The Velocity Theory of Population

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that, "by design or otherwise," regulatory Commissions have permitted rapidly growing firms to realize higher earnings than less rapidly growing organizations (although he points out some exceptions). An alternate explanation for Texas might be that local regulators "adopt rates with but little or no investigation as to what rate ought to be fixed." Professor Morrissey's selection criteria, unfortunately, excluded all firms located in the local-regulation states of Iowa, South Dakota, and Mississippi (see footnote 2). The one Minnesota firm included in his study, however, ranked well above the median both in percent of return on common equity and on total capital.

The foregoing does not necessarily prove that the local rate regulation of electrical utilities in Texas is more lax than the state-level regulation of adjacent states. All that can be said definitely is that during the years 1951 to 1955 consumers of the product of the locally-regulated Texas firms studied paid an average price which was more than seven percent per unit higher for their electrical service than was the price paid by consumers of the services of the state-regulated non-Texas firms studied, and that during the same period relative profits of the Texas firms averaged more than twenty-five percent higher per dollar of assets owned than did the profits of the non-Texas firms. At least until further studies are made, however, one could not be criticized severely for suspecting that local regulation of electric rates in Texas results in higher prices to consumers and higher profits to electrical utilities than would be forthcoming under rate regulation at the state level as practiced in neighboring states.

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ACCORDING to the quantity theory of money, primitively expressed, the total supply of money (M) exchanges for the total supply of goods offered in trade (T). For the only market function of money is to operate as a medium of exchange. If the supply of money doubles or is halved without a corresponding increase or decrease in the supply of commodities offered in trade, the price level (P) must also double or be halved since at all times all the money, having no other than an exchange function, is needed to purchase all the goods. As a result, the primitive quantity theory is expressed by the formula $P = \frac{M}{T}$.

There is however a slight snag to it. For a dollar bill does not only purchase a dollar's worth of commodities offered in trade: It purchases a dollar's worth of commodities each time it changes hands. The person receiving it can at once buy something else with the same bill; and so can the next, and the next. If in a closed community a million dollars worth of goods is offered in trade, a million dollars in money is needed if each bill or coin changes hands once. But if they change hands twice, that is if their velocity (V) doubles, only $500,000 are needed to effect a million dollars worth of transactions, and only $100,000 if the velocity is 10.

In other words, a change in the *velocity* of money has the same effect as if the *quantity* of money had changed. As an inflation may thus be caused quantitatively by an increase in the supply of money, it may also be caused qualitatively by an increase in the money's velocity. When this happens, as for instance in the case of panic, a tightening of the supply of money would have no restraining effect whatever on the price level. Only the administration of a mass tranquilizer slowing down the velocity of monetary circulation would in this case be capable of producing results. Because of the quantitative effect of velocity, the adjusted theory reads therefore; $P = \frac{MV}{T}$. There are other refinements but these are not needed for the purposes of this article.

The interesting thing about the quantity theory is that its underlying principle applies also to population problems. For just as the price level changes in response not only to monetary quantity but also to velocity changes, so the density of a population may change not only as a result of a change in its

physical size but also because of a change in its pace, the velocity of its movement.

In analogy to the quantity theory of money we may therefore formulate a quantity theory of population. Primitively expressed, it states once more the obvious: that the density of population (D) is determined by the size or number of a population (P) in relation to available living space (L). Its formula, similar to the primitive monetary formula, reads therefore: $D = \frac{P}{L}$. This means that, if a rise in the population figure increases its density to the point of overpopulation, two solutions are possible. One is to reduce P through either birth control or emigration (if Mathus' positive checks—war, famine, disease—fail to do their macabre job). The other: to enlarge L through either conquest (extensively) or through the mobilization of technology (intensively). Since the population theory has never been pushed beyond its primitive formulation, no other solution could so far have been offered beyond these two.

But as in the case of its monetary cousin, here too a modification becomes necessary if the formula is to take into account all forces exerting pressure on density. For, as already indicated, the quantity of a population may increase not only as a result of an influx of more people but also as a result of an increase in the pace (the velocity) with which people move. This explains, for instance, why theaters must have emergency exits though ordinary exits are amply sufficient for audiences moving at ordinary pace. But if the velocity of movement doubles under the impact of apprehension or quadruples as a result of panic, the effect is the same as if the audience itself had doubled, or quadrupled. Dealing with the problem quantitatively, theaters furnish a greater number of exits than are normally needed. But, were it not for the brevity of time available in an emergency, they could deal with it also qualitatively, as indeed they always try when they exhort their audiences that, in case of fire, they should keep their pace slow: *Walk, Do Not Run.*

As a result, according to the adjusted theory, which because of its emphasis on the volume increasing effect of pace may be called the *velocity theory of population*, density is determined not by population number alone but by the number of a population times its velocity in relation to available living space. Its full formula should therefore read: $D = \frac{PV}{L}$.

