Long Cycles in Residential Construction

I. The Problem

When we examine monthly figures we find that construction activity has cyclical fluctuations that correspond fairly closely to the cycles in general business, but when we examine annual figures these fluctuations tend to vanish before the eye, while cycles lasting from fifteen to twenty years obtrude themselves. These longer cycles consist of actual rises and declines, not merely of variations in the rate of growth such as are found in the secular trends of all industries. Long cycles of large amplitude characterize railroad construction as well as building construction, and appear to be a feature of investment in fixed capital wherever economic life is organized on a business basis.

The long cycles in building construction have recently received considerable attention in this country. Numerous historical studies for individual localities have been published. The results are remarkably uniform: they show that in one locality and the next there are long cycles of large amplitude in the construction of buildings, and that similar cycles are found in subdivision activity and real-estate trading—so that the cycles in construction are but one phase of the long cycles that characterize real-estate 'activity.' The most painstaking and scholarly of the local studies is Homer Hoyt's *One Hundred Years of Land Values in Chicago*, recently published by the University of Chicago Press.

While the local cycles diverge considerably, they also show a fair degree of similarity in their timing. Hence, it is to be expected that clearly defined long cycles will be found in national construction. This problem has been investigated by Dr. John R. Riggleman, and in June 1933 he published in the *Journal of the American Statistical Association* a preliminary index of building construction in the United States, based on building-permits data, for the period 1875 to 1932. The index has lately been revised and extended. In its present form it begins in 1830 with three cities, includes twenty cities by 1875, and sixty-five cities by 1900, this number being retained through 1933. Dr. Riggleman's index

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shows long cycles of large amplitude across a century of American experience. The following quotation from an unpublished manuscript by Dr. Riggleman on "Building Cycles in the United States" indicates their duration and amplitude: "The curve moved up from 49 per cent below normal in 1830 to 81 per cent above normal in 1836, down to 57 below in 1843, up to 74 above in 1853, down to 58 below in 1864, up to 19 above in 1869, down to 45 below in 1878, up to 58 above in 1890, down to 30 below in 1900, up to 33 above in 1909, down to 75 below in 1918, up to 66 above in 1925, and down to 87 below in 1933." Dr. Riggleman has tested his national index by constructing separate indexes for seven geographic regions for the period since 1875. The regional indexes show a fair degree of synchronism.[1]

Dr. Riggleman's index does not segregate residential buildings from other types of buildings. The same is true of most of the long-range studies for localities. But it is to be expected that if there are long cycles in the total construction of buildings there will also be long cycles in the construction of residential buildings, first, because residential construction is a substantial part of the total,[2] and second, because much other building is closely correlated with it. Such figures as we have confirm this expectation. Data for St. Louis since 1880, for New York City since 1902, and for Chicago since 1912 show that the long cycles in the total construction of buildings represent fairly well, except for a dampening of the amplitude, the long cycles in the construction of residential buildings. The short series of broad coverage—the Dodge figures since 1919 and the Bureau of Labor Statistics figures since 1921—reveal the same tendency.

The indications are, then, that there are long cycles in residential construction, that these cycles attain enormous amplitudes, and that they synchronize roughly in the various regions of the country. We attempt in this paper to explore the rational basis of the long cycles in residential construction. Other types of building and alterations are left out of account. But the major forces that impinge on residential construction are not peculiar to it

[1] The writer is sincerely indebted to Dr. Riggleman for permission to quote from his manuscript.

[2] The Bureau of Labor Statistics figures on estimated expenditures for new buildings, covering from 257 to 364 cities, indicate that residential construction accounted for 61 per cent of the total during 1921-1933. The F. W. Dodge Corporation figures on contracts awarded, covering from twenty-seven to thirty-seven states, indicate that residential construction during 1919-1933 accounted for 55 per cent of the floor space and for 49 per cent of the dollar value represented by all contracts exclusive of public works and utilities.

alone. Much of our analysis, though with qualifications that we do not make, applies also to other types of construction.

II. The Governing Hypothesis and Method of Approach

The long cycles in residential construction are a result of certain characteristics of dwellings and of men. Normally, our dwellings have a long life; they provide accommodations for their occupants that admit of some shrinkage; they are not subject to transportation; and they are standardized only to a moderate extent. Normally, the inhabitants of this country move more freely from one district of a town to another than from one town to another; they move more freely from dwellings of one class to dwellings of the same general class than to dwellings of another class; they grow in numbers at a rate that varies considerably from year to year whether we consider a hamlet or the country as a whole; and the wisest among them are unable accurately to forecast the future state of the residential market. These characteristics of dwellings and of men are the 'basic' factors in the long cycles of residential construction. We can say more simply that they consist of variability in the rate of population increase, durability of dwellings, immobility of dwellings and men, inconstancy of the housing standard, and the uncertainty of men.

These basic factors provide a peculiarly apt setting, even when not worked upon by pecuniary institutions, for the formation of long cycles in residential construction. Their cyclical power will be clearly exposed if we analyze an imaginary economy that aims to provide residential facilities on some standard of need. We shall assume, therefore, that the Planning Council of a collectivist state sets a standard of one residential unit per person, that the Council ordinarily fixes building programs in the light of this standard, and that the construction scheduled for a year is fully executed in that year. It is perhaps necessary to stress that we shall use collectivism merely as a vehicle for expressing the basic factors in the residential cycles of our business economy, which is the sole object of our inquiry and to which we return explicitly in the last section of the paper.

Let us first dispose of some matters of definition. We shall understand by a residential district the area over which the physical distribution of dwellings exercises an important influence on the shifts of persons from one residence to another. If a surplus of residential units in A affects the movements of the population of

B and a surplus in B affects the population of A, but neither the one nor the other exercises any appreciable influence on the population of C, then A and B belong to one residential district and C belongs to another. We shall assume that the country consists of a large number of residential districts whose boundaries remain unchanged over the period which concerns us. We do not exclude migration across the boundary lines; all that we assume is that such migration is not influenced perceptibly by housing conditions.

We shall consider the population of a residential district to be composed of several communities, each community to consist of members of a residential class who normally dwell in a distinct type of residential unit. The Council might classify persons for residential purposes according to their industrial grade, marital status, age, or all these and others; so that persons may or may not be permanently attached to the same residential class. But whatever the principle of classification, the members of a residential class will shift freely, as occasion requires, among the residential units corresponding to their class, but reluctantly—if at all—among other residential units. In view of our definitions of a residential district and a community, any surplus of residential units in one community will be of no more use to any other community in the same district than to any of the communities in any other district. The community, therefore, will be the fundamental unit for the accounts of construction.

Residential units we shall consider as durable over time and immobile over space. The residential units intended for the various communities will differ in design, but the units intended for a particular residential class will always be of the same construction. We shall assume that residential units of various types call for an equal expenditure of productive effort. It will therefore be permissible to add the various types of residential units to obtain totals of construction. However, comparisons of the demand for the use of residential units with the supply will still be ambiguous if the totals embrace more than a single community.

The Council cannot hope that the number of residential units in each community will invariably equal the size of its population, but under normal conditions it will use one means or another of approximating this end. The Council might set annual quotas for communities on the basis of estimates of population change and of replacement needs, taking due account of any surplus or shortage that is known to exist. Or else the Council might follow

the convenient mechanical rule of basing the building quota for a year on the change in population during the preceding year, plus the number of residential units retired by nature or the state during the preceding year. The first method proceeds partly on known demand and partly on estimated demand. The second method proceeds entirely on an artificial conception of known demand. Let us suppose that the Council uses this method.

