

The Economics of Personal Space

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Abstract: This paper focuses on the economic dimension of interpersonal distances, and how they are essentially culturally and economically determined and rationed. Its purpose is to trace the linkages between social psychology and economic theory in the field of personal space studies. It concludes with a few applications on regional economics in particular on the rental price of land and housing, and transportation.

Prelude: During the seventies and the eighties, Japanese car makers increased their shares in world and U.S. markets threatening Detroit with extinction, and heralding the new era of the economy car. No longer was the great American highway dominated by mostly born-in-the-USA wheels. And the smaller culprit was, much to the lament of the bigger American gas guzzler, more energy-efficient, cheaper, albeit less spacious. The new Japanese product was more in tune with the economic, ecological, demographic, and spatial rhythm of the times. It took the lead in fulfilling an emerging need: to adapt to a growing population straining the environment with an insatiable demand for resources in a world that needs not only to be energy-wise, but also one that can afford each of its inhabitants less and less space!

The compact and economy car foots the bill at least in comparison to the luxurious space of the American auto before the eighties. But who could think in such small terms successfully?

Only those who are comfortable in small confines and who can be graceful within their limits, those who have internalized the concept of space to the point where its manipulation becomes feasible can accomplish such deeds. It was the Japanese who did it because the environment they grew up in prepared them. A report in *Landscape* in 1970 indicates that indoors, studying, eating, sleeping, or socializing occur in any of the few small rooms of the Japanese house. Outdoors, children play in a street, about twelve feet wide, with no sidewalks, which is already jammed with people and cars.

"Utility poles ... become formidable obstacles to speedy Datsuns, and are, therefore, used by children to provide protection for their portable playgrounds ... The drainage ditch (mizo) between the street and buildings is an extremely effective traffic control device. Anyone who inadvertently drives into an open mizo develops an active respect for places cars are not supposed to go. Again, children find the narrow place between the drain and the house good for making mud pies on straw mats and relatively safe from the interference of parents and pedestrians, as well as from vehicles of all kinds." (Smith 70, p.8).

It is the contention of this paper that a higher spatial density indoors and outdoors forces one to adjust by decreasing his or her vital personal space. This translates into shorter observed interpersonal distances during social interaction. That does not necessarily imply, however, a lower degree of preferred privacy as Marshall (1972) and Traver (1984) inferred. Interpersonal distance is only one of several mechanisms that regulate privacy. Altman (1977) demonstrated that privacy is a process that occurs in all cultures but differed among cultures in terms of the behavioral mechanisms adopted to regulate its desired levels (p. 66). Eye contact, verbal disclosure, smiling, partitions and walls, and social practices could all be manipulated to obtain more privacy when interpersonal distance is involuntarily close. Privacy itself could be described as the selective control of access to the self and group (Altman 1975), the regulation of social interaction to enhance autonomy (Rapoport 1975), and as composed of dimensions of solitude, isolation, anonymity, and reserve (Westin 1970) that may not be correlated to each other (Pedersen 1979).

Nevertheless, and any which way privacy is defined, another factor that could explain shorter interpersonal distances and less overall preference for privacy, in addition to density, is the degree to which primary groups, such as family, clan, tribe, sect, etc. ... predominate in the life of the individual, as a self that is actualized through social units would be less self-contained. Indirect support for this auxiliary hypothesis is inferred from the work of Webb et al. (1986) who determined that categorization eliminates partially the impact of crowding. This may be because individuals are less salient in a subgroup in their own and others' eyes, and therefore less arousing (Webb et al. 1986, p. 544). And it may be because others in the group are mere social extensions of the individual self, which explains why we need less personal space from friends than strangers.

The focus of this paper, though, is on interpersonal distances, how they are essentially culturally determined, how psychology and economics interact to explain the rationing of individual space. It concludes with a few applications of the concept of personal space in economics on the rental price of land and housing, and transportation.