This indicates that there exists a largely ignored third solution of overpopulation problems aside from the first two which resulted from the primitive formulation of the population theory. This is: reduction of the velocity with which people move. The new alternative is the more significant as the two older solutions seem to have reached the limit of usefulness; the one—territorial expansion—because, even in the age of sputniks, the supply of physical space capable of absorbing excess populations is nearly exhausted; the other—technological progress—because, whatever may be added in living space through more intensive exploitation of existing resources, tends to be lost because of progress' concommittant side effect of increasing man's velocity. Thus, instead of solving the problem of overpopulation, technological advance merely changes its character from a quantitative to a qualitative problem, from one involving the number of particles to one involving their speed. Moreover, since accelerating velocity must ultimately have the effect of increasing the mass of a population at a faster rate than the rate at which progress can come forth with appropriate solutions, technological advance has the tendency beyond a certain point not only of *changing* overpopulation problems but of actually *aggravating* them.

This is why remedial measures, such as are now universally applied, for example in all modern urban areas, seem invariably to create more problems than they solve. The most common of these, and the most symbolic of contemporary overpopulation problems, is the traffic glut, attributed by most planners to the fact that too many people have come to live together in too narrow a space. Interpreting and therefore attacking the problem quantitatively, they try to solve it through more and better highways, one-way streets, unobstructed over and underpasses, ampler parking facilities, and so forth. The result? Worse traffic gluts after every improvement than before.

For gluts are the product not only of too many people in a given area but, like the gluts of logs floating down rivers, also of the pace with which people move. And pace is, of course, not reduced but increased by the construction of new traffic facilities which, while likely to shift the location of the problem, are unlikely to diminish it (unless all terminal points such as cities were to be eliminated and all people kept moving in the flow of traffic all their lives). Numerically, the population of New York is about eight million. But multiplied by its daytime velocity, its mass (depending on the hour) is in effect that of a population of twenty to fifty million with the result that the same city, which is amply adequate at the near zero velocity prevailing at night or the low velocities of late evenings, is hopelessly inadequate at the high and increasing velocities of the day. Ancient Rome, with two million inhabitants but a velocity that was slow even at daytime, produced few accounts indicating that it suffered greatly from overpopulation problems. Nor did the beehive populations of medieval cities. Twentieth-century New Brunswick, New Jersey, on the other hand, with a mere 40,000 inhabitants but a daytime velocity that multiplies its mass perhaps tenfold, is glutted from morning to night, day in, day out, not in spite but because of the effort of modern municipal governments to speed traffic by every means, including, if necessary, through the gradual erasure of their cities.

Thus, technological improvement, far from correcting crowd conditions, actually worsens them because of the effect it has on the pace of life. Another factor responsible for intensifying over-population problems as a result of its accelerating influence on velocity lies in the improvement achieved in techniques of administration which, spurred on by technological improvements, permitted a high degree of social and economic integration. Previously, remote and largely autonomous districts discouraged large-scale movement since they hardly ever required contact with their distant central government. This changed when technical advance brought them closer to administrative centers and they could be assigned special as well as specialized roles in the integrated pattern of their national societies. For with increasing integration came increasing contacts; with increasing contacts, increasing communication; with increasing communication, increasing velocity; and with increasing velocity, an increase not in the number but in the *effective* mass of the people. A provincial, who used to visit his capital or other cities perhaps once in a life time for pleasure, must now visit it with increasing frequency on business, to straighten out things which got entangled in the process of centralization. And while it looks to him, and 9,999 others of his kind, as if he were visiting Washington only ten times a year, the collective entry in Washington's statistical surveys recording the same data lists not 10,000 but 100,000 visitors—10,000 actual visitors times their velocity. And the corresponding accommodations must, of course, be adjusted to a crowd not of 10,000 but 100,000.

The modern problem of overpopulation thus being so largely a problem of velocity rather than of actual population number or living space, it follows that it can be successfully attacked only if remedial measures are directed not at the population or space but at the velocity factor. But how can this be reduced in an age whose every invention and policy seems to speed it up?

