Tradable Hospital Admissions Permits: Creating a Market for the Medically Indigent

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Abstract

As a matter of the social contract American society does not deny health care to the medically indigent. Two problems arise: First, the price at which care is reimbursed is government determined without much regard to the market place. Second, the social liability of providing hospital care for the indigent is not shared equally by all hospitals. This could lead to some socially undesirable consequences, such as the closure of hospitals in poor areas. This paper proposes tradeable admissions permits as a method for restoring the 'missing market' for care for the poor. As an alternative to the prospective payments system, admissions permits can achieve both efficiency and equity.

I. Introduction

One of the earliest and most robust findings of economics is that where relative costs of performing an activity differ among individuals, firms, or regions there are almost always potential gains from trade. Conversely, where prices are determined by some mechanism other than market forces there is a loss in economic efficiency. This time-honored principle has found its way into many public policy areas previously perceived as impervious to its application. Noticing the different costs of reducing pollution among firms, for example, economists have long advocated the use of emission permits tradable among different firms to reduce the total level of pollution.[i]

Here, we propose "tradable admission permits" as one alternative to solving the problem of providing medical services to the medically indigent who are unevenly distributed among hospitals (Health and Human Services, 2006). This unevenness has created a caste structure within the health care system: some ('geographically disadvantaged') hospitals are overburdened with under- and uninsured patients[ii] while others service mostly able-to-pay patients. This reality has unnecessary and socially undesirable consequences, such as closure of neighborhood hospitals[iii] that were previously accessible to local residents whose mobility may be limited. The issue can be thought of as an externality problem. In the case of emission control, tradable pollution permits are used to create a market–oriented solution for the reduction of a negative externality in a cost-effective way. In health care policy makers are facing the opposite issue, how to promote the provision of health care more efficiently.

Providing health care for the medically indigent has become problematic, and is becoming more so (Fronstin, 2002). In the past the U.S. had locally centralized systems for dealing with the social liability of equal access to medical care without regard to the ability to pay (Barr 1993, Pps. 291-2 and Blaisdell 1994). Any solution to the question of providing care for the poor must address a number of circumstances. The poor may be relatively immobile; going to a hospital outside of their neighborhood may limit their access to basic care (see HHS 2006, Buchmueller, Jacobson and Wold 2004, Cunningham and Nichols 2005 and Long, King and Coughlin 2006). Once they become ill, the poor and elderly are more costly to treat than the affluent (Smith and Telles 1991, Elliot, Renier and Vecchi 1995, Hahn and Flood 1995, Vigdor 2003 and Florence 2005). Some hospitals face a greater burden of caring for the poor than others (Sloan, Valvona and Mullner, 1986). In addition, the poor tend to use a tertiary care facility as their source for primary care thereby raising hospital operating costs (Florence 2005). These forces, on top of unilaterally determined fee schedules, all come together to place a burden on providers and the poor.

A system of tradable admissions permits obviates the need for a government agency, state or federal, to determine the reimbursement rates for serving the poor. Creating a market for the care for the poor also makes the question of a hospital's obligation to provide care and an indigent person's right to care moot (Reinhardt 1986 and Olick 1994). A market for permits will also be more responsive to the growing proportion of medically indigent in the population (Sloan, Morrisey and Valvona, 1988). Also, by using tradable admissions permits, the public policy authority responsible for acute health care is able to overcome the fact that neither hospitals nor patients are very mobile.

In section 2 we state the model and prove that a market will exist for tradeable admissions permits. Some comparative statics results are stated in section 3. Conclusions and directions for future work are presented in section 4.

II. A Model of Tradeable Admissions Permits

There is a city arranged along a street of unit length.[iv] There are two classes of consumers: Those who are able-to-pay for their hospital care (the rich, denoted by R) and those who cannot (the badly off, denoted by B). The poor live on the interval [0,L]. The rich live on the interval [L,1]. In effect the city is segregated by ability to pay. The abilities to pay of the two types of consumer are perfectly distinguishable. The density of residents, w, along the street is the same for both classes of consumer. Hence, the total number of poor people on the street is $\int_0^L w dx = wL$ and the total number of able-to-pay people is $\int_L^1 w dx = w(1-L)$.

