Volume Title: Long Swings in Urban Development

Volume Author/Editor: Manuel Gottlieb

Volume Publisher: NBER

Volume ISBN: 0-870-14226-7

Volume URL: http://www.nber.org/books/gott76-1

Publication Date: 1976

Chapter Title: Statistical Techniques and Procedures

Chapter Author: Manuel Gottlieb

Chapter URL: http://www.nber.org/chapters/c3785

Chapter pages in book: (p. 33 - 58)

CHAPTER 2

Statistical Techniques and Procedures

A. SURVEY EXPERIENCE LIMITED

Our study of local building cycles encompassed all urban areas for which suitable time series were available, with at least two full long cycles of building activity unaffected by major war or extended governmental intervention. As a result, the series were affected primarily by forces generated by private decisions made in open markets. For most of Europe, this meant closing the books of our research at or near to 1914; for the U.S., at 1939. This limitation should be explained.

The practice of other investigators has varied, depending partly upon the time of writing and upon whether European or American experience was central to the story. The earliest continental European students of long building cycles derived their generalizations almost exclusively from pre-1914 local experience. To interwar analysts the catastrophic effects of the prolonged war and its aftermath of inflation and other disturbance made very questionable the projection into the postwar period of a process which required a considerable time period and "normal" conditions to come to fruition. Aggravated inflation continued in many European areas long after major hostilities ceased and in some cases was only overcome late in the 1920's. Fixed exchange rates and their concomitant financial stability were maintained for only about six years before their breakdown in the Great Depression. Price controls on housing and corresponding programs for public housing persisted through the thirties. As late as 1938, one-quarter of the English stock of housing remained under rent control, and a high proportion of newly erected homes were constructed only with governmental assistance [167, p. 230; 28]. Governmental controls over housing and building activities were extended during the period of World War II.[1]

Brinley Thomas expressly predicated "swings" of the "old"

Atlantic economy, distinguished from a "new" Atlantic economy, "born of the nineties and come to fruition after the second World War" and destined to "evolve its own conditions of equilibrium" for which "past experience is not always a reliable guide" [245]. And speaking still more plainly, the most recent British investigator characterized the swing that closed in 1913 as "the last building cycle of our uncontrolled economy" and noted that the growth of control made the "economic climate" prevailing in the postwar years "far different from any that has existed before" [167, pp. 209 and 233].

This use of a categoric 1914 boundary line has been absent from the work of more recent American investigators, who have primarily reviewed American experience.[2] American experience did involve a lesser degree of dependence upon outside terms of trade or access to capital. In America, World War I impacted on the economy chiefly as a dynamic of inflation and as a stimulus to industrial development. In the American view, the Great Depression, though affected by the "dislocations" produced by World War I and its aftermath, took on the character of a downswing phase of an American building cycle and was otherwise more readily accommodated to our tradition of heightened cyclical instability, extended contractions, and more recent experience with financial crisis. It was easier for American analysis to include the twenties and thirties in the long-swing chronology and we have done so in this work.

It is a different matter, however, to presuppose that the long-swing process continued on through the next three decades and is still at work. Here we meet the judgment of "comparability" pointed up by Simon Kuznets in his monumental *Capital in the American Economy*. We would not, says Kuznets, put in one time series trends of gross national products of American society in the sixteenth and nineteenth centuries because of our judgment "that the size, technological levels, social institutions, and international relations of the sixteenth century Indian society were vastly different from those of the United States economy during the last century and the latter cannot therefore be regarded as a continuation or later expression of the forces that molded the former." It was deemed proper to treat as a single period for study the stretch of years between the 1870's and the 1950's. There are many likenesses ranging from the political parties to political constitutions and there may be many differ-

ences "ranging from the income tax to the H-bomb." The judgment is then "necessarily a matter of weighing the likenesses against the differences." This judgment must be made in relation to the purposes of inquiry, which for Kuznets concentrated upon characteristics of "underlying trend" and not the "long swings" which merely complicated "both our statistical analysis and our explanatory task." Given these purposes, Kuznets made the determination "that the balance is in favor of treating the 1870's and the 1950's in this country as belonging to the same historical epoch" [161, pp. 39 f., 200].

