and non PO Box reception externalities plus an adjustment factor based on the difference between the prices of PO Box addressed and street addressed mail. This adjustment factor is positive, negative, or zero as the former is less than, greater than or equal to the latter.

$$r^* = \alpha - \alpha_S + \frac{\alpha_S [v(p_B) - v(p_S)] + x}{v(p_B)}$$

where  $x = S(p_S) - S(p_B)$

## Access pricing in “competitive” PO Box markets

- Competitive PO Box markets would presumably operate similarly to competitive mobile phone markets:
  - PO Box providers compete for subscribers, attempting to make money on postal access charges
    - I.e., by creating “competitive bottlenecks”
  - Unlikely to subsidize subscription
    - Receivers cannot guarantee access revenues
  - Reception subsidies likely
- Assume that free entry and exit of PO Box providers ensures zero profits:

$$m^c = b \text{ and } r^c = a^c - c.$$

# What's the appropriate benchmark for PO Box access policy?

- If benchmark is unconstrained welfare max
  - “Bill and Keep” looks pretty good, especially if  $c \approx \alpha \approx 0$ .
- If benchmark is outcome in *competitive, disintegrated* PO Box and postal markets
  - Access price might even exceed ECPR!
- Because of 2-sided market effects, cost based rules don't seem adequate.
- Additional models to explore:
  - Integrated dominate firm with postal service competitive fringe
  - PO Box duopolists facing competitive postal sector
  - Integrated duopoly



# Measuring the Costs of Postal Universal Service Obligations (USO)

- USO costs consist of resource costs and foregone revenue costs
- Measuring them requires specification of unsubsidized market alternative
- Determining any appropriate Universal Service Fund *payments* requires, in addition, consideration of competitive environment.
- Regulated monopoly benchmark
- Analysis of various competitive scenarios

To measure USO costs it is necessary to specify an unsubsidized market scenario.

- By definition, a USO mandates a flow of subsidy toward one group of users or another.
- USO costs depend upon
  - cost of the resources used to provide the service
  - the prices at which the service is to be provided
  - the subsidy mechanism through which Universal Service is to be achieved
- All may be affected by competitive environment

# USO costs are *not* solely cost-based

- Incremental cost of USO must recognize incremental costs of serving groups of customers, not just services.
- USO costs are defined with reference to a particular set of services and rates.
- The USF payment required to allow incumbent to assume any particular USO must be jointly determined with rates and degree of competition.

# USO Costs in a Stylized Postal Network

- Two delivery areas
  - Low cost (A)
  - High cost (B)
- Two services
  - Basic service 1
  - Premium service 2
- Two cost components
  - Delivery D
  - “Sorting” S
- Affine costs
- Independent Demands

$$D^k = F_T^k + d_{k1} V_{k1} + d_{k2} V_{k2}$$

$$S = F_T^S + s_1 (V_{A1} + V_{B1}) + s_2 (V_{A2} + V_{B2})$$

$$k = A, B \quad T \subseteq \{1, 2\}$$

$$N_{kj}(p_{kj}) = (p_{kj} - d_{kj} - s_j) V_{kj}$$

$$k = A, B \quad j = 1, 2$$

# Regulated Monopoly Benchmark

- Break-even: Sum of contributions covers overheads
- Separate profitable and unprofitable regions
- Rewrite Break-even condition
- Add USF payments as another source of contribution

$$N_{A1}(p_{A1}) + N_{A2}(p_{A2}) + N_{B1}(p_{B1}) + N_{B2}(p_{B2}) = F_{12}^S + F_{12}^A + F_{12}^B$$

$$N_{A1}(p_{A1}) + N_{A2}(p_{A2}) = [F_{12}^B - N_{B1}(p_{B1}) - N_{B2}(p_{B2})] + F_{12}^S + F_{12}^A$$

$$\equiv U(p_{B1}, p_{B2}) + I_{12}^A$$

$$P + N_{A1}(p_{A1}) + N_{A2}(p_{A2}) \equiv U(p_{B1}, p_{B2}) + I_{12}^A$$

## Subsidy-free USF payments

- USO costs equal area B losses
- Payments must cover these, else area A revenues exceed its stand-alone costs
- If payments exceed sum of USO costs and non-delivery overhead, area A is not covering its incremental cost