There are two hospitals in the city. Their locations are assumed to have been predetermined by historical accident (see note 3 on the infrequency of hospital openings). For simplicity the hospitals are symmetrically located at a distance 'a' about the midpoint on the street. Hospital 1, located in the poor neighborhood, is located at (½ - a) and Hospital 2, which is located in the affluent neighborhood, is located at (½ + a). The two hospitals provide identical services and compete on the basis of price as the strategic variable. Neither hospital can turn away a customer on the basis of the ability to pay. This linear city and its hospitals appears as in Figure 1.

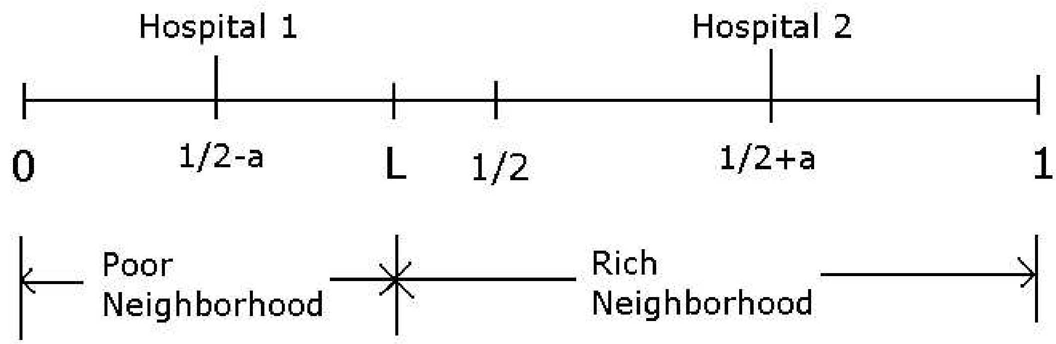

Figure 1

The consumers must make a mutually exclusive choice of hospital on the basis of utility surplus (Anderson, DePalma and Thisse, 1992). The utility derived from choosing hospital i=1,2 by a patient of type k=B,R who is located at x is defined by

$U^k(i,x) = m_k - p(i,x,k)$ where m_k is the reservation price of patient type k for health care and p(.) is the real utility cost suffered by the consumer upon choosing hospital i.

To make things specific, define the real utility cost for the able-to-pay to be

(1) $$p_i + t(x - x_i)^2 + q_R(D_i - K_i)$$

where p_i is the price for a unit of care at Hospital i and t is travel cost, assumed to be the same for both types of consumer. The opportunity cost of time for a given type of consumer is q_j , j=R (ich), B(adly off). The difference between total demand for care at the hospital, D_i, and its capacity, K_i, is a measure of the waiting time for care at the i^{th} hospital. Hence, the first term is the fee paid by the patient or her insurance carrier, the second term is the total travel cost, and the last term is the monetary cost of hospital congestion. Since the poor are unable to pay any out of pocket expenses beyond transportation and the opportunity cost of waiting, their real utility cost will be

(2) $$t(x-x_i)^2+q_B(D_i-K_i)$$

Obviously there are marginal individuals of both types who will be indifferent between the two hospitals. The location of the marginal able-to-pay customer is found by setting equal the utility cost of being served at the respective hospitals and solving for x, the consumer's location. Hence, the location of the marginal able-to-pay customer is given by

(3) $$^{R}=\frac{\left(p_2-p_1\right)+q_R\left(\left[D_2-K_2\right]-\left[D_1-K_1\right]\right)}{4ta}+\frac{1}{2}$$

Since patients are uniformly distributed throughout the city, 1/2 is the location of the randomly drawn patient and 4ta is that patient's cost of making a round trip to each hospital. The numerator of the first term is the incremental monetary expense of choosing hospital 2 instead of hospital 1. The aggregate demand of type R customers for services at Hospital 1, located in the poor neighborhood, will be