III. Construction in a Single Community under Collectivism

We begin with a single community. If the community is new, but established upon a sound basis, it will tend to grow in numbers year in and year out. There will be no need to replace residential units except when fire or tornado cause destruction. We assume that we have a new community which escapes destructive visitations by nature. The volume of construction will then vary to the extent that increases in population vary. Suppose that the community numbers successively, as of the first of the year, 10,000, 10,140, 10,230, 10,290, and 10,400 persons. The annual increases are, then, 140, 90, 60, and 110. The number of residential units constructed annually will correspond exactly to these increases of population, but it will lag by one year. While the percentage changes in the population are small and positive (+1.4, +0.9, +0.6, and+1.1), the percentage changes in the increases of the population and in the volume of building are large and oscillatory (−36, −33, and +83). To be sure, the violent fluctuations in building reproduce the increases of what are merely hypothetical figures of population. But the fluctuations in the increases of our imaginary community are as nothing compared to what will frequently happen in small areas.[3] Should the increases in population have a rising tendency for a half dozen years or so, and then a declining tendency, the construction industry would trace out long cycles; and, since the relative fluctuations of the increases in population tend to be large, the cycles in construction would also tend to show large amplitudes.

While the variability of population increases will introduce a violent rhythm in building activity, it will have no such effect on

[3] It may be of interest to note that the relative fluctuations of the increases in the entire population of the United States have at times been greater; though this is of dubious relevance in the present connection, since pecuniary forces have played an important role in these fluctuations.

the output of a relatively perishable commodity such as shoes.[4] Suppose that the Council sets a standard of one pair of shoes per person per year and that the production quota for a year is set at the level of the population at the beginning of the year. The annual output of shoes intended for the community will then rise successively by 1.4, 0.9, 0.6, and 1.1 per cent. There will be no cyclical fluctuations in production; there will be fluctuations only in the rate of increase in production. Our buildings and shoes can therefore be viewed as rough instances of a general principle: If real income is to bear a fixed ratio to population, the output of a commodity admitting of only a single use will vary with the size of population, while the output of a commodity admitting of perpetual use will vary with the increases in population. The fluctuations of an empirical population series are virtually always much smaller than the fluctuations of the increases in the series. Hence the fluctuations in the production of residential units will be much greater than in shoes. The reader may, if he so chooses, consider the fluctuations in shoes as the standard of comparison when reference is made in this paper to 'large' fluctuations in construction. In this sense the fluctuations in construction will be 'large' even if the fluctuations of the increases in population are regarded as 'small.'

Our preceding example assumes an uninterrupted rise in population. Let us next consider a decline in population. The community has, let us say, entered the phase when decreases in population take place occasionally, but it has not yet reached the age when residential units must be retired because of physical depreciation. Continuing with the last figure in the example, the population numbers may run 10,400, 10,360, 10,350, 10,350, 10,360, 10,400, 10,450. The volume of construction required on account of population change will then be −40, −10, 0, +10, +40, +50. Since the volume of construction cannot drop below zero, it will remain at zero until the earlier peak in total population has been passed. This means that when an upward trend in population is intermittently marked by declines, the amplitude of construction will be smaller both absolutely and relatively than that of changes in population[5]; that if the level and amplitude of changes in population are on the average the same in the present

[4] Cf. J. M. Clark, *Strategic Factors in Business Cycles* (National Bureau of Economic Research, 1934), pp. 27-44.

[5] In this paper we consider the standard deviation (σ) as the measure of absolute amplitude and the ratio of the standard deviation to the mean as the measure of relative amplitude.

'stage' as in the 'stage' of steady growth, the amplitude of construction in this 'stage' will be smaller both absolutely and relatively than in the preceding 'stage'; that the volume of construction may lag by more than one year after changes in population; that a minor cycle following upon a negative population change may not appear at all in the construction curve; and, finally, that whenever the population remains below a peak figure for some years and then rises above that figure a temporal skeleton of a long cycle in construction may be formed.

Let us now take account of replacements. They will become an appreciable factor in construction when the age of the community has outgrown the useful life of residential units. But first we must indicate more exactly the procedure of the Council in arriving at building quotas. The quota for each year measures the actual construction during the year. The quota is set at the beginning of the year according to the difference which then exists between the size of population and the number of residential units available for residential use. If the former is larger than the latter—that is, if the difference is positive—the quota for the coming year will equal the size of the difference. If the difference is negative or zero, the quota will be zero. Thus the difference always measures the 'required construction' in a year, but it is a theoretical quantity when negative. Were the difference invariably positive the Council could reach the same quota by taking the algebraic sum of the following preceding-year quantities: change in population, number of residential units destroyed by natural elements, and number retired from use as living quarters by state order. The sum of the last two items gives the 'required replacements.' The sum of all three items gives what may be called the 'presumptive construction.' If the required construction is negative or zero the actual construction will be zero; if the presumptive construction is negative or zero the actual construction will also be zero; if the presumptive construction is positive the actual construction may still be zero, for the required construction may be negative or zero. The actual construction would be the same as the presumptive construction only if the negative construction required in any year could actually be realized in that year. We shall therefore need to pay as much attention to presumptive construction as to actual construction when we come to consider the influence of immobility on the amplitude of construction cycles.

We can gain some idea of the role of replacements in total con-

struction by making simple assumptions. Suppose that residential units are retired by order of the Council when they reach a fixed age but are not retired in any other way. Let R stand for the ratio of replacements to total construction in a year, the subscript n for the year, k for the age at retirement, and a for the largest whole number obtained by dividing k into $(n-1)$. Then, if population increases annually by a constant amount,

$$R_n = \frac{a}{a+1}$$

Assume that $k = 50$; R will then be zero from the first through the fiftieth year of the community, 0.5 from the fifty-first through the one hundredth year, 0.67 from the one hundred-first through the one hundred-fiftieth year, and so on. But if the population increases annually by a constant percentage,[6]

$$R_n = \frac{r^{ak}-1}{r^{ak+k}-1}$$

where r is the ratio of the population of any year to that of the preceding year, and where n is not equal to $(ak+1)$. The replacement ratio will now approach $1/r^k$ as a limit, instead of 1. Suppose that $r=1.02$ and $k=50$; then, $R_{52}=0.27$, $R_{102}=0.34$, $R_{152}=0.36$, and $R_{n\to\infty}=0.37+$. In general, R increases as a increases, decreases as r increases, and decreases as k increases.

The fluctuations in the number of residential units destroyed by the elements are likely to be uncorrelated with the fluctuations of population changes. The same remark applies to voluntary retirements—at least if we assume that the retirements are based on a standard of fitness, that there is no periodic cycle in changes of population, and that replacements on account of natural destruction are not a negligible portion of total replacements. Hence, if the required construction is at no time negative the absolute amplitude of construction will on the average tend to be larger than that of population changes.[7] This means, of course, that if population conditions are similar, the construction of a community advanced in age will tend to be of larger amplitude than the construction of a community requiring no replacements. However, population decreases may counteract this tendency. If the

[6] The writer is indebted to Mr. Arthur Stein and to Mr. Milton Friedman for this expression.

[7] See G. U. Yule, *An Introduction to the Theory of Statistics* (8th edn., Charles Griffin and Company, 1927), Chap. XI, paragraph 2.

decline in population is numerically larger than the volume of required replacements, construction will drop to zero and remain at zero until after equality between the number of residential units in existence and the number of persons has been restored by the movement of either or both variables. Under such conditions the amplitude of construction may be smaller than that of changes in population. Irrespective of the sign of population changes, the timing of building fluctuations in the replacement stage will no longer be regularly related to the timing of population changes; there will now be leads and lags of varying duration and occasional coincidences.

Population changes and required replacements will form all sorts of combinations. This is of great importance, for out of these combinations long cycles may be formed in construction even when there are no such cycles in population changes. While required replacements and population changes will tend to be uncorrelated over long periods, they will nevertheless be correlated over short periods—now positively, then inversely. Although the fluctuations of required replacements will ordinarily be smaller than those of population changes, for a time they may be larger. The peaks or troughs of the two variables may at some turns be approximately coincident. At others the peak of one variable may be coincident with the trough of the other. In the neighborhood of such turning points both variables may undergo especially violent movements, those in required replacements perhaps being the more violent. Chance alternations in the character of the short-time correlation between the two variables are thus likely to promote to some extent the formation of long cycles in construction. This tendency will gain in strength if such declines as occur in population occasionally exceed the volume of required replacements, so that the presumptive construction is negative. The actual construction curve will now be apt to skip completely some minor cycles in the curve of presumptive construction. And if this curve remains below the zero line for several years the curve of actual construction will form a zero trough over a longer period; a temporal base for a long cycle will thus be fashioned, which the construction contributed by other communities may transform into an actual long cycle for the residential district.