On the basis of similar reasoning but altered purposes, Moses Abramovitz in his main work on long swings made the same determination, assuming that the characteristics of long swings, and not their underlying trends, were common to both the 1870's and the 1950's. Abramovitz was prepared to recognize that many modifications in economic institutions and patterning—the subsidence of railway construction once so unruly, the emergence of public construction geared to nonmarket forces, the shift to owner-occupied construction carried on by merchant builders, altered conditions of finance, a much restrained elasticity of population growth, a restricted role of construction in aggregate construction expenditure, and altered susceptibility to deep depression—indicate that the whole interplay between construction and the rest of economic activity is altered "in ways we cannot now clearly see." Notwithstanding, Abramovitz concluded that the causes of long swings may be more deeply embedded "than we realize, causing the phenomenon to persist, even if in somewhat modified form, through many apparently radical alterations in our economic arrangements" [1, pp. 8f., 133–136]. For these reasons, presumably, Abramovitz added the three decades after 1933 to his stock of long-swing experience. Easterlin, who has followed Abramovitz in this decision, attempts to show that the essential features of long-swing analysis hold for the 1960's as much as for the 1860's. His book is an extended argument for the "similarities" between "recent and longer term experience" [78]. This same search for "similarities" dominated the discussion at the 1964 Christmas session of the American Economics Association, responding to the query, "The Postwar Retardation: Another Long Swing in the Rate of Growth?" Only much later has Abramovitz put a different interpretation on contemporary experience and in a

cogently argued paper testified to the "passing of the Kuznets Cycle" from this experience.[3]

The similarities grow in part out of the basic fact that any slowdown in rate of growth, induced either by extended depression or short bursts of connected recessions, will in turn result in higher incidence of mass unemployment, which, since it is concentrated among the young, will in turn affect fertility and nuptiality and labor force participation rates. Easterlin has carefully traced the effects of a slowdown upon these demographic phenomena, which have persisted long enough to influence the character of American population projections for coming decades.

Similarities in "effect," however, are not at issue; concern rather is felt over similarity in causation. Was the slowdown in building and investment expenditure and the interplay between construction and over-all economic activity induced by the same process at work in previous long swings? Can it be seriously contended that the period of building expansion which took off in 1933 and was resumed after World War II lapsed into a period of slowdown in the later fifties and early sixties *for reasons which are comparable to those which played a role in earlier long-swing decline periods?* The very length of this period and the peculiar combination of forces which provided its driving power, the role of war and the institutional transformation which war spearheaded, the wholly altered international setting with world devastation set plumb in the middle of this "expansion period," all this and more argue against putting old labels on new facts.

And, if we turn to the contraction period or "slowdown" which set in during the middle 1950's, the unfitness of the old labels or formulas to illuminate the processes at work is obvious.

On balance our judgment—reached early in the sixties—held that the feedback process between construction and the total economy and between residential building and real estate markets had altered in so many fundamental respects that, given our purpose of isolating and illuminating this feedback process, it seemed worthwhile to drop out of review the thirty years after the Great Depression trough (1933) and thus put our American data on the same basis as data from other areas. It is conceded that we could have processed additional time series and have shown these alongside our series. The later series could have

been excluded from the calculation of "average patterns." We did not wish, however, to complicate our presentation without at the same time being in a position to clarify its meaning and to evaluate its results. Because this was not possible, it seemed better to make that analysis when the period now in process can be reviewed with greater perspective. This does not exclude consideration of some aspects of recent American experience in a suitable context. We have, for example, compared the relation of recent American vacancy experience and residential building with earlier patterns. But we have excluded recent experience of processes which have in past periods connected up development booms, investment surging, and urban growth. This act of judgment is provisional and may at a later time be modified.

B. SURVEYED SERIES

Some thirty-one urban areas or closely related groups of areas with long-term building time series were available for study in Europe, Australia, and North America. In addition, we analyzed five American cities, for which only deed or lot development activity was available.

The thirty-one urban areas are distributed as follows:

Australia (2)	Melbourne (Victoria), Sydney (New South Wales)
North America (12)	Chicago, Cincinnati, Cleveland, Detroit, Manhattan (New York), Montreal, Ohio sample groups I, II, III, IV, V, St. Louis
Great Britain (11)	Birmingham, Bradford, Exeter, Glasgow, Hull, Liverpool, London, Manchester, Newport, South Wales, Swindon
Germany (3)	Berlin, Bremen, Hamburg
Other Europe (3)	Amsterdam, Paris, Stockholm

For eleven of the surveyed urban areas, only information on building activity was available. For nineteen of the areas, matching series were available for long time periods covering three or more phases of real estate market activity or building determinants. These areas, and the series covered by each, are shown in Table 2-1. The greatest detail on determinants of building activity for European cities is found in Berlin; of