(4) $$D_1^R=\int_L^{R} w\,dx=w\left(\ ^{R}-L\right)$$

Their demand for services from Hospital 2, located in their own neighborhood, will be

(5) $$D_2^R=\int_R^{1} w\,dx=w\left(1-\ ^{R}\right)$$

Similar calculations can be made for the unable-to-pay group of customers. The location of the indigent patient indifferent between the two hospitals is

(6) $$ {}_{B} = \frac{q_B\left(\left[D_2 - K_2\right] - \left[D_1 - K_1\right]\right)}{4ta} + \frac{1}{2} $$

The aggregate demand of type B customers for services at Hospital 1, located in their own neighborhood, will be

(7) $$ D_1^B = \int_0^{{}_{B}} w dx = w \;{}^{B} \; . $$

The aggregate demand by indigent patients for services from the hospital in the affluent neighborhood will be

(8) $$ D_2^B = \int_{{}_{B}}^{L} w dx = w\left(L - \;{}^{B}\right) \; . $$

The demand side of the model can be solved to determine the number of patients served at the poor hospital, denoted D_1, and the number served at the rich hospital, denoted D_2.

(9) $$ D_1 = \frac{w\left[\left(p_1 - p_2\right) + q_R\left(w - \left(K_2 - K_1\right)\right)\right]}{4ta + 2taq_R w} + \frac{w\left(1 - L\right)}{1 + \frac{q_R w}{2ta}} $$

(10) $$ D_2 = \frac{w\left[\left(p_1 - p_2\right) + q_R\left(w + \left(K_2 - K_1\right)\right)\right]}{4ta + 2taq_R w} + \frac{wL}{1 + \frac{q_R w}{2ta}} $$

where q_B has been set to one to simplify the algebra.

Turning to the supply side of the market, the constant marginal cost of serving an able to pay customer is f^R. The constant marginal cost of serving an indigent patient is f^B. In order to serve a paying-customer, the hospital must have an admissions permit. Initially Hospital 1, in the poor neighborhood, has an endowment of n such permits.[v] If Hospital 1 has fewer than n paying customers then it can sell the additional permits in the marketplace. Symmetrically, if Hospital 2 is to serve any able-to-pay customers then it must purchase an admissions permit from Hospital 1. Formally, the objective of the first hospital, in the indigent area, is

$$\text{(11)} \quad \begin{array}{ll} \textit{Maximize} & {}_1 = \left(p_1 - f^R\right) D_1^R + s_1 C_1 - f^B D_1^B \\ \textit{subject to} & D_1^R + C_1 \leq n \\ & \left(p_1 - f^R\right) D_1^R + s_1 C_1 \geq f^B D_1^B \\ & C_1 \geq 0 \; ; \; p_1 \geq 0 \end{array}$$

The first constraint is the sale limit constraint. A total of D_1^R paying customers come to the poor hospital and it can sell an additional C_1 permits at an asking price of s_1 dollars each, up to the total of its initial endowment of such permits, n. The second constraint is the incentive constraint. Hospital 1 should at least break even on the sale of patient care and admissions permits. The objective of the second hospital, in the rich area, is similarly represented in equation 12.

$$\text{(12)} \quad \begin{array}{ll} \textit{Maximize} & {}_2 = \left(p_2 - f^R - s_2\right) D_2^R - f^B D_2^B \\ \textit{subject to} & D_2^R \leq n - D_1^R \\ & \left(p_2 - f^R - s_2\right) D_2^R - f^B D_2^B \geq 0 \\ & p_2 \geq 0 \end{array}$$