IV. National Construction under Collectivism

Let us now abandon the community for a larger area. If the population of each of the communities that compose a residential

district increases every year and replacements are not needed, the construction of the district will reproduce with a one-year lag the annual fluctuations of the increases in the population of the district. Under similar conditions the residential construction of the country will reproduce with a one-year lag the increases in the national population. The relative fluctuations of increases in population will be smaller in the country taken as a whole than in the generality of communities. Hence the relative fluctuations of construction will be smaller; but they are still apt to be large, since the fluctuations of the increases in national population are likely to be large. The volume of national construction will trace out long cycles only if there are such cycles in the increases of national population; but long cycles may characterize the increases of national population even if there are no such cycles in the generality of residential districts or communities. Under the simple assumptions we have made, the fluctuations in the construction of a residential district or of the country as a whole, no less than of a single community, reflect the force of only two factors: variability of population increases and durability of residential units.

But variability of population increases would have little cyclical power if the longevity of buildings were no greater than of shoes. Suppose that there are long waves in the increases of national population. They will not suffice to generate long cycles in the production of shoes. With a footwear standard of one pair of shoes per person per year and quotas based on the population at the beginning of the year, the output of shoes will simply reproduce the curve of national population. There will be no cycles of any sort in this curve. Hence there will be no cycles of any sort in the output of shoes, though there will be long cycles in the rate of increase in output. Only the immobility of shoes in use could disturb the rigid relation between their production and total population; but for this to happen a net decline would have to take place in the national population of some 'footwear class.' Given a constant standard of housing and footwear, there will need to be long cycles in the population of the country if there are to be long cycles in the production of a perishable good such as shoes, while long cycles in the increases of the population will suffice to generate long cycles in the production of a lasting good such as dwellings.

Residential units, however, do not have everlasting life and in growing communities will sooner or later need to be replaced. If

the presumptive construction is at no time negative in any of the communities—that is, if there are no declines in population, or if declines in population are smaller than required replacements—the actual volume of national construction, no less than that of a single community, will be the same as the presumptive construction. We have previously argued that the fluctuations of required replacements will tend to be uncorrelated with the fluctuations of population changes. Under present assumptions, therefore, the absolute amplitude of construction, whatever the area, will tend to be larger than the amplitude of changes in population. The timing relationship between construction and changes in population will tend to be irregular. And, just as the combination of required replacements and population changes may produce long cycles in the construction of a community even when there are no such cycles in its population changes, so the combination of required replacements and population changes may produce long cycles in the total construction of the country even when there are no long cycles in changes of population in either the component areas or the country as a whole.

Let us next consider the possibility that the presumptive construction is at times negative in some of the communities. This will be the case if there are occasional declines in population but no replacements, or if in certain communities at certain dates the volume of required replacements is smaller than the decline of population. If residential units or men were perfectly mobile, the theoretical requirement of negative construction could be satisfied by diverting the surplus of some communities to others. Hence the actual construction of the country would exactly reproduce the presumptive construction—that is, the algebraic sum of the presumptive construction in the individual communities. The theoretical requirement of negative construction in some of the communities would influence neither the correspondence of actual construction to presumptive construction nor the relation of construction to changes in national population; both would be the same as in the case when presumptive construction is invariably positive. Only if the presumptive construction for the country occasionally fell below zero would the curve of actual construction differ from the curve of presumptive construction; and even this could not happen if the mobility of residential units extended to nonresidential uses.

Under conditions of immobility, however, the theoretical requirement of negative construction in any year can be satisfied

only through failure to build in later years; and if the negative construction required is much larger than the average annual volume of construction, a surplus of residential units may continue for some years. Immobility is therefore likely to exert an influence on the character of the cycles in national construction whenever the presumptive construction is negative in any of the communities. Suppose that the population throughout the country has been stationary for some time, that there are as many residential units in each of the various communities as there are persons, and that replacements are unnecessary. Suddenly, in district 1 the population increases by 100 in community A and decreases by 100 in B, and in district 2 the population decreases by 100 in A and increases by 100 in B. There are three possible ways of restoring equilibrium without new construction. First, the surplus population of A in district 1 could move to residences of type A in district 2, and the surplus population of B in district 2 to residences of type B in district 1. Second, residential units of type A could be moved to district 1 and of type B to district 2. Third, in district 1 the surplus population of A could move to quarters of type B and in district 2 the surplus population of B to quarters of type A. But each of these possibilities is closed by the assumption of immobility contained in our original definitions of a residential district, a residential unit, and a community. Although the total population has remained unchanged in districts 1 and 2 and in the country as a whole, 100 residential units will have to be built in each of these districts.

In this example immobility has led to a fluctuation in construction when there was none in the changes of total population. Under conditions of mobility the movements of the two variables would be inexorably linked. It is clear, then, that immobility may serve to confuse the relation between national construction and changes of national population. However, we must not infer from the example that immobility will intensify the fluctuations of national construction whenever the presumptive construction is negative in any of the communities. Suppose, for instance, that there are two distinct groups of communities in the country and that replacements are nowhere required. Group I consists of communities that gain in numbers each year; the volume of construction of this group will therefore vary as the increases of its population vary. Group II consists of communities that experience periodic fluctuations in population but along horizontal or declining trends; the construction of this group will therefore be

zero. The curve of national construction will reproduce with a one-year lag the curve of population changes in Group I. But the amplitude of population changes in Group I may be smaller or larger than the amplitude of population changes in the entire country, depending—roughly speaking—on whether the population-change curves of Groups I and II are positively or inversely correlated. Hence, immobility may dampen the fluctuations of national construction, magnify them, or leave them uninfluenced.

We may now take replacements into account and formulate more exactly the influence of immobility. Each year we can distribute the presumptive construction for the country between two groups. Let us define Group I as a quantity which equals each year the volume of national construction. By subtracting this quantity from the presumptive construction for the country we shall obtain Group II. The communities having a positive requirement for construction contribute to Group I. The communities having a negative or zero required construction contribute to Group II, as do those having a positive requirement for construction lower than the presumptive construction. There is some overlap between the communities in the two groups, but it will be negligible in a growing country. The composition of both groups will change from year to year.

Inasmuch as national construction reproduces the curve of Group I rather than the curve of presumptive construction for the entire country, immobility may result in an amplitude of construction that is larger or smaller than what would occur under conditions of mobility. The crucial factor is the character of the correlation between Groups I and II.[8] Let r represent the coefficient of correlation between Groups I and II, σ_{I} the amplitude of Group I, σ_{II} the amplitude of Group II, and σ_N the amplitude of the presumptive construction for the country.[9] Then, if $r=+1$,

$$\sigma_N = \sigma_{\mathrm{I}} + \sigma_{\mathrm{II}}$$

and if $r=0$,

$$\sigma^2{}_N = \sigma^2{}_{\mathrm{I}} + \sigma^2{}_{\mathrm{II}}$$

In either case $\sigma_{\mathrm{I}} < \sigma_N$; that is to say, immobility will dampen the

[8] In this argument we assume implicitly that changes in the presumptive construction of the country are independent of immobility. We do not assume, however, that the presumptive construction of Groups I and II is independent of immobility. The reasonableness of the first assumption can hardly be questioned—particularly if it is observed that required replacements are determined by physical criteria, so that the assumption is simply that changes in national population are independent of immobility.