I. Personal Space

Definition

It was already pointed out that the level of spatial density conditions people to adapt to a socially given concept of personal space. But what is personal space exactly? It is an area around the body that represents portable territory whose invasion or intrusion elicits discomfort. Hadyuk called it "an infinitely malleable entity that is exquisitely responsive to situational demand" (1983, p. 277). For example, Pease (1987, p.26) depicts in his popular handbook on body language averages of typical personal space zones for white suburban middle-class North American, English, and Australian people. These, of course, are mere averages that mask differences in sex, age, status, culture, and others. Yet, those figures have the advantage of pinpointing the role interpersonal distance plays in regulating privacy. The discomfort function is nonlinear as "relatively large movements are required to provide the initial increment in discomfort" (Hayduk 1983, p. 299). Similarly, the impact of surrounding individuals rises the closer they are.

Within each band of ranges of personal space defined by background densities other factors interplay. For example, non-conclusive evidence suggests that introverts occupy larger personal spaces than extroverts (Sundstrom 1977, p. 516). Subsequently, Oldham (1988) found that individuals who had low stimulus-screening scores or high need-for-privacy scores reported the largest decreases in crowding after moving from an open office to a larger open one, or an equally sized office with partitions (p. 257). Crowding here is the negative psychological feeling, the stress that is sometimes associated with spatial density or sheer multitudes.

The Homeostatic Principle

First advanced by Argyle and Dean (1965), this proposition states that human interaction and particularly privacy, is maintained at an optimal amount of closeness that yields neither anxiety nor boredom. "People actively attempt to achieve their desired level of social interaction by the ways they locate themselves in their settings and the ways they use and arrange their settings" (Sundstrom 1977, p.513).

Here, the homeostatic principle is applied to the effect of familiarity on personal space, but the principle is equally applicable to other factors. What matters is that behavioral mechanisms operate as a system to maintain optimum social stimulation. In an elevator packed with strangers, for example, the unwritten code prohibits one from continuously smiling at, while maintaining eye contact with, the next person. Allegedly the most important privacy mechanism the Chinese adopt in cramped living quarters is the minimization of emotional involvement with others, e.g., smiling (Traver 1984, p. 636). This also squares well with the observation that Arabs, who are from a "contact culture" (Hall 1966), dodge direct personal questions and deem them impolite.

On the inverted U-shaped interpersonal distance curve, if we assume some measure of the level of comfort or utility on the y-axis and distance from others on the x-axis, where A is the optimum distance point at the peak of the bell-shaped curve and B any point to its left and C any point to its right, we can surmise that leaning back or turning away occurs in the case of encroachment so as to get from point B to A, and "closing in" compensates for unusually high interaction distances so as to attempt to correct the imbalance by moving from point C to A. Shifting the whole curve right or left to represent introversion versus extroversion, cross-or sub-cultural differences, gender, age, situation, etc... usually leads to shifts in other curves relating intimacy, architectural barriers, or nonverbal intimacy for example, to discomfort.

On the Shape and Flexibility of Personal Space

Controversy still encircles the shape of the concept of personal space. One of the few generalizations that could be made is that personal space occupies three-dimensional space, is somewhat flexible, and assumes variable permeability with different individuals, where "permeability is normally operationalized as the shape or slope of the function linking distance to discomfort" (Hayduk 1983, p. 298). It seems that personal space is spheroid, rather than cylindrical, circular or angular, and is slightly larger from the front, or wherever the face is directed, than the rear. Some claim that this is more true for women than men. But what could have "a potential

diagnostic use of spatial measurements" is that larger rear than front areas are reported for violent and delinquent individuals (Hayduk 1983, p. 298), which is another way of expressing the term "looking over one's shoulder all the time"!

Flexibility and shape are correlated. Downward pressure on personal space required an expansion along the horizontal axis (Cochran and Urbanczyk 1982, p. 138). This was later confirmed by experimentation showing that "personal space was relatively small when measured out of doors" (Cochran et al. 1984, p. 123). No sex differences were observed, and regardless of culture, crowding occurs at much closer personal distances in parks, beaches, and other roofless spaces, which supports a spheroid model of personal space.