The first constraint simply states that the second hospital must purchase from Hospital 1 a permit for every able-to-pay customer it serves. In the second constraint Hospital 2 stipulates that it will not bid so high for a permit, s_2, that it will lose money on its newly purchased permit. Of immediate interest is whether there is a price, s, for an admissions permit that will allow trade between the hospitals. There are both necessary and sufficient conditions. If trade in permits is observed to have taken place then it must have been the case that Hospital 1 was not able to cover the cost of caring for the indigent from the revenues it earned from services sold to the affluent. That is, $\ ^{B} f^{B} w \geq \left(\ ^{R} - L\right)\left(p_1 - f^{R}\right) w$. Similarly, after paying the explicit costs of caring for both its rich and poor patients, Hospital 2 must have some revenue left to buy permits. That is, $w\left(\ ^{R} - L\right)\left(p_1 - f^{R}\right) \geq w\left(L - \ ^{B}\right) f^{B}$. These inequalities can be rearranged to yield the necessary condition

$$\frac{\left[\dfrac{\ ^{R} - L}{1 - \ ^{R}}\right]}{\left[\dfrac{\ ^{B}}{L - \ ^{B}}\right]} \leq \frac{p_2 - f^{R}}{p_1 - f^{R}}$$

In the numerator on the left hand side is the odds of a rich patient going to Hospital 1, the denominator is the odds of a poor patient going to Hospital 1. The right hand side is the ratio of the Hospital 2's profit from caring for the affluent to that of Hospital 1. Since $0 < \ ^{B} \leq L \leq \ ^{R} < 1$, we know that the odds ratio and, hence the ratio of profits, will always be positive. A sufficient condition is that at the market clearing prices for care, the difference between the bid (s_2) and ask (s_1) price of a permit must be positive. Hospital 1, in the poor area, will accept a price for its admissions permits no lower than $\dfrac{f^{B} D_1^{B} - \left(p_1 - f^{R}\right) D_1^{R}}{n - D_1^{R}}$. This is positive and finite only if the hospital can cover the care it provides the poor with the revenue it earns from serving the able-to-pay and selling its excess admissions permits. At the same time, the permit price must be below $p_2 - f^{R} - \dfrac{f^{B} D_2^{B}}{n - D_1^{R}}$, or Hospital 2 will not buy any permits offered to it. Taking the difference between the maximum price that Hospital 2 will pay and the minimum acceptable price to Hospital 1 yields $\left(p_2 - f^{R}\right)\left(n - D_1^{R}\right) + \left(p_1 - f^{R}\right) D_1^{R} - f^{B}\left(D_2^{B} + D_1^{B}\right)$. This will be positive as long as the marginal cost of caring for the poor, f^{B}, is not too great and/or there are not too many of them, $D_2^{B} + D_1^{B}$.

The maximization problem for the two hospitals can be solved to yield the optimal prices to be charged to paying customers. The solution will yield a Nash (price) equilibrium. The solution is found by substituting for D_1^R, D_1^B, D_2^R, D_2^B and the aggregate demands in the objective functions. Each hospital takes the other's price as given, so the objective functions are differentiated with respect to the respective prices. The two first order conditions can then be solved for the optimal prices, given by

$$p_1=\frac{2}{3}(1-2L)+\frac{2}{3}s_1+\frac{1}{3}s_2-\frac{w}{2ta+w}f^B+f^R+\frac{2}{3}\frac{taq_R}{2ta+w}\left[2n-(K_2-K_1)\right]+\frac{4}{3}\frac{\tan}{w}$$

$$p_2=-\frac{2}{3}ta(1-2L)+\frac{1}{3}s_1+\frac{2}{3}s_2-\frac{w}{2ta+w}f^B+f^R+\frac{2}{3}\frac{taq_R}{2ta+w}\left[4n+(K_2-K_1)\right]+\frac{8}{3}\frac{\tan}{w}$$