[9] Supra, notes 5 and 7.

amplitude of construction whether Groups I and II are uncorrelated or positively correlated. But if the two groups are inversely correlated immobility may intensify the amplitude of construction. Thus if $r = -1$, the amplitude will be intensified provided $\sigma_{II} < 2\sigma_I$. If $r = -0.8$, the amplitude will be intensified provided $\sigma_{II} < 1.6\sigma_I$. In general, $\sigma_I > \sigma_N$ if $\sigma_{II} < |2r\sigma_I|$. But the two groups may have both major and minor cycles, the major cycles being correlated in one manner and the minor cycles in another. If the major cycles are correlated positively and the minor ones inversely, immobility will dampen the major cycles in construction and may magnify the minor cycles; while if the major cycles are correlated inversely and the minor cycles positively, it may magnify the major cycles and will dampen the minor ones. The influence of immobility on the amplitude of national construction cannot therefore be known unless the data of Groups I and II are known.

The most we can do is to rely on reasoned expectations. We may anticipate that the communities of a growing country will tend to be subject to common influences on the side of natural increase and to random influences on the side of required replacements. But we may also expect that the rate of natural increase of some communities will depart from the national pattern; that net immigration will impinge chiefly on growing areas; and that internal migration will tend to produce an inverse relation between the population changes of the gaining and losing communities. Bearing in mind the composition of Groups I and II, it therefore seems probable that if the country experiences extensive internal migration the two groups will be inversely correlated. Immigration will tend to make the amplitude of Group I larger than that of Group II. Even if the amplitude of Group II were the same as that of Group I, a negative coefficient of correlation just greater than 0.5 would suffice to indicate that immobility had intensified the amplitude of national construction. All in all, therefore, it seems more reasonable to anticipate that immobility will magnify the building fluctuations of a progressive country than that it will dampen them.

We have proceeded on the assumption that the Council invariably adheres to the theoretical housing standard of one residential unit per person. Let us now drop this assumption. In practice the Council may occasionally find it desirable to suspend the standard. It will then make use of an instrument that has even greater cyclical power than fluctuations in the rate of population

change. Suppose that there are 1,000 persons and 990 residential units in each community. To maintain the theoretical standard ten residential units will need to be built in each community. But if the standard is lowered by 0.5 per cent, only five units will be required; if it is lowered by 1 per cent, no construction at all will be required; if it is lowered by 5 per cent, a negative volume of forty units will be required. Thus, if the housing standard is reduced by a small percentage, the volume of building will be reduced by a much larger percentage from the level that would have been realized under a constant housing standard; the decline in building may readily reach 100 per cent and even then leave a surplus so large that all construction will need to cease for several years. In our example a 1 per cent drop in the housing standard has as much cyclical effect as would a 100 per cent drop in the sum of population change and required replacements. In other cases the disparity between the cyclical effects of the two factors may be larger or smaller; but it is nevertheless to be expected that occasional variations in the housing standard will tend to increase enormously the cyclical fluctuations in construction—even if the variations in the standard are correlated inversely with fluctuations in population changes. The great cyclical power of a fluctuating housing standard might, of course, be harnessed by the Council to counteract the impulses making for instability in construction that derive from a fluctuating rate of population change and of required replacements; but we must repeat that we "use collectivism merely as a vehicle for expressing the basic factors in the residential cycles of our business economy."

If the housing standard is at times reduced the occasions when negative construction is theoretically required will be multiplied. The cyclical role of immobility will therefore be larger; but it is difficult to say whether the role will be to dampen or to magnify the amplitude of construction. Much will depend on the frequency of the changes, their magnitude, and the degree of their uniformity in the various communities. We previously reached the conclusion that immobility is likely to magnify the building fluctuations of a growing country operating on a constant housing standard. This conclusion will still hold if the changes in housing conditions are infrequent but uniform over the country, while their influence on the volume of building is smaller than that of population changes. It will also hold under a variety of other conditions; but there can be little advantage from endowing our imaginary economy with special characteristics beyond the point

that we have already gone. We need merely to recall that once the data of Groups I and II are known, the influence of immobility can be deduced from them.

Just as the cyclical power of fluctuations in the rate of population change derives from the durability of residential units, so does the cyclical power of inconstancy in the housing standard derive from the same source. A given reduction in the footwear standard, as previously defined, will produce merely a proportionate reduction in the output of shoes from the level that would have been attained under an unchanged standard. Thus, if the population of each community is 1,000 and the footwear standard is maintained the output of shoes will be 1,000 pairs for each community; otherwise it will be 995, 990, or 950, according as the standard is lowered by 0.5, 1, or 5 per cent. We may therefore say that durability is a necessary condition of the full release of the cyclical power of fluctuations in the housing standard; though durability can release only what is at its disposal—so that the cyclical power of durability will be zero if both the housing standard and population changes are constant. It is also true that the cyclical power of immobility derives from the durability of residential units. But we can no more say that durability—rather than inconstancy of the housing standard, or a fluctuating rate of population change, or immobility—is *the* basic factor in the fluctuations of residential construction, than we can say that "it is the upper" rather than "the under blade of a pair of scissors that cuts a piece of paper:"[10] they are all basic.

The large cyclical power of the basic factors in residential construction creates a presumption that long cycles will be produced through their joint action. The composition of the national construction curve changes. The incomers emerge from troughs of zero construction, the outgoers enter zero troughs. Any concentration of incomers or outgoers at certain dates will not fail to impress itself on the curve of construction. Temporary suspensions of the theoretical housing standard will also tend to produce sharp movements in the construction curve. If the housing standard is constant that curve, speaking roughly, is a composite of population changes and required replacements; but these variables may move in similar or in opposite directions. Over some years required replacements and population changes may tend upward quite generally, the movements of required replacements may be more violent than those of population changes, the housing stand-

10 Alfred Marshall, *Principles of Economics* (8th edn., Macmillan, 1925), p. 348.

ard may move towards parity, and the incomers from zero troughs may greatly outnumber the outgoers. In other years other combinations will emerge. The combination of factors determining the volume of national construction will change over time; and the changing combination of factors of large cyclical power may easily produce long cycles in residential construction—all the more readily, of course, if there be long cycles in the increases of national population. In the absence of long cycles in population changes in the country as a whole, or in the areas gaining through internal migration, the minor cycles in construction may at times obscure the major cycles.

V. Intensifying Power of Uncertainty under Collectivism

Our analysis must now be extended to include the factor of uncertainty. We have abstracted from this factor by assuming that the Council sets building quotas according to known demand. But under this scheme there will rarely be a nice adjustment of the supply of residential units to the demand implied by the ruling housing standard. With the standard constant there will be a permanent undersupply of residential units in case the population increases steadily, and shortages will dominate over surpluses in case the population fluctuates but along a rising trend. Let us suppose that the Council normally seeks to attain a closer approximation to the theoretical standard of one residential unit per person. It will then be necessary to set the building quota for a year by estimating the new demand that will arise during the year and adjusting this estimate for any surplus or shortage that is known to exist. By assuming that the Council sets building quotas on the basis of only partial knowledge of demand, we shall take account of the factor of uncertainty and therefore approach more closely the conditions underlying the residential cycles of our business economy.

At the outset let us revert to a single community which gains in population each year and escapes the need for replacements. In this case the Council will need to estimate only the increases in population. Let P stand for the actual increase in population during a year, K for the estimated increase during the year, B for both the building quota and the number of residential units built during the year, S for the surplus (or shortage) of residential units at the beginning of the year, M for the size of population at

the beginning of the year, H for the number of units available for residential use at the beginning of the year; and let subscripts refer to successive years. Then we have

$$B_n = K_n - S_n = K_n - H_n + M_n$$

when this quantity is positive; otherwise $B_n = 0$. If the negative construction required in any year could be realized in that year, the following relations would hold:

$$B_n = K_n - S_n = K_n - H_n + M_n = K_n - K_{n-1} + P_{n-1}$$

Actually, however, B_n may be zero when $(K_n - K_{n-1} + P_{n-1})$ is positive, because $(K_n - H_n + M_n)$ may be negative or zero. In conformity to earlier usage, $(K_n - H_n + M_n)$ measures the 'required construction' and $(K_n - K_{n-1} + P_{n-1})$ the 'presumptive construction.' Both are estimated quantities; $(K_n - P_n)$ measures the error of each. Since the increases of population will tend to fluctuate considerably, the estimates will be in error nearly always to some extent and at times to a great extent. These errors may serve to magnify the fluctuations in building; to make them larger than they would be if they were governed by population increases alone. We shall simplify the analysis by restricting it at first to the case where $(K_n - S_n)$ is invariably positive.