One possible implication of the spheroid model which is pertinent for urban design, and therefore regional science, is the observation that "domed ceilings would produce less discomfort with close interpersonal distance than would traditional flat ceilings" (Cochran et al. 1984, p. 123). Quite possibly, it was a sense of such principles that led the first Arab architects to construct mosques, which are places of public gatherings, with domed-shaped ceilings whose vertices, alongside minarets, still dot the skyline of Muslim cities and towns.

Consequences of Violation of Privacy

The inability to control privacy or desired interpersonal distance when other privacy mechanisms also could not be controlled, leads to serious psychological consequences. Work performance may or may not suffer, but individual well-being definitely does. To be unable to maintain adequate privacy and personal space continuously, especially during childhood, makes the development and maintenance of self-identity difficult. In fact, "the psychological viability of an individual or a group is dependent on the ability to control interactions with others" (Altman 1977, p. 68). This would affect the self-perception of the individual as overloading the system with excess stimuli results in experiencing general inadequacy. Individuals with low self-perception "tend to exhibit impaired social, personal, emotional, and intellectual functioning (Ruff and Korchin, 1967)" (Hughey 1983, p. 1014).

Excessive stimuli leading to low self-perception is more relevant to introverts than extroverts, and may be excessive stimulation is one mechanism by which introversion is generated or enhanced, as introversion becomes a flight from discomfort. "Aiello et al., (1977), for example, found that all subjects, regardless of spatial preferences, performed poorly on a cognitive task after being exposed to crowding, but that those preferring greater chair spacings reacted most quickly and developed the highest levels of arousal" (Hayduk 1983, p. 302). These would be persons with stronger introverted tendencies. The stress of crowding links personal space to antisocial behavior. Violent people could be no more than introverts venting out the accumulated stress of excessive crowding, people who otherwise would rather have been left alone.

II. Cross-and Sub-Cultural Differences in Personal Space

Hall (1966) described Mediterranean, Latin American, and Arab people as having a "contact culture". The Indians and Pakistanis, who come from noncontact cultures, use up less space than two of the supposedly contact cultures (Latin Americans and South Europeans; Watson 1970, p. 79). This, and many other seemingly inconsistent results from studies of cross-cultural comparisons, are supposed to shroud the literature with confusion. It is true that there are some universals such as the observation that both sexes keep male strangers farther away than female strangers, but how does one interpret the observation that opposite-sex pairings use shorter interpersonal distances than same-sex pairings in the U.S., while the opposite is true in the Arab World? In fact, "Egyptian females kept male friends almost as far away as male strangers" (Sanders et al., 1985, p. 15). Rustemli (1986) replicated similar results for a Turkish sample.

First, one has to recognize that from a historical perspective, space has been less variable than people. Increasing social density leaves less space per individual and thus creates a smaller allotted average number of square feet or meters per person. This defines and conditions a band of personal space ranges. In Germany, just as in Egypt, acquaintances create less crowding than in the American culture. And more importantly, Germans felt more discomfort by being "left alone" with only a few people at a large distance (Six et al., 1983, p. 66). The authors attribute this effect to the more densely populated German environment.

In comparing densities between countries, one should also pay heed to the actual population density by eliminating areas that are uninhabitable or uninhabited in a country. Only then might we have a more accurate representation of actual population density as experienced by citizens. In doing so, North America and Australia

would emerge as the least dense. Asian countries would still be the most dense. The Arab World, after accounting for deserts, would probably fall in the category of densely populated countries, with the Gaza Strip emerging as the most densely populated in the world. Egyptians, for example, are mostly concentrated in the one-percent of the total area of Egypt around the Nile. By the same token, it is not surprising that Mexicans occupy smaller spaces than North Americans. And in a process similar to osmosis, migration sifts through the semi-permeable international and geographic borders in a natural tendency towards self-equilibrating personal space across nations.