where s_1 and s_2 are the ask and bid prices for admissions permits. With the prices for care in hand it is possible to re-examine the question of the price of an admissions permit, s. This is accomplished by imposing a zero profit constraint[vi] under a given allocation of patients between the two hospitals. From each of the zero profit constraints one obtains an expression for the price of a permit. Setting these prices equal to each other and substituting away from the price of care yields the desired solution. There are four possible allocations of patients between the hospitals. In the simplest case all of the poor patients go to Hospital 1 and all of the paying patients go to Hospital 2. In this case the marginal patients are located at L. In the second case Hospital 1 gets no paying patients, but some poor patients now go to Hospital 2. In the third case all of the poor patients go to Hospital 1, but some paying patients now also go to Hospital 1. In the final case both hospitals have both types of patients. For the first case, in which patients patronize their neighborhood hospital, the price of an admissions permit will be

$$s=w\left(\frac{L}{n}+\frac{1}{2ta+w}\right)f^B+\frac{2ta}{3}((1-L)-L)-\frac{2}{3}\frac{2ta}{2ta+w}\left[q_R(K_2-K_1)+\frac{2ta}{w}+n(q_R+1)\right]$$

In the expression for s, q_R is the opportunity cost of waiting for those who are able to pay. K_2-K_1 is the net capacity of Hospital 2 over Hospital 1. f^B is the marginal cost of caring for an additional indigent patient. Note that 2ta/w is the per capita cost of a trip between the two hospitals. L/n is the ratio of poor patients to the number of paying patients for whom permits are available. n/w is the ratio of paying patients for whom there are permits to the number of patients in the population. (1-L)-L is the net proportion of paying patients in the population. Hence, s>0 if travel costs are not too high, the opportunity cost of waiting is not too great, the proportion of poor is low enough, and hospital 2 has enough capacity relative to hospital 1.

In the fourth case, when some of each type of patient go to each hospital, the price of an admission permit is

$$s=\left[\frac{w\left(\left({}^{R}-L\right)-\left(1-{}^{R}\right)\right)-n}{\left(n-2w\left({}^{R}-L\right)\right)\left(1-{}^{R}\right)}\right]{}^{B} f^{B}$$

$$+\frac{\left[w\left[w\left(2\left(1-{}^{R}\right)+L\right)\left({}^{R}-L\right)+2Lta\left({}^{R}-L\right)+n\left({}^{R}-L\right)-1\right]-2\tan L\right]}{\left(n-2w\left({}^{R}-L\right)\right)\left({}^{R}-L\right)\left(2ta+w\right)} f^{B}$$

$$+\frac{2atn}{3}\frac{6w\left({}^{R}-L\right)-4n-\left(K_{2}-K_{1}\right)}{\left(n-2w\left({}^{R}-L\right)\right)\left(2ta+w\right)}q^{R}+\frac{2}{3}\frac{atn\left(w\left(6{}^{R}-8L+1\right)-4n\right)}{w\left(n-2w\left({}^{R}-L\right)\right)}$$

In this expression for s, ^{R}-L is the proportion of paying patients who receive service from Hospital 1 and 2ta is the cost of a trip between the hospitals. Not surprisingly, the price of an admissions permit is an increasing function of the location of the marginal poor patient (^{B}) and the marginal cost of caring for the poor. Other comparative static results are taken up in the next section.

III. Implications

At the equilibrium prices, comparative statics yields some interesting results, summarized in Table 1. The first column shows the variable being changed. The remaining columns of the table can be divided into two parts in the vertical dimension. The first pair of columns shows the response of the price of care to changes in key variables. The second pair of columns shows the response of the bid (s_2) and offer (s_1) price of an admissions permit to changes in key variables.

Changes in the price of care are considered first. As the offer price of an admissions permit rises, Hospital 1 will increase the price it charges those who are able to pay for care. This response is a result of the fact that caring for the affluent now has a higher opportunity cost. Hospital 1's response to an increase in Hospital 2's bid price for a permit is also positive but smaller. Again the response is explained by a higher opportunity cost of providing care rather than selling the right to provide care.