The Council will be faced with the task of forecasting population. Suppose that a constant is chosen in some fashion as the estimate of population increase. Assuming equilibrium between population and residences at the start, we have $B_1 = K_1$. Subsequently, however, we have $B_n = P_{n-1}$, since $K_n - K_{n-1} = 0$. Hence, no matter how large the errors of estimate may be, the building curve will be the same as if each year's output had been mechanically set at the level of increase in population during the preceding year. Unfortunately, the assumption of a constant estimate is likely to be inconsistent with the controlling assumption that the Council will attempt to approximate as closely as possible the theoretical housing standard. If an appreciable shortage or surplus continues for several years, the estimated constant will be abandoned. Given the purpose of the Council, the variable nature of population increase will almost certainly lead to inconstancy in the estimates of increase. In any case we shall assume that the estimates are of this character.

Suppose, next, that the Council resorts to 'rational' forecasts, making the best use it can of the knowledge at hand. In that case $(B_n - P_n)$ is likely to be uncorrelated with P_n. Hence the ampli-

tude of B will tend to be larger than that of P; that is to say, the fluctuations of construction will tend to be magnified through errors of estimate.[11] Or else the Council may resort to 'mechanical' forecasts, using some simple formula that appears logical. It might, for example, take as an estimate of population increase in a given year, the actual increase during the preceding year; in this case,

$$B_n = 2P_{n-1} - P_{n-2}$$

Or it might estimate the population increase in a given year at the average increase during the two preceding years; in this case,

$$B_n = 1/2\,(3P_{n-1} - P_{n-3})$$

In general, if the estimate is equal to the arithmetic mean of the actual increases during s preceding years,

$$B_n = 1/s[\,(s+1)P_{n-1} - P_{n-1-s}]$$

Clearly, any two-year combination of a large and small increase in population will produce an accentuated fluctuation in the curve of building; but the intensification will be largest when $s = 1$. As s increases in size the tendency will be for the fluctuations in building to approach the fluctuations in increases of population;[12] the smaller, therefore, will be the intensification of amplitude produced by errors of estimate.

Let us assume, for illustrative purposes, that the increase in population for a given year is estimated at the level of the preceding year; that is to say, that $s = 1$. The increases in population trace out fluctuations which, let us say, are irregular but clearly defined. The year following upon a cyclical peak in population increases will then witness a volume of building equal to twice the increase in population during the peak year minus the increase in population during the year preceding the peak. Hence, the peak in building will be sharper than the peak in population increases and is likely to follow it by one year. Similarly, the trough in building will be lower than the trough in population increases and is likely to lag by one year. During a cyclical rise in population increases the estimates are continually too low, which results in a shortage of residential units. To be sure, the shortage at the beginning of one year is corrected in that year, but underestimates of growth in population continue as long as the cyclical rise continues; a short-

[11] Yule, *op.cit.*, Chap. XI, paragraph 3.

[12] If there is a strictly periodic cycle in the increases of population, the amplitudes of P and B will be the same whenever s is a multiple of the period of the cycle.

age therefore continues. Once a peak in population increases has been reached, the volume of construction in the following year not only corrects the shortage but also creates a surplus. The corrective movement in construction during the next year is therefore particularly pronounced, the recession being sharper than could be expected merely from a knowledge of the amplitude of population change. Similarly, there is a surplus of residential units during a cyclical decline in population increases; this becomes converted into a shortage after the trough in population has been passed; and the revivals in construction are peculiarly vigorous.

The intensification of cyclical fluctuations in construction will be more pronounced if we assume a somewhat different method of forecasting. Let us suppose that the estimate of population increase for a given year is fixed at the level of the actual population increase during the preceding year plus the excess of the actual increase during the preceding year over the increase during the next preceding year; that is,

$$K_n = 2\ P_{n-1} - P_{n-2}$$

The estimates of population increase will now bear exactly the same relation to the actual increases as the volume of building bears to the actual increases when the estimate for each year is fixed at the level of the actual increase during the preceding year. The estimates, therefore, now undergo fluctuations larger than those of the actual increases of population. They will tend to err on the side of 'optimism' or 'pessimism' according as the second differences of the curve of population increases happen to be negative or positive. The magnified fluctuations of the estimates will lead to still more magnified fluctuations in construction, so that the cycles in construction will be much more violent than in increases of population. How large the opportunities for magnification become, particularly just after the cyclical turning points in population increases are passed, is apparent from the construction formula which expresses the present method of making estimates:

$$B_n = 3\ P_{n-1} - 3\ P_{n-2} + P_{n-3}$$

The preceding description of the intensifying mechanism that may be contained in the technique of estimation is limited by the condition that the fluctuations in population increases are never so large as to make S_n exceed K_n. When this occurs a negative volume of construction is theoretically required. Since construction can drop to zero but not lower, it will be impossible to

correct the surplus in one year and construction activity may therefore need to be suspended for some time. If the fluctuations in population increases are so large that $(K_n—S_n)$ is frequently negative, there may be little similarity between the cycles in construction and the cycles in population increases. Out of such conditions, however, temporal skeletons of long cycles in construction may be produced.

Let us illustrate by a numerical example the principle of magnification through errors of estimate, without reference to any specific method of estimation. We start with 10,000 persons and 10,000 residential units; that is, with equilibrium between the demand for the use of residential units and their supply. On the basis of recent experience and current prospects the Council anticipates an increase in population of 100; it therefore orders that 100 residential units be built during the year. If the increase in population is 10 instead of 100, there will be a surplus of 90 units. Let us suppose that the Council considers this year abnormal and again plans for an anticipated increase in population of 100. Since there is a surplus of 90 residential units, only 10 will be ordered built. But the population may again increase by only 10, and the surplus will therefore remain 90. It is likely that the Council will now lower drastically its estimate of population increase in the coming year. Suppose that the estimate is 10; in this case the surplus of residential units will be nine times as large as the number required by anticipated growth during the year. All construction will therefore cease; and, if the annual increases in population vary subsequently between 5 and 15, ten years may elapse before construction is again undertaken.

In this example errors of estimate reinforce variability of population increase, the original impulse making for fluctuations in construction. The amplitude of fluctuations is increased and a temporal framework for a long cycle is created. Quasi-cyclical forces are set in motion, in the sense that a given error leads to a corrective adjustment; but these forces have limited scope—the process of adjustment does not of itself breed fresh errors. The volume of building no longer lags passively after population increases, but anticipates them; it may therefore trace out fluctuations even when there are none in population increases. Thus, we could recast the preceding example by assuming that population actually grows at a stable rate, and that errors of estimate originating in inaccurate statistics lead to excessive construction,

the errors being later detected through the improved data that accompany the introduction of building quotas.

But the most striking and significant feature of the example is that the magnified fluctuations in construction result from small errors in the forecasts of total population; or, what is the same thing for our purpose, from small errors in the forecasts of total demand for the use of residential units. The estimate of population for the end of the first year is 10,100, the second year 10,110, the third year 10,030. The actual population at the end of the first year is 10,010, the second 10,020, and the third anywhere from 10,025 to 10,035. Hence, there is an overestimate of only 0.9 per cent in the first and second years, and a maximum overestimate or underestimate of 0.05 per cent in the third year. But these small errors in the estimates of total demand mean enormous errors in the estimates of increase in demand: in each of the first two years the increase is overestimated by 900 per cent, and in the third year there is a maximum overestimate of 100 per cent or underestimate of 33 per cent. Under our assumptions the volume of construction in a year would equal the actual increase in demand if there were no errors in the estimates of demand. However, since small errors in estimates of demand mean large errors in estimates of increase in demand, they may produce fluctuations in construction that are vastly larger than the fluctuations in the increases of demand. Even a small overestimate of demand may result, as in the example, in a volume of construction that far exceeds the actual increase in demand; so that many years of inactivity in the construction industry will need to elapse before the error can be corrected.