TABLE 2-1
Local Time Series, Thirty Areas, by Activity

	Period	*No. of Series*	*Activity Covered by Time Series*															
			Residential Building	*Total Building*	*Nonresidential Building*	*Marriage*	*Population or Migration*	*Mortgage Lending*	*Lot Development*	*Selling Price Improved Realty*	*Building Costs*	*Volume of Real Estate Activity*	*Vacancy Rates*	*Rental Prices*	*Foreclosures*	*Street Construction*	*Other*
Manhattan	1868–1940	9	x	x	x					x	x			x		x	x[a]
Chicago	1835–1931	8		x		x	x		x			x		x		x	x[b]
St. Louis	1890–1933	6	x	x									x	x	x		
Detroit	1830–1944	2		x					x								
Ohio-Cincinnati[c]	1857–1920	4	x	x		x		x									
Ohio-Cleveland[c]	1857–1920	7	x	x		x		x	x	x							
Ohio-Sample II	1857–1920	17	x	x	x	x		x	x	x		x					

Ohio-Sample III	1857–1920	17	x	x	x	x		x	x	x		x					
.Ohio-Sample IV	1857–1920	17	x	x	x	x		x	x	x		x					
Ohio-Sample V	1857–1920	17	x	x	x	x		x	x	x		x					
Montreal	1867–1914	1		x													
London	1856–1914	3	x								x		x				
Glasgow	1864–1914	6	x		x	x					x		x			x	
9 English Cities	varied	9	x														
Berlin	1840–1910	7	x				x	x		x			x	x	x		
Bremen	1855–1914	1	x														
Hamburg	1875–1913	5	x		x								x	x			
Paris	1833–1914	5		x		x				x			x				
Stockholm	1867–1948	4	x			x							x				
Amsterdam	1870–1935	3	x		x		x										
New South Wales	1861–1900	4	x	x							x						
Victoria	1861–1941	3		x							x						
Number of series of each type:		155	25	14	8	10	3	7	7	8	5	7	7	5	2	3	2

[a] Mortgage-yield differential.
[b] Manufacturing.
[c] Not shown when grouped together as Ohio-Sample I.

American urban areas, Chicago and Manhattan are liberally served with comparable measures.

A comprehensive set of measures for the State of Ohio was discovered and studied. The counties containing two of the larger cities of the state—Cleveland and Cincinnati—were analyzed individually and are so represented in Table 2-1. Eight additional counties out of the eighty-five available were selected for detailed study as moderately urbanized counties with central cities exceeding 24,000 in population by 1900. Returns for these ten counties were tabulated in three subgroups: large metropolitan, containing Cleveland and Cincinnati (sample group I); large urban, containing three major urban areas (sample group II); and small urban, containing five smaller urban centers (sample group III).

Ten additional counties selected for detailed scrutiny were combined in two groups of five counties each. One group with some industrial development was drawn from the southeastern part of the state along the Ohio River. These counties have a modest degree of urbanization, with city size classes by 1900 under 24,000 persons. The other group was drawn from rural counties of northwestern Ohio, with no city in 1900 over 10,000 persons. These two sample groups together with the three mentioned above thus represent areas spanning the spectrum of urbanization, industry, and city size. A detailed report on the makeup of the Ohio group samples and procedures used is provided in Appendix C.

C. SELECTING SPECIFIC CHRONOLOGIES

Time series for the local communities under survey can tell their story of long swings only if these long swings can be accurately identified and measured.

To this end, our first objective was to select chronologies, that is, sequences of dates corresponding to our best judgment of peaks and troughs or turning points for both short and long cyclical movements [41]. Our short-cycle chronologies were selected mechanically, by counting every reversal of direction as a specific turning point. These chronologies were used chiefly as a means of smoothing the time series by eliminating the influence of overt short cyclical and irregular influences. Out of the smoothed series, measures for average annual rate of growth

were computed from cycle to cycle or phase to phase, as well as averages of these rates which approximate satisfactorily to a long-term secular growth rate of an underlying trend value.