May be the most important manifestation of the conditioning impact of density in generating different concepts of vital personal space is the sub-cultural distinction within every region between rural and urban characteristics. In a study of the Chinese in Hong Kong, Traver (1984), found that "living in the countryside displays an especially close association with a desire for seclusion" (p. 64). Those who resided in rural areas for prolonged periods of time, carry a larger portable personal space than urban residents. When that is not feasible, as in Hong Kong, other forms of spatial privacy are sought, including "getting away from people" or "controlling domestic space" (Traver, 1984, p. 64).

Hence, when Hughey (1983) found that college students assigned in triples to dorm rooms originally designed for double-occupancy suffered low self-esteem, he should have accounted statistically for the fact that most of his sample came from a rural middle class background (p. 1014). The difference would probably be equivalent to that between the spatial preferences of introverts and extroverts.

At any rate, in attempting to clear up the confusion regarding inconsistent results on spatial preferences across cultures, it is important first to account for the basic relationship between density and personal space: the higher the density, the lower the space. Then it is important not to confuse "contact" with interpersonal distance. The latter is mainly, albeit not solely, a function of density. The former is a distinct intimacy-regulating mechanism. Its presence merely signifies the organic individual dependence on social units like the family, tribe, or other reference group. Its absence could be indicative of the predominance of flagrant individualism, as in Western societies, or could be substituted for by other intimacy-regulating mechanisms.

Thus, while the American culture is relatively open about opposite-sex interaction, it is less tolerant of same-sex interaction, for fear that it could culminate in homosexuality. Traditional Arab societies are more tolerant of same-sex interaction, and less tolerant of opposite-sex interaction or homosexuality. Couples, even married ones, are expected to maintain socially acceptable distances in public. A dichotomy between public and private behavior emerges thereof. This means that the effect of crowding is generated faster in the Arab World in a room full of couples than in the U.S., while the opposite is true about crowding in the case of same-sex gatherings. Thus, social norms and practices interact with density to generate cross-cultural differences.

III. "Contact" between Psychology and Economics?

Assumptions on the Homos Economicus

In Economics man is assumed to be continuously maximizing utility. However, utility is also about relieving the anxiety of unfulfilled needs when their fulfillment is not readily feasible. In the realm of personal space, this represents a movement from point B or C to point A on the comfort-distance curve that is referred to in section I above. Typically, acquiring utility will take the form of working in order to fulfill the needs of sleeping, eating, drinking, etc ..., or going on vacation to a deserted island. But what about cases where we are seeking high density without experiencing the associated negative crowdedness as in parties, concerts, sports, political rallies? Those are clearly cases where the individual is attempting to move from point C up to point A on the utility-distance curve.

Such behavior cannot be explained by traditional neoclassical economics with its emphasis on individualistic, as opposed to social, fulfillment. In cases where individuals seek arousal, instead of relief, the neoclassical model stands sterile. Extreme extroverts in the social arena, i.e., social butterflies, simply do not exist. But discomfort will also arise if interaction is conducted at distances that are too high (Hayduk 1983, p. 298). The same is true for too little interaction. Too large a distance is the source of the discomfort experienced by foreigners attempting to interact with Americans. They try to adjust by moving in closer. That causes an interacting American to experience discomfort from the anxiety of too close a distance. The result would be an infinite loop of action-reaction in which the interaction would occur all over the place before its premature termination. From the viewpoint of the assumptions of neoclassical economics, only the behavior of the American makes sense

because only responses to the anxiety of unfulfilled needs, other than stimulation, are comprehensible. In effect, the need for social, as well as "physical and mental stimulation" (Amos 1991, p. 6) should be reconsidered in Economics.