This will be the case only when the commodity produced is highly durable. Let us suppose again that the theoretical footwear standard is one pair of shoes per person per year. Provision will now be made for the year-end population, so that estimates of this quantity will be identical with estimates of the total demand for shoes. The errors of the estimates of population assumed in the above example will lead also to errors in the production of shoes. But these errors are negligible in size; and, since the unadjusted quotas for the production of shoes vary as the estimates of population, not as the estimates of the increases in population, the errors in the actual production of shoes will also be negligible in size. Hence they will be subject to quick correction and their power to produce fluctuations will be insignificant. Thus the output of shoes in the first year will be 10,100, which is only 0.9 per cent in excess of what is actually required in that year; assum-

ing, of course, that the population is homogeneous from the standpoint of footwear as well as residences. But the output of residential units will leave a surplus equal to 900 per cent of the actual need for new residential units in the year. In the second year the output of shoes will be 10,020, a decline of 0.8 per cent from the preceding year; and the surplus at the end of the year will be 0.9 per cent in excess of true demand. The output of residential units will decline by as much as 90 per cent; but the surplus will nevertheless continue to be nine times as large as the actual demand for new residential units during the year. In the third year the output of shoes will be 9,940, a decline of 0.8 per cent from the preceding year; this will mean a maximum surplus or shortage of 5 pairs of shoes, depending on whether the population is 10,025 or 10,035. However, although the output of residential units will decline by 100 per cent, the surplus of residential units will not be less than five times and may be seventeen times as large as the demand for new units during the year.

The contrast between dwellings and shoes will be even more pronounced if we posit that errors of estimate can cumulate. All along we have assumed that the volume of construction projected at the beginning of each year will correct fully for any error of estimate that may have been made at the beginning of the preceding year, provided, of course, that the correction does not require a negative quantity of construction. We have therefore proceeded on the assumption that errors cannot cumulate. Once the possibility of cumulation is admitted, the opportunities for magnifying building fluctuations through errors of forecast are indefinitely increased. We might assume, for example, that what is known when quotas are set is the surplus or shortage at the beginning of the preceding year rather than of the given year; that is to say, that B_n will be governed by $(K_n - H_{n-1} + M_{n-1})$. Thus, to return to the above example, if $H_0 = M_0$ and $P_0 = B_0$, B_1 will be 100 and B_2 will also be 100. The consequence of delay in the discovery of errors will be a larger surplus of residential units and therefore a longer cessation of building activity. But the effect on the production of shoes will again be negligible.

The preceding analysis is restricted to a community that experiences uninterrupted growth, requires no replacements, and attempts to adhere closely to a standard of one residential unit per person. These restrictions can be removed by writing the equation for B_n in more general form. In addition to the symbols already defined, let R_n be the number of residential units retired

during any year, L_n the estimate of this quantity, and C_n the housing standard during the year. If we assume again that errors cannot cumulate, then

$$B_n = C_nK_n+L_n-H_n+C_nM_n$$

when this quantity is positive; otherwise $B_n = 0$. The preceding analysis, therefore, requires little elaboration. Since population changes may now be negative, there may be zero troughs of construction even when there are no errors of estimate. The task of estimation will consist of two parts, one estimate being of population change and the other of required replacements. The errors of these estimates will at times be cumulative, at others compensatory. When they are cumulative and positive, a larger surplus will arise than if the zone of errors had been confined to population change. The larger surpluses will tend to promote longer cessations of building activity; but this tendency will be counteracted by the decline in the useful stock of residential units through failure to make replacements. However, if even a slight reduction of the housing standard should be concurrent with, or follow shortly, a sizable overestimate of required construction, building might need to be suspended for many years.

Errors of estimate are likely to magnify the fluctuations of national construction as well as of the construction of a single community. This would tend to be the case even under conditions of mobility, since the errors for individual communities will not be entirely self-canceling. Immobility, however, may reinforce the amplifying stimulus of errors of estimate; for the errors will tend powerfully to multiply the occasions when negative construction is theoretically required, and in this way to enlarge the zone within which immobility can exercise its cyclical influence. If the housing standard is constant our earlier conclusion that immobility is likely to intensify the amplitude of national construction will probably still be valid—particularly if estimates for the various communities are made by the same mechanical formula. But if there are occasional departures from the standard of one residential unit per person the outcome is more uncertain. In any case once the data of Groups I and II are known, the influence of immobility can be deduced from them. Group I is now the sum for each year of the quantities $(C_nK_n+L_n-H_n+C_nM_n)$ wherever they are positive; while Group II is the quantity we get for each year by subtracting Group I from the algebraic sum of the quantities $[C_n(K_n+M_n)$

$+L_n - C_{n-1}(K_{n-1}+M_{n-1}) - L_{n-1}+R_{n-1}]$ for all communities[13]—this being the construction that would take place under conditions of mobility.

With uncertainty at free play the cyclical power of the several basic factors in residential construction will be at a maximum. The troughs will last longer and be more numerous than when quotas were set by the method of known demand. Some tendency towards direct correlation of errors will arise if the same forecasting method is applied to the communities of a country whose population growth is fairly well diffused geographically. This will promote a clustering of zero troughs, which in turn will promote the formation of long cycles. But chance alone will be almost certain to produce some degree of clustering; thus the errors will be generally positive if some unexpected factor acts to diminish the growth of communities throughout the country. Hence the presumption is that when uncertainty reinforces the cyclical power of the other basic factors, the curve of actual construction will show long cycles with clearly defined contours.

VI. Long Construction Cycles in a Business Economy

We have shown that long cycles in residential construction may easily come into existence in a collectivist economy that adumbrates our business economy. But these long cycles are mechanical in character; and the process of their formation differs in important respects from that of the long cycles in our business economy. We must now extend and adapt the analysis, so that it may apply to the pecuniary organization of our economy. For our purpose the essence of pecuniary organization is economic freedom, which resolves itself into independent action on the part of individuals or groups with a view, mainly, to private advantage.

The touch of rigor in the preceding pages has exposed the power of the basic factors in the cycles of residential construction. But it is important to note that under collectivism, as we have sketched it, these factors are related only in the sense that a certain state of some factor or factors is a necessary condition of the expression of the cyclical power of other factors. In the actual economy, these integrative ties are maintained, but in addition strong geographic and temporal ties are established through the impact of pecuniary forces. Thus pecuniary forces tend to exercise similar sway over

[13] This expression is derived from the preceding expression by substituting for H_n the following quantity: $C_{n-1}(M_{n-1}+K_{n-1})+L_{n-1}-R_{n-1}$.

the various regions of the country, which leads to a fair degree of correlation in the fluctuations of construction of the various regions. Further, the common impress of pecuniary forces on the basic factors results in a sharp increase in their effective cyclical power—particularly during periods of extreme expansion or depression in general business. For example, a vigorous and sustained improvement in business conditions will ordinarily stimulate immigration, increase the demand for housing on the part of the average person or family, hasten the retirement of obsolete residential units, and lead to exaggerated forecasts of the real-estate market. In our analysis of collectivism we showed that such changes have large cyclical power in the case of the construction industry. Now, they will tend cumulatively to increase the volume of building once vacancies are at a relatively low level; and the impossibility of transferring dwellings from places or uses of declining demand to places or uses of rising demand, without incurring heavy sacrifices, will promote exaggerated forecasts and therefore work in the same direction. Sooner or later a condition of overbuilding will be discovered; and, as our previous analysis suggests, the durability of dwellings may enforce many years of comparative idleness on the construction industry.