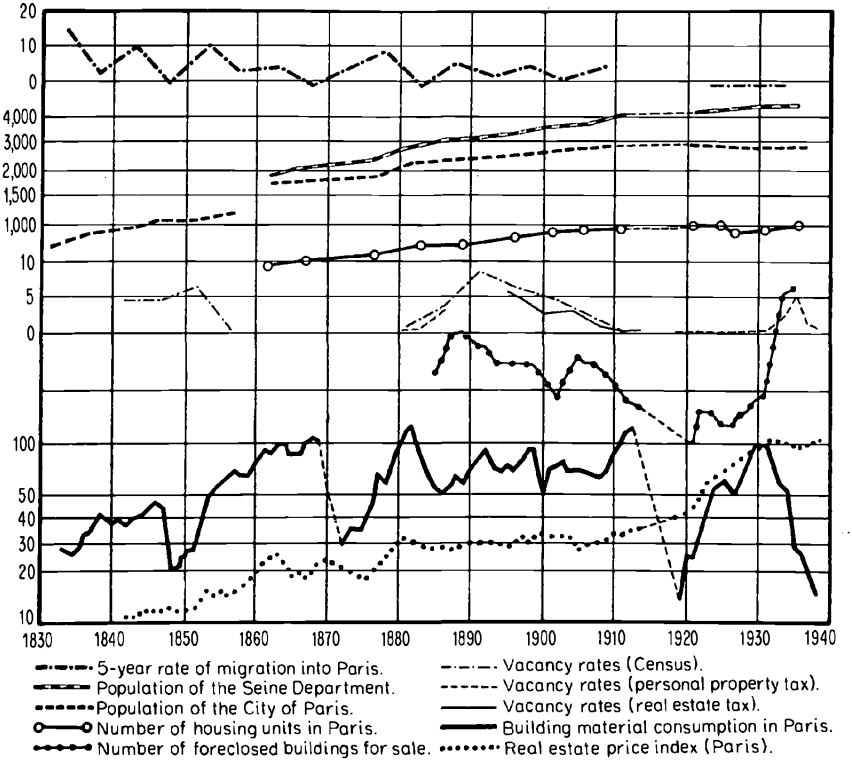
Our procedure for long-term chronologies was formally similar but substantively more difficult. Series were graphed in their annual values or, if the data were very irregular, with a three- or five-year moving average. By inspection, selection was then made of turning points in the quest for recognition of periods of sustained contraction. Since virtually all of the series exhibited secular growth, processes of expansion did not require special identification. A period of sustained contraction was recognized, if it extended, with a few exceptions, for three or more years of continuous or intermittent decline, making up in depth for narrowness of breadth. For series with a steady upward trend but with little movement around trend, a clear-cut shift in trend of growth was recognized as a turning point. Most turning points involved reversals of clear-cut movements in the original data. Hence, though our methods, like those of Burns and Mitchell, "make no pretensions to elegance" [41, p. 64], we feel the results are trustworthy. The patterns of cycle behavior will give their own evidence of this, for short and shallow long-swing contractions appear dubious when depicted in the form of a cycle pattern.

While most of our series possessed very plausible turning points, this was not true of all. For thirty-seven of them—nearly all of which were in Ohio—no specific cycles could be traced. These series measured sluggish activities, such as marriages, number of deeds, or relationships not systematically affected by long movements. In a few cases, specialized types of building for schools or public purposes responded to no distinctive specific long-wave pattern.

The work of judgment in the selection of turning points was troublesome in the case of our four Paris series. Market forces were paramount, but the stress of the past and storms of the future marked out their own chronology on the building and real estate life of that city. This is rather clearly indicated in Chart 2-1, which reproduces the various time series of building real estate and demographic activity in Paris. Comparison of the behavior of the building series, represented by building materials utilized, with other more direct measures of building available for certain decades indicates close and dependable covariation.

CHART 2-1

Real Estate, Building, and Other Activity, Paris, France, 1834–1939



Building activity until the 1870's exhibited a strong upward trend punctuated by sharp two-year declines around 1848 and 1870. These declines attest to the bursts of street fighting and political commotion which have made those years red-letter dates in French political history. The second drop in building associated with the Paris Commune in 1870 was sharper, corresponding to the greater intensity and more prolonged character of the political struggle during that year. World War I understandably left an even greater imprint on annual aggregates of building, partly because its effects were cumulative.

However, between 1870 and 1914 the rhythm of long swings is apparent. The long wave of 1870–86 was marked, and that of 1886–1908 is observable. And even if the contraction phases of 1848 and 1870 are excluded, a plausible average cyclical pattern emerges. There are many indications that the resulting pattern of long-wave movement (excluding the declines of 1848 and 1870)

may be traced during the earlier swings. Thus the two real estate price series reached clear peaks not in 1870 but in 1863 and in 1867.

These peaks marked the culmination of a classical building boom, reflecting in part the release of economic energies and the adventure in creative real estate finance for which the second Napoleonic Empire was distinguished.[4] The standard NBER reference cycle chronology for France follows conventional business cycle history in dating annual peaks at 1847 and 1869.[5]

We concluded that building and real estate activity in Paris exhibited clear-cut long waves which were sometimes reinforced and sometimes disturbed by political events.