Jain (1987) determined that "the presence of other persons in a smaller space while performing a task, even in the absence of verbal and behavioral interactions, created the feeling of crowding" (p. 336). This result, which was obtained in India, would be even more applicable to the U.S. where personal spaces are larger. But it also makes one wonder when microeconomics textbooks explain diminishing returns as a result of applying additional portions of one input to a fixed one if diminishing returns would occur sooner in the U.S. than in India, as more laborers are employed to work a piece of land! Is our Economics ethnocentric?

On Socioeconomic Status

The literature on spatial preferences suggests that socioeconomic level helps explain the size of personal space and even perceptions of crowding in a neighborhood. In examining conversation distances of fourth-grade children on a school playground, Scherer (1974) found that "black and white children from a low socioeconomic level showed no differences, while middle-class children of both colors showed larger distances" (Sundstrom 1977, p. 517). Bonnes et al. (1991) found socioeconomic level most significant in the evaluation of crowding in a study of neighborhood satisfaction in Rome, Italy. According to the authors, an evaluation of non-crowding in the neighborhood is due to the broader range of choices afforded by a higher socioeconomic level (p. 548).

Therefore, while Economics borrows its assumptions, such as the rational pursuit of individualistic self-satisfaction, from psychology, economic forces help mold and determine psychological interactions such as interpersonal distances.

Crowding and Scarcity

Jain (1987) tested the effect of scarcity of resources, holding spatial and social density constant, and found the feeling of crowding higher under scarce than abundant resources. He points out that scarcity of resources seems to be "an important non-spatial variable responsible for the feeling of crowding" (p.336). And although Jain builds on the Attribution model, which is slightly different from the homeostatic principle, his results on scarcity and crowding are not inconsistent with the Argyle-Dean model. Scarce resources force individuals to move about mentally and physically more intensively and extensively to achieve a given objective. This creates anxiety as individuals become potential and actual impediments in each other's way tightening personal space. This conditions them in the long-term to adapt to less personal space, and enhances competition. I believe this lies at the heart of the "reduction in liking that accompanies doubling the number of people in a room" (Hayduk 1983, p. 300). Such dislike fuels conflict over scarce resources.

In a different research, McClelland and Auslander (1978) observed that "smaller interpersonal distances are likely to be associated with larger groups, occupied seating, queues, and waiting lines, whereas larger interpersonal distances occur in conjunction with fewer persons, standing postures, free seating, and pleasant and visually complex environments" (Hayduk, 1983, p. 302). Henceforth, smaller distances are imposed by scarcity, whereas larger personal distances are made possible by abundance.

Scarcity, the most important problem in Economics, is hereby associated with crowding, its link to competition.

On Space as Resource

In regional Economics, economics gains a spatial dimension. The focus is on accessibility. No point in space is similar to the other because each point is located differently from every other one. Resources are not evenly distributed and are imperfectly mobile. Consequently, being at any point on a plane presents one with a particular set of choices and constraints. One is separated by the friction of distance differentially from different points since even social ties and public services are sprinkled asymmetrically in the distance (LaGory, 1982). That presents one with different economic distances, and therefore economic choices that by themselves make certain points in space more advantageous than others. That much has always been recognized at least by regional economists.

"Space imposes limits, or bounds, on our knowledge of available choices as well" (LaGory, 1982, p. 68). For example, "for choice of residence, selection of home sites tends to occur within sectoral areas, indicative of the sector-like distribution of socio-economic statuses" (LaGory 1982, p. 68-69). This also differentiates regions from each other making the spatial location itself a productive resource, making space a means of production, as well as consumption. Cosmopolitan areas are densely populated and diverse culturally and provide a different set of choices for lifestyle than highly populated culturally homogeneous areas in the third world, or low-density, culturally homogeneous suburbs (LaGory, 1982).