The answer is not too difficult once we find what makes people move at the density increasing pace of our day. Is it cars? Indeed! But cars are primarily a means not a cause of movement. The principal cause of the acceleration of modern movement is the necessity of spanning what may be called *technological* distances, that is distances imposed not by the need but the tools of social existence. Amongst these may be ranged the growing distance between home and work made possible through high-speed commuting facilities; the growing distance between factories of parts and factories of wholes resulting from increasing specialization; the growing distance between producer and consumer; between residence and administrative center; between home and market, home and school, home and theater, home and inn. The wider these become, the greater becomes social speed, the more so as most persons are normally involved in the task of spanning not one but several of these distances every day, thereby increasing glut, crowd, accident, and other overpopulation problems at a geometric ratio with every arithmetic increase in the distances to be negotiated.

This being the case, the answer to the modern in contrast to the older problem of overpopulation lies, paradoxically, not in

expansion but contraction. While expansion, such as we witness in the widening urban sprawls, reduces *physical density* by spreading a given population (P) over a wider living space (L), this very process increases more than proportionately *velocity density* by permeating the wider L with greater V. This is why, after a given point, communal expansion produces more burdens than gains. Contraction, on the other hand, while adding to the physical density of communal centers through the narrowing of L, diminishes aggregate density (D) through the more than proportionate reducing effect it has on velocity density. Theoretically, velocity could of course be reduced also by legal speed limits which would ultimately also draw populations physically more tightly together simply because at low speeds they cannot afford to live too far apart. But practically the only reliable method seems not the *control* of speed but but the elimination of the *motive* of speed through the elimination of technological distances.

The solution of overpopulation problems offered by the velocity theory is therefore the very opposite from the one tried during the first part of the twentieth century on the basis of the more primitive quantity theory of population. Instead of increasing the growing sprawls of undefinable, cancerous suburban galaxies, it suggests that cities become cities again; that is metropolitan centers of smaller area, larger populations, and yet lesser aggregate densities, resulting from the restoration of a largely pedestrian mode of life.

To bring this about, one must above all deprive people of the motive of commuter travel by persuading them that, instead of maintaining expensive suburban prestige dormitories, it is both more sensible and more elegant to *live where you work and work where you live*. Once this is understood, the most wasteful of technological distances accounting for perhaps 60% of all traffic and road gluts will have disappeared. But commuting is only one of the motives of movement responsible for modern superdensities. Other things besides one's working place must therefore be brought back to within walking distance such as operas, museums, universities, sidewalk cafes, and similar amenities of social existence which can now be reached only with expensive high velocity means of travel. This is why so few of them exist: not because interest in them is lacking or admission cannot be afforded but, servicing 20 or 30 million people spread over thousands of square miles, the price of getting there is too high. But once every town of perhaps 30,000 inhabitants offers these institutions in urban arrangements free of technological distances, its citizens, when invited to travel to Paris or Milan, will soon ask: "What for? What can I find there that I cannot find at less cost in our own town?" The effect will at once be a significant lessening of crowd conditions; seats in the opera will again be available without the need of half a year's prior reservation, and leisurely visits to museums and galleries will be uninterrupted by the barbarian shocktroup invasions of contemporary tourist hordes.

The only question is: Could smaller cities afford the sums needed for maintaining theaters or universities of a caliber that would effectively diminish the motive of travel? The answer is: "Of course not, as long as their citizens have to spend the sort of sums now needed for the maintenance of highways, cars, and other instruments of integrated long-distance and vast-area living. But once velocity expenditures resulting from purely technological travel are reduced to nearly zero, the savings would be such that, as the far less endowed Italian and German city states of earlier ages have shown, even relatively small towns could afford not only first rate theaters, universities and galleries, but many other things besides, such as splendid cathedrals, parking places and streets laid out in marble, fountains, swimming pools for horses, and what not.

The reduction of social movement to purposes of commerce, holidays, and adventure, would thus have both a social and an unexpected cultural consequence. In the first place, it would lead to a significant diminution of the effective density of populations, thereby relieving the pressure of one of the worst problems of our time. And secondly, it would restore to the city its original mission of being a center of leisure, thought, elegance, and culture. To turn the velocity theory into a tool of policy, however, more is needed than its mere statement. Its variables must be expressed with greater precision by mathematicians, and movements such as those motivated by commuting, entertainment, cultural, and commercial reasons must be measured statistically before plans can be worked out on the basis of its principles. But this would exceed both the purpose of this sketch and the talent of its author.

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