Table 1

Comparative Statics:

Impact of Parameter Changes

	Price of Care		Price of Permit	
Variable	Hospital 1	Hospital 2	Hospital 1's Asking Price	Hospital 2's Bid Price
S_1	2/3	1/3	- -	-2
S_2	1/3	2/3	-1/2	- -
K_1	$\frac{2}{3}\frac{taq_R}{2ta+w}$	$-\frac{2}{3}\frac{taq_R}{2ta+w}$	$-\frac{taq_R}{2ta+w}$	$\frac{taq_R}{2ta+w}$
K_2	$-\frac{2}{3}\frac{taq_R}{2ta+w}$	$\frac{2}{3}\frac{taq_R}{2ta+w}$	$\frac{taq_R}{2ta+w}$	$-\frac{taq_R}{2ta+w}$
q_r	$2ta\left[\frac{2n+K_1-K_2}{2ta+w}\right]$	$2ta\left[\frac{4n+K_1-K_2}{2ta+w}\right]$	$-3ta\left[\frac{2n+K_1-K_2}{2ta+w}\right]$	$-3ta\left[\frac{4n+K_1-K_2}{2ta+w}\right]$
L	$-\frac{4ta}{3}$	$\frac{4ta}{3}$	$2ta$	$-2ta$
f^B	$-\frac{w}{2ta+w}$	$-\frac{w}{2ta+w}$	$\frac{3w}{2(2ta+w)}$	$\frac{3w}{2(2ta+w)}$
f^R	1	1	-3/2	-3/2

The price charged for care by a hospital increases as its own capacity increases. An increase in capacity will reduce waiting time. In turn, the total opportunity cost incurred by a paying patient will fall. As a consequence the hospital is able to raise price and capture some of the consumer's net gain in the real utility cost of having purchased care. If the hospital's competitor increases capacity then the correct response is to drop price.

As the opportunity cost of time for the affluent (q_R) increases, the price for their care will rise at both hospitals. That is, the hospitals correctly determine that price can be used to ration capacity so that the total cost of waiting by an affluent patient will remain unchanged.

As the proportion (L) of unable-to-pay patients in the population increases, the price for care falls at Hospital 1 and rises at Hospital 2. This results from Hospital 1 having to compete more fiercely for the dwindling number of geographically more distant patients who are able to pay. At Hospital 2 they must raise the price for the affluent as their burden of unable to pay patients increases.

The price response to an increase in the marginal cost of caring for the able to pay is also equal to the opportunity cost of time for the indigent. However, if the marginal cost of caring for an indigent patient rises then the price charged to the affluent must decrease. This response is necessary to attract more paying customers to offset the higher cost of caring for the indigent.

Turning to the effects of variable changes on admissions permit prices, the minus signs in admissions permit cross derivatives indicate that the spread between the offer and bid price will increase in response to an increase in either one of them. An increase in its own capacity will cause Hospital 1 to lower its offer price. The logic is that reduced waiting time will draw more paying customers to Hospital 1 so the sale of an admissions permit to Hospital 2 is not as attractive. An increase in Hospital 2's capacity will cause Hospital 1 to raise the offer price for a permit. In this case waiting times at Hospital 2 are falling so more paying patients will go there and the hospital is willing to pay more for the right to care for them. The explanation of the sign patterns for Hospital 2's bid prices is symmetric. An increase in the opportunity cost of time for the affluent (q_R) will cause both offer and bid price for a permit to fall. Both prices fall because the total fee for service must fall to compensate the able to pay customer for the increasing cost of waiting for care. As the proportion of indigent in the population increases, the first hospital will raise its offer price. This is necessary in order to offset the increased burden of caring for the indigent. Hospital 2's burden of caring for the poor will also increase, hence they will not pay as high a price for the right to provide care for the affluent. When the marginal cost of caring for the indigent rises, Hospital 1 must ask a higher price for its permits and Hospital 2 will raise the price it is willing to pay for those permits. The response of Hospital 1 is obvious. The response of Hospital 2 is explained by the fact that it is willing to pay more for the right to care for the affluent, the only source of income to offset the cost of caring for the poor. When the cost of caring for the affluent goes up, the price that Hospital 1 asks for its permits will go down and the willingness of Hospital 2 to pay for a permit will also decline. Hospital 1 must lower its offer price and Hospital 2 must lower its bid price since a paying customer is no longer as lucrative.