In addition, what this paper suggests is that space, in and of itself, is a valuable resource regardless of location or economic and social endowments. Space is necessary for the existence of personal space, it therefore has value. It is less abundant than air and water. As population densities increase, space in and of itself becomes more scarce. And as with any scarce resource, there has to exist a mechanism for its rationing. In the previous centuries this problem was partially alleviated by the discovery of the New World. Unless humans manage to increase their supply of space by inhabiting new planets, the scarcity of space worldwide will increase in the few coming decades and the problem will acquire added importance.

Means of Resolving the Problem

In an ideal situation crowding could be alleviated if humans learn to be courteous and considerate towards each other. The comparatively extreme politeness and grace in Asian cultures is a matter of necessity if people are to coexist instead of fight each other for space. That is one alternative (Smith 1970, p. 1-10). The resolution of crowding here takes place via a socio-cultural mechanism.

But the human race has not been so ideal in history. For one thing we have the example of Europeans who, when crowded in their continent simply annihilated the Native American population of the American Continent and took over its space. Colonialism in the third world could be looked upon in the same light. In fact, colonial powers were encouraging the growth of the population of the colonial state. To understand this relationship better, we have to define the concept of territory which is a relationship between humans and places that encompasses the contours of individual active spaces within which persons live, work, entertain, socialize, etc ... (Sundstrom, 1977, Khoury 1984). The sum total of the active spaces of a tribe, for example, represents the territory of a village. The territory of all the members of a nation is the nation-state. Like all territory, including those of animals, it is demarcated, defended, and relatively fixed. Its center is usually the home of the occupant, and it serves economic, biological, social, political and cultural needs (Khoury 1984, p. 17).

Using 58 international invasions of territory from the 1950's and the 1960's, Khoury (1984) estimated the territorial permeability function described on the individual level by Hayduk. The dependent variable was the discomfort experienced by the invaded measured indirectly by the number of casualties inflicted upon the invader by the territorial incumbent. The independent variables, the equivalent of interpersonal distance for the individual, were the number of invaders, and the duration of invader presence in a territory. The coefficients of both variables were found to be significant and so was the F-statistic ($R^2 = .178$).

War, moreover, is an organized invasion by one nation into the space of another. It is one means of expanding the space of a group of people at the expense of another.

On the individual level, violence figures prominently in resolving the problem of scarcity of space also. The best examples are taken from prisons, where space is literally scarce (more than outside in a typical country). The ever-rising density of inmates within prison walls is an acknowledged problem, even though not much is being done about it. In giving a new meaning to the "Prisoners' Dilemma", the literature suggests that the more violent prisoners have higher personal space requirements.

In Wi Tako Prison, a minimum security jail in New Zealand, "interpersonal distance was second only to current offense among the 17 variables in discriminating between violent and nonviolent offenders" (Walkey and Gilmour 1984, p. 333). The prison was designed to hold 112 inmates, but was occupied by 172, 50% more than intended. "The results indicate that the most likely instigators of violence are those with high interpersonal distance scores" (p. 336).

Hayduk (1983) analyzes this phenomenon as a result of two mechanisms operating for people with high personal space requirements:

- 1) "depersonalization occurs at greater distances, and

2) more frequent and intense intrusions plague those with larger spaces (Borraem et al., 1977, Lothstein 1972)" (p. 298).

So violence here would be the result of the insecurity of a perceived threat. From a purely neoclassical perspective, however, if we consider perpetrated violence in these examples a measure of the stronger demand for space, Pareto optimality is achieved since space is going to those with the highest marginal use for it. If we consider violence simply a measure of physical strength or ferocity, an exogenous variable, allocation of space follows a command economy that may or may not be Pareto-efficient.

IV. Applications to Economics

A - Effect on Rental Price of Land and Housing

In daily life outside prison walls and international politics, the conflict over spatial resources is resolved through the price mechanism. When social density rises, given constant income and space, demand per unit of space increases. As the available space has to be rationed amongst an ever-increasing number of souls, the relative rental price of land and housing rises. This causes a net transfer of income to landlords, economic growth, and a migration of capital and labor to less inhabited land, in a classical regeneration of the Ricardian Rent Theory. The mechanisms through which these processes unfold are elaborated below.