Uncertainty is but one factor in the mechanism of long residential cycles. However, given durable dwellings and the institutional framework of the building and real-estate industries, it is a strategic factor in the prolongation of construction cycles. Let us therefore consider how pecuniary organization, by creating uncertainty at almost every turn, increases the difficulty of adjusting the supply of dwellings to the demand for their use. The current state of the residential market is never a matter of exact knowledge, because dwellings are heterogeneous and realized rentals cannot be ascertained precisely. The volume of current construction is influenced by prospective demand as well as by current demand. Prospective demand may be interpreted in the sense of gross income. This depends on the level of rentals, the size of population, and its housing standard; but these factors are interrelated, and the future state of each is uncertain—partly because it depends to some extent on the volume of future construction. The volume of current construction is governed also by conditions of cost; but land values and construction costs in the present or in the proximate future are only less uncertain than maintenance costs in the distant future. A speculative builder cannot appraise the prospective net income from a certain class of dwellings with-

out taking account of the prospective supply of all classes of dwellings in the same residential district. He must therefore make due allowance for the actions of his fellow builders, who are not in the habit of consulting with him; many of whom, he knows, are more deficient than he in balancing nicely estimates of future income against estimates of present and future costs; and some of whom, he anticipates, have as yet not 'discovered' that deed-searching and house-painting are less profitable than house-building.

The opportunities for producing maladjustment between supply and demand in the market for dwellings are clearly ample. They are enhanced by lax methods of financing construction and by the existence of a double market for dwellings—one for the use of dwellings, another for the dwellings themselves. Excessive liberality in the extension of credit promotes speculation; for it may enable a builder to put up houses without risking much of his own capital. The double market for dwellings also promotes speculation; for, in the first place, it permits the investing public to participate with building operatives in appraising the future state of the rental market, and in the second place, it permits both builders and the public to devote their energies for a time to traffic in real estate with little heed to the rate of interest at which prospective incomes are being capitalized in prices. If a building operative put up houses with a view to rental rather than sale and if he could borrow only a small fraction of his outlays on construction, he would curtail his operations in case he considered the prospects of the rental market unfavorable. But this will not happen if he firmly believes that the outlook of the generality of real-estate traders, or the public who have turned traders, is genuinely optimistic. Nor will it happen if he firmly believes that traders have only a vague notion, if any, concerning the prospective market for the use of dwellings, but nevertheless entertain extremely optimistic notions concerning the prospective market for dwellings. In either case, if costs are not prohibitive, he will build more energetically than ever in the hope of making quick sales. And he will act in the same way, no matter what others may think about real estate, if only his banker is optimistic enough, or expects the public that buys real-estate bonds to be gullible enough, to be willing to lend on the security of what is proposed to be built as much as or more than it will cost to build it.[14] If the disaster envisaged by the building operative actually eventu-

[14] See F. F. French, *Financing Private Construction*, an address at the Fifteenth Convention of the Associated General Contractors of America, January 30, 1934.

ates, but not before he has succeeded in closing his operations at a profit, his private rationality will have contributed to the collapse of the real-estate market largely produced by mass irrationality.

With disequilibrium between demand and supply as the normal condition in the market for dwellings, corrective forces are constantly being set in motion by the profit motive. But the progress of corrective forces is slow in the case of dwellings, partly because of their durability, partly because of methods of financing and of transferring title, and partly because the profit motive often works blindly. Once a corrective adjustment gets firmly under way, it tends to be carried too far, so that errors are produced which in turn require correction. Hence long cycles operating on the reaction principle are likely to occur in residential construction, no matter what the period of the cycles in the changes in the demand for the use of dwellings may be; though the fluctuations of changes in demand will in actual fact be influenced by the long cycles in construction.[15]

Let us assume that after construction activity has been declining some eight or ten years, a vigorous revival in general business gets under way.[16] There will then be a sharp increase in the demand for the use of dwellings. Families that have 'doubled up' will seek separate quarters; marriages that have been postponed will be consummated; urban families that have sought refuge on farms will return to the cities; the normal flow of rural population to the cities will be resumed; and immigration will again set in. The number of vacancies will therefore diminish quickly, and

[15] The statistical indications are that annual increases in the population of the United States have traced out long cycles; that these cycles are largely, but not entirely, attributable to long cycles in immigration; that major depressions in this country have been followed by sharp and protracted declines in immigration and that this factor has played a dominant role in the formation of long cycles in immigration; and, finally, that the long cycles in the increases of national population have corresponded fairly closely, except for the eighties, to the long cycles in the construction of buildings.

[16] Some aspects of the mechanism of long cycles in construction are discussed ably and documented statistically by H. Hoyt in his *One Hundred Years of Land Values in Chicago* (University of Chicago Press, 1933), particularly in Chap. VII. A few suggestive hints are given by Clark, *op.cit.*, passim. For an elaborate statistical inquiry into the major factors in the long cycles of real-estate 'activity,' as exemplified by St. Louis, see R. Wenzlick, "The Problem of Analyzing Local Real Estate Cycles," *Proceedings of the American Statistical Association*, March 1933, and D. S. Wenzlick, "What about Rents," *Journal of the American Institute of Real Estate Appraisers*, January 1933. For illustrative data on fluctuations of real-estate prices, see J. G. Clark, "The Real Estate Cycle in San Diego, California, 1900 to 1932," *ibid.*, April 1933.

rentals may move slowly upward. Hence the gross income from real estate will rise; and the net income will rise faster, since the costs of maintenance are not likely to change appreciably. The pressure on owners of real estate will diminish; foreclosures will decline rapidly; and while there may as yet be little trading in real estate, prices will be higher than in the days when foreclosures were rampant. Conditions in the loan market for both new and old buildings will be improved. Construction costs are likely to be higher; but rising costs will be no bar to construction if the present value of the prospective income from dwellings is reckoned to be larger than their cost. As trading in real estate is revived, and the speculative public again enters the market, the prices of real estate will advance faster than costs of construction. Hence the incentive to new building will be increased.

Once the level of rentals and the rate of occupancy have reached a stage that is generally recognized as profitable, new capital will be increasingly attracted into building. For some time, however, as the demand for the use of dwellings increases, the stock of usable dwellings will increase more slowly. Builders proceed cautiously, fearing that the increase in demand may prove evanescent; much time needs to be expended in choosing sites, formulating plans, arranging loans, letting contracts, and so on; the process of physical construction requires a few months or longer; and the increase in the stock of dwellings is smaller than the volume of new construction, chiefly because of the replacement of obsolete units. But as vacancies tend to disappear, the incentive to build grows stronger; and within a few years the volume of construction will be perhaps several times as large as at the trough of the construction cycle.

There may now occur a depression in general business. This will be reflected in a reduced volume of residential construction. But the level of building activity will continue to be high, since a considerable volume of construction is in process and the condition of the rental market is still sufficiently favorable to stimulate a goodly number of new projects. The continuance of residential construction at a relatively high level will tend to check both the severity and the duration of the depression, while the close of the depression will give a new fillip to both the rental market and the market for houses. Easy credit and speculative zeal will now sharply advance the prices of real estate, and with little regard to the rate of interest at which prospective incomes are being capitalized. As the margin between construction costs

and comparable real-estate prices continues to be wide, the volume of building will rise swiftly, particularly since the ranks of builders, no less than of traders, will be swollen by accessions from the public. With speculation rife the adjustment of the supply of dwellings to the increase in demand will be carried too far; and it is only a matter of time before a condition of overbuilding will be generally recognized to exist. At this stage much real estate, both old and new, will be in the hands of owners who have but a thin equity in their property and who will therefore find themselves in difficulty as soon as any decline takes place in rentals or in other sources of income.