IV. Conclusions

In this paper we have modeled the essential features of the urban healthcare landscape. Namely, as a result of historical accident some hospitals are located in poor areas and have an excessive burden of caring for the poor. Other hospitals located in more affluent neighborhoods do not have a comparable burden. The result is that although the hospitals in the two types of neighborhoods may be equally well run, one group is always on the brink of financial ruin. To overcome the unequal burden, society has relied on various public care arrangements and inserted uncompensated care components into the prospective payment systems. Medicaid is used to reimburse for care provided to the poor and uninsured. Medicare is used to provide for the underinsured elderly. Neither system reimburses at the market rate since there are no true markets for paying and indigent patients. Instead the systems rely on providers' self-reporting. Furthermore, these large, slow moving bureaucracies are only moderately responsive to the vicissitudes of the market place in determining the reimbursement schedules unilaterally. Neither Medicare/Medicaid nor a system of taxes will be successful since neither mechanism solves the problem of the missing market for the care of the medically indigent.

In the model proposed here the hospitals located in poor neighborhoods are endowed with the right to care for patients who are able to pay, either out of pocket or with insurance. These rights are termed admissions permits. Hospitals in affluent neighborhoods must purchase the right to care for patients from the their less affluent brethren. This places the mechanism for determining the appropriate reimbursement schedule in the hands of those who need care and those who provide it.[vii]

An additional feature of market with tradable admission permits would be reduced courtship of paying patients (Braithwaite 1993). Permit prices would reflect case load mix, the proportion of poor in the wider urban area, and the costs of travel and waiting for care. The model can be modified to illustrate and compare the welfare effects of health care markets which do not have permit trading with those that allow permit trading and with those in which the hospital receives a lump sum subsidy for each patient treated. The model could also be used to explore the incentives for an affluent hospital to operate an outpatient clinic in the shadow of the poor hospital. By providing such care, the affluent hospital reduces the marginal cost of caring for the indigent at the poor hospital. As a result, the price of a bed permit would decline.

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[i] Indeed, there is a rapidly developing body of environmental practice among policy-makers in the United States and elsewhere that attempts to make use of the market place in this manner to achieve environmental goals. Examples from the United States include the sulfur dioxide permit trading system in the acid rain program, the Regional Clean Air Incentives Market(RECLAIM) in the Los Angeles Area. “Tradable deficit permits” have been proposed as a solution for the efficient implementation of the Stability Pact in the European Monetary Union (Cassela, 1999).

[ii] Throughout 2006 National Public Radio reported on the dumping of indigent patients on the streets of Los Angeles and San Francisco by Kaiser Permanente hospitals. Two stories in particular received widespread attention: Chideya (2006) and Jaffee and Block (2006).

[iii] During the 1990's there were a total of 440 hospital closings, 78 hospital openings, and 22 reopenings. In that same period the stock of hospitals nationally declined from 5026 to 4657. There does not seem to be any data on hospitals that have changed locations, but the number of newly opened and reopened hospitals is so low that our assertion that current location is an immutable inheritance is valid (Flowers, 2001).

[iv] This is a simplifying assumption. The hospitals could be located along a street of any arbitrary length, on a circular road, or on a disk without changing the qualitative result.

[v] It is known from the Coase Theorem that, absent transactions costs, the initial allocation between hospitals overburdened with indigent care and those that are not so burdened doesn’t matter.

[vi] This would be the case if the firms were acting as though in a competitive market. The constraint could be on the return to capital in a different version of the model.

[vii] It would be incorrect to conclude that affluent sick people subsidize poor sick people. Rather, it is both sick and healthy people that subsidize the poor, but at rates that are determined by the market mechanism.