To understand the sequence better, it pays to reexamine the Japanese example where every bit of available space is used efficiently. Take rooftops for example, "wood platforms are commonly built upon the sloping tile roofs of houses throughout the city. These are used for clothes drying and the airing of bedding, for holding a profusion of potted plants to create a virtual roof garden, and for sunbathing" (Smith 1970, p. 10). Children's amusement parks occupy much of the space on the roofs of large department stores. Also, small Shinto shrines and benches placed in park-like settings among potted trees occupy the rooftops of many tall buildings. It is not uncommon to find rooftop restaurants, and a few yen telescope view of the city. Subterranean spaces are occupied by subways, grocery shops, movie theaters, and others.

Agriculture obeys the same rule of efficient use of space. "Doubling of function is a motif typical of the core area. A compost pile doubles as sweet potato hotbed; the threshing floor of a courtyard doubles as a tax-free bit of temporary garden; renga clover in winter fields serves as feed for stall-fed dairy cattle while the roots nurture the next rice crops; and various forms of inter-row cropping repeat the doubling theme with endless variations"... (Landscape, spring 1960; Smith 1970, p. 5).

While Euro-americans partition the entire built environment into domestic and nondomestic areas, we do not see that in Japan, and many other parts of the world for that matter. In the U.S., "hospitals, shops, schools, restaurants, offices, arenas, etc ... are conceived of much differently than the domestic dwelling ... " (Kent 1991, p. 453). Not so in many other parts of the world.

In a study of 73 societies, Kent (1991) argues that activity-specific and status-specific designation of areas is a function of increasing sociopolitical complexity, the division of labor, and a sedentary habitat. Yet in spite of the presence of all these factors in Japan, businesses, government agencies, plants, and houses habitually coexist in the same neighborhood (Smith 1970, p.7). "... The salient characteristic of land throughout the city is its diversity and intensity of use. A place whose chief identity after 6:00 p.m. is that of a bar- and-cabaret district becomes, during the day, an entirely respectable street of houses with children playing outside" (Smith 1970, p. 5).

The multiple use of spaces, however, is equivalent to increasing the marginal product of land (MP_l). Assuming constant land prices initially, an increase in MP of land implies an increase in the rental price of land (R_l). Hence, $MP_l \times p = R_l \implies MP_l = R_l/p \implies MP_l \text{ increase} \implies R_l \text{ increase}$, where p is the market value of the now higher marginal product of land. Graphically, this represents a shift in the demand curve for land to the right. Given that the supply of land in a country is highly inelastic, increased demand leads to relatively higher land rates and prices. No wonder then that "it has been estimated that the market value of land in Japan is more than three times GNP, as compared with about two-thirds GNP in the United States (Mills and Ohta, 1976)" (Mills and Hamilton, 1989, p. 378).

Naturally, the higher price of land increases the cost of housing which shifts the supply curve of housing to the left in the housing market. The increase in population density in itself acts independently to make the demand curve for housing steeper because given a fixed supply of housing units and total expenditure in the short-run, fewer units of housing could be bought at the same rental price. In other words, if we assume the quantity of housing, as measured in cubic feet or meters on the y-axis, and the quality of housing on the x-axis, with a space filled with housing indifference curves as adapted by Mills and Hamilton (1989, p. 187), we can surmise that an increase in the rental rate of land would shift the budget constraint inwards, leading to a decrease in the equilibrium quantity-quality of housing per household, i.e., smaller housing units. Yet, the rise in population density increases the relative price of housing comparatively more.

Suburbanization

The higher land value makes it imperative to increase the capital-land ratio. This generates economic development in the centers, and pressure on the periphery as capital and households look for a cheaper rental price of land and housing nearby. In areas where space is limited, growth takes a vertical shape, e.g., New York City or Hong Kong, assuming zoning laws allow it. In areas where space is relatively abundant and land is relatively cheaper, growth takes a horizontal shape, e.g., Oklahoma City. The frontier mentality of the American people, the heritage of exploring cheap abundant space, and the predominance of the individualistic ethic, fuel the drive towards suburbanization in addition to other factors discussed in Mills and Hamilton (1989, p. 379-385).