$$U(p_{B1}, p_{B2}) = F_{12}^B - N_{B1}(p_{B1}) - N_{B2}(p_{B2})$$

$$P \geq U(p_{B1}, p_{B2})$$

$$P \leq U(p_{B1}, p_{B2}) + F_{12}^S$$

# Competition with reserved area

- Competition limits contribution from service 2 in area A
- Trade-off between higher basic service price and USF payment
- Uniform pricing requirement further limits flexibility by increasing U

$$N_{A1}(p_1^R) + N_{A2}^i(p_{2i}^R, p_{2e}^R) + N_{B1}(p_1^R) + N_{B2}(p_2^R) + P = F_{12}^A + F_{12}^B + F_{12}^S$$

$$[N_{A1}(p_1) + N_{A2}^i(p_{2i}^R, p_{2e}^R) - F_{12}^A] + P = U + F_{12}^S$$

# Competition without a Reserved Service

- Competition determines *all* prices
- Competition limits *all* area A contributions
- With uniform pricing, competition also determines USO costs
- USF payments only policy instrument to cover network costs

$$[N_{A1}^i(p_{1i}^N, p_{1e}^N) + N_{A2}^i(p_{2i}^N, p_{2e}^N) - F_{12}^A] + P = U(p_{1i}^N, p_{2i}^N) + F_{12}^S$$



# Competition with Downstream Access

- Assume one (unreserved) service
- Now there are two policy instruments: P and a
- Higher access price means lower USO costs
- Area A profits plus P must cover U plus network overhead

$$(p_i^* - d_A - s)V_A^i + (p_i^* - d_B - s)V_B^i + (a - d_B)V_B^e + P = F^A + F^B + F^S$$

$$(p_i^* - d_A - s)V_A^i - F^A + P = [F^B - (p_i^* - d_B - s)V_B^i - (a - d_B)V_B^e] + F^S$$

$$N_A^i - F^A + P = U^A + F^S$$

# Auctioning off the USO

- Assume one unreserved service, uniform prices
- Area B *delivery* is not a service
- Terms must be specified for transfer price of mail to USO holder
- Lowest bid depends upon  $t$  as well as  $p$

$$N_A(p) - F^A + P = [F^B - N_B(p)] + F^S = U(p) + F^S$$

$$P^e = F^{B^e} - (t - d_B^e)V_B(p)$$

# Winning bid as USO “cost”?

- What are “reasonable” transfer prices?
  - Stamp price less unit sorting costs:  $t = p - s$
  - No per unit transfer payment:  $t = 0$
  - Transfer equal to marginal delivery costs  $t = d_B$
- Winning bid approach “narrows” subsidy-free range

$$(p - d_A - s)V_A - F^A - F^S = 0$$

$$P^e = F^{B^e} + d_B^e V_B(p)$$

$$(p - d_A - s)V_A(p) = (p - s)V_B(p) - F^A - F^S = 0$$

# USO Conclusions

- USO “costs” cannot be solely cost-based
- USF payments can/must exceed USO costs depending upon:
  - Reserved services
  - Uniform pricing requirements
  - Downstream access requirements
- USO auctions cannot provide “objective” cost measures without specification of transfer prices.

# “Terminal Dues” for international mail

- Foreign post collects the revenue, but domestic post delivers within its national network
  - What is the appropriate charge for this “access”
  - Domestic stamp price?
  - Incremental cost?
- Arbitrage and “Remailing”
- Mail volumes as an indicator of “development”
- “Optimal” EU rules?