A condition of overbuilding is slowly and reluctantly admitted; for what is merely the rising wave of a long cycle is generally mistaken for the underlying trend. The true state of the rental market is screened by the high rate of mobility of occupants of dwellings and by the double demand exercised for some months by families contemplating to vacate rented premises as soon as their new homes are completed. But two sets of forces gather momentum and conspire to bring the boom in residential construction to a halt. In the first place, the rental market becomes strained. It is more and more difficult to rent new dwellings at prices the expectation of which evoked the construction. Renting conditions are still worse in older houses which are also burdened by fairly numerous vacancies. Should a decline in general business occur at this stage, it will sharply intensify the tension in the rental market. In the second place, construction costs creep up on prices of comparable real estate. The competition among builders tends to raise the prices of labor and materials, and the frantic activity tends to diminish the efficiency of labor and management. Hence construction costs rise more sharply than the familiar index numbers may suggest. What is perhaps of even greater importance is that the rise in costs is very uneven, being highest for the inexperienced builders, who have only recently entered the trade. The pressure of rising costs, particularly on inexperienced builders, and of rentals that are barely maintained if not actually declining, will eventually be precipitated in a recognition that a state of overbuilding exists.

A condition of overbuilding cannot be corrected quickly. For a time, the difficulties on the supply side are even likely to increase. Some builders, or else their bankers, may find that the type of dwelling which they construct or the district which they serve still enjoys a favorable market; and this type of construction

may continue unabated. Some building projects have been carried too far to be abandoned, and will add to the volume of construction activity for many months. And a demand for specially designed dwellings to be erected on certain preferred sites keeps recurring. Hence, although the volume of building declines, it lingers at a relatively high level at a time when a complete cessation of new construction for several years might be no more than sufficient to bring the supply of dwellings into adjustment with even an increased demand. As the new buildings are completed they enter into competition with the older stock and therefore help to depress rentals.

Therefore, the incentives to new construction progressively diminish. Owners find that their net income from real estate drops much faster than rentals, since costs of maintenance do not decline appreciably and may even rise. Cash sales of real estate are few; and while there may be a semblance of stable values, in actual fact real estate can now be sold at only sharply reduced prices. For a time owners make all sorts of sacrifices to preserve their equities, by drawing upon their savings and business incomes to meet interest on mortgages, amortization payments, and taxes. But if a decline in general business did not set in contemporaneously with the decline in residential construction, it will make its appearance not more than two or three years later. A reduction of the housing standard will take place; and we have already seen that a slight reduction of the housing standard may dispense with the need for new construction even in the face of an increasing population. Nominal rentals will fall considerably and realized rentals even more, at a time when the ability of owners of real estate to draw upon outside sources of income is declining. Hence the transfer of property from owners to creditors will commence on a large scale. The process of liquidation will extend over several years, partly because the period elapsing between the time of default and the end of foreclosure proceedings is normally a half year or longer, partly because mortgages have a term of several years and expire in but small quantities at any one time, and partly because some owners continue to resist stubbornly the loss of their equities at a time when they would do better financially to cut themselves loose from their heavily indebted property. As mortgagees acquire real estate, they are frequently glad to dispose of it for the face value of the mortgage or less, if only because they do not relish the function of real-estate management. There are also distress sales by persons seeking to

realize some cash to protect other investments or to meet urgent household needs. Buyers bid cautiously, and many are excluded from the market because transfers cannot be adequately financed. The prices of real estate therefore drop precipitously, and since construction costs do not decline nearly so much, the prices at which dwellings only recently built change hands are considerably lower than it would now cost to build them. Hence the volume of residential construction is negligible, most of it being attributable to demand of a specialized character.

The severe drop in residential construction may help to bring about a deep and protracted depression in general business—one lasting from four to six years, such as that from 1837 to 1842, from 1873 to 1879, or from 1929 to 1933. But if conditions other than the state of the residential market are favorable, the depression will be short-lived. Improvement in general business will be accompanied by improvement in renting conditions. There will also be a revival in residential construction, though most of it will be in regions that have gained by population shifts and much of the rest will be initiated by owners, scattered through the country, who contemplate occupancy. But in spite of the revival the absolute volume of construction will continue at a low level, and will therefore promote an early recession in general business. For, with foreclosures at a high rate and vacancies in most places still numerous, the liquidation in the real-estate market will be uncompleted. So long as foreclosures are active and financial institutions hold title to property that they do not care to manage or to exhibit in their statements, the prices of real estate will continue at levels that imply high capitalization rates of even current incomes. The trend of residential construction will therefore be downward; though its course may be marked by two or three minor waves corresponding to the business cycles that are in the meantime undergoing their swing. We must note that the downward 'trend' of construction is but the declining phase of a long cycle.

Gradually, secular and cyclical forces change the face of the residential market. While the volume of construction has been declining, the trend of population in most cities has been rising; so that the condition of the rental market is bettered. New transportation facilities have become available, or old ones extended; so that residence in the suburbs has become more feasible. At the same time the technique of construction has been improving, and promising innovations in residential facilities have been mul-

tiplying. The prices of materials and of labor have, in all likelihood, fallen; and, what is of equal importance on the side of costs, the contractors now bidding for jobs are the more efficient builders who have survived the long depression in residential construction and they can command efficient labor. Finally, foreclosures and distress sales eventually turn downward. The gap between construction costs and comparable real-estate prices will therefore be narrowed, especially in the case of those types of dwellings that have won special favor. For a time, however, little money will be available for financing construction, lenders now tending to be as timorous as some eight or ten years ago they were venturesome.

Nevertheless, the volume of building will slowly rise. Of the many who have long postponed building a home, some will decide that it is not worth risking further hesitation. Some speculative builders, well equipped with capital, will build on a modest scale in anticipation of demand, devoting their resources primarily to houses of the sort that have lately gained most in esteem, but which are better, or more conspicuously, equipped. The revival in building may be one of the agencies that will usher in a revival in general business. Or, what is more likely, the revival in construction will reinforce the revival in other branches of industry, which occurred earlier and itself stimulated the improvement in construction; and it is only as readjustments spread from industry to industry that a general revival in business will get under way. But no matter what the sequence of factors may be, and whatever the role of the ever-disturbing random forces—from which we have abstracted completely in our brief and schematic description—a vigorous revival in business will sooner or later get under way. From this point the long construction cycle will repeat itself. It will not, of course, be a replica of its predecessor; but its general features will be the same and it will belong to the same class of economic movements.

The secular, cyclical, and random forces that combine to terminate the downward movement in the long construction cycle do not appear in exactly the same guise throughout the country. Hence the revival in construction is not synchronous in the various regions of the country, and some districts may entirely escape it. The timing of recessions is no more uniform than the timing of revivals. Only a moderate degree of synchronism in the long construction cycles of the various residential districts is to be expected, and just this is to be found. Since the differences among residential districts are less prominent than the similarities, we

can justifiably speak of a long cycle in national construction. But the differences among the districts cannot be set aside, especially if our view extends beyond urban areas. We must therefore revert to the question of the influence of immobility on the amplitude of fluctuations in the national construction of dwellings.

We have already suggested that immobility is one of the channels through which pecuniary forces breed errors and thereby help to bring about, as the case may be, a condition of overbuilding or underbuilding. This might be interpreted as creating a presumption that immobility serves to intensify the fluctuations in national construction, but it does not prove the point. Nor can an analysis of Groups I and II, along the lines earlier suggested, yield a strict proof in the case of a business economy. For, quite apart from the considerations that the unit is now the owner of a dwelling instead of a community and that the data on presumptive construction for Group II are psychic facts, we may no longer assume that the presumptive construction of the country is independent of immobility. Only rough methods and correspondingly uncertain results seem possible. For the period since 1920 we have annual estimates of the increases of the urban and farm population of the United States. If we accepted the increases in urban population as a rough index of Group I and the increases in national population as an index of the presumptive construction of the country, we would infer from their amplitudes that immobility has definitely served to increase the amplitude of national construction. This conclusion is plausible; but it rests on so many dubious assumptions that even the figures involved in the comparison are not worth presenting.