The increase of population density and the capital-land ratio in the center also allows reaching internal, agglomeration and urbanization economies within smaller areas than would have been otherwise feasible. This exerts further upward pressure on the price of land as industries with the highest benefits from those economies outbid others for locations in the central business districts. That flattens the residential density gradient in the direction of the periphery.

In an application from Veblen, some of the superrich buy or rent penthouses where space is most scarce to flaunt their wealth, and torment envious eyes. They command space where space is dearest.

Transportation

In attempting to determine which mode of transportation to use for commuting from and to work, usually time and money costs are the two variables considered most. Commuters seem to choose the combination of alternatives with the minimum time and money cost given their income and preferences. For a country like the U.S., this choice of transportation affects congestion and all the losses in pollution, energy, and work hours associated with it. A high number of cars entering a freeway during rush hour beyond a critical number increases the time cost of travel for all cars at an increasing rate.

Using the graphical model delineated in Mills and Hamilton (1989, p. 262) for transportation, where T is the number of vehicles entering per hour at point A, on the horizontal axis, and the cost of transportation on the vertical, suppose $AC(T)$ is the average cost per vehicle mile of travel between points A and B. Until a hypothetical point T_0 , $AC(T)$ is constant. Beyond T_0 , road capacity is exceeded and AC rises at an increasing rate per user. The number of people who choose car travel is a function of car travel cost and is represented by the usual downward sloping demand curve D . Since the MC curve lies above the AC curve in the rising portion of the AC curve, the equilibrium number of vehicles travelling per hour is actually T_1 (where the demand and the average cost curves intersect) which is a higher volume of traffic than T_2 (where the demand and the marginal cost curves intersect), the socially optimum equilibrium of lesser traffic. Such models usually suggest charging a toll equal to $MC(T_2) - AC(T_2)$ to restore equilibrium car travel to equilibrium point T_2 .

Now let us tackle the problem from the viewpoint of personal space. Suppose privacy and comfort are included in the calculation of cost of travel in different modes of transportation. In reality one of the reasons the car is preferred to the bus or subway is the privacy and comfort it affords the traveller. As population density increases and people are conditioned into accepting smaller spaces, *ceteris paribus*, not only do they buy smaller Japanese and Korean cars, but they also become less averse to travelling by bus and subway. The average cost of using public transit becomes less. That increases its quantity demanded and in the process decreases the relative demand for car travel, but increases the quantity demanded of car pooling. The demand for car travel shifts to the left. The demand curve for carpooling and public transit stays the same, but the average cost curves associated with them shifts downwards, increasing equilibrium quantity consumed.

We see that the numbers support the integration of personal space into the model. In fact, between 1975 and 1980, the relative rate of increase in public transit was about 23%, while the growth rate of automobile travel was around 10%. The divergence of income distribution in the U.S. during the same period reinforces the same conclusion. A lower income conditions people into a smaller personal space as noted earlier.

Concluding Remark:

Finally, pulling all this together, we can probably generalize that civilizations in a period of growth can afford its people more personal space as economic growth accelerates and incomes rise. This effect is compounded by the growth pole expanding its territory at the expense of other people by force or money (the same way Alaska was bought from Russia). The reverse is true. Higher densities without higher income lead to the constriction of individual personal space, conflict, and may be violence.

International migration, the price mechanism, the efficient use of space, and the exploration of new habitation all could affect the scarcity of space. But if our knowledge, including economics, psychology, and the interconnections between them, is to be worth anything, it should help us learn to alleviate conflict over space on a planet that does not seem well-prepared to cater for all the additional billion guests that will fill its space to the rim through the 21st century.

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