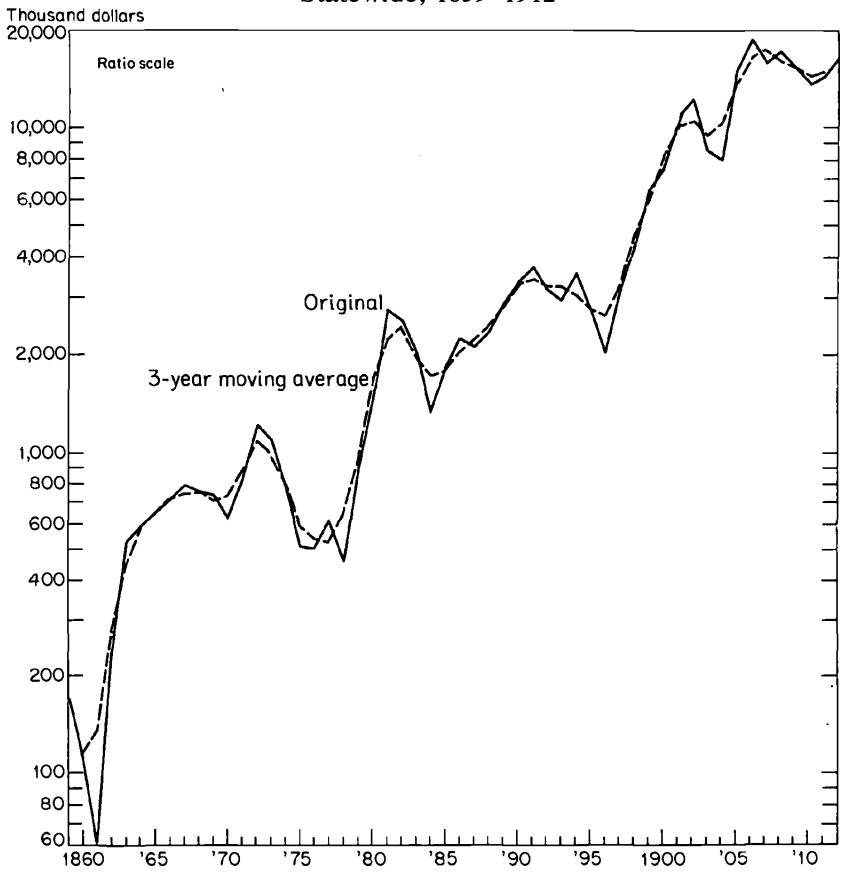
The Ohio series on industrial building was also difficult to accommodate to long-wave chronology. Chart 2-2 shows Ohio industrial building in three-year moving averages. The annual data exhibit a conventional short-cycle movement with tendencies to a clear-cut decennial (major or Juglar) movement. The smoothed series exhibits this major decennial rhythm with peaks in the early 1880's, 1890's, and 1900's. The prominent character of this rhythm indicates the close connection of industrial building with industrial investment generally, and the correspondingly close connection of both with business cycles.

Using contracts data on industrial building for later years, Arthur Burns noted that "the enormous cyclical amplitudes and high degree of conformity of each series on industrial contracts, together with the close similarity in timing between the specific cycles in total industrial contracts and business cycles, indicate that industrial building has exceptionally strong causal ties with business cycles—more so than any other branch of building" [39, p. 57]. Accordingly, we marked out a set of conventional short-cycle and long-cycle chronologies which result in the unusually short duration for long cycles of eight years (on a statewide basis) and somewhat longer for the sample groups (mean: eleven years).

D. REFERENCE CHRONOLOGIES

Analysis of our time series by their specific chronologies yields measurements showing the distinctive characteristics of wave movements for each of the series. In the terminology of the National Bureau, these characteristics are "specific" to a par-

CHART 2-2
Industrial Building, Ohio, Annually and 3-Year Moving Averages, Statewide, 1859–1912



ticular series. Our interests, however, go beyond knowledge about such characteristics. We also want to know how the various activities in a given area relate to each other and to any more diffused patterns of movement. Specific cycles in each series could have been related to each other, but when the analysis covers hundreds of series, as Burns and Mitchell noted, "It is clumsy and wasteful to compare the timing of each series with every other." Much clearer results "can be attained by adopting some common denominator, i.e., by setting up a reference scale on which every series can be laid out in a strictly uniform fashion" [41, p. 70].

The search for a common denominator or reference chronology clearly pointed to residential building, which has, at least in

terms of volume, outweighed other kinds of building. For the United States and for England, residential building ran to between 49 and 65 per cent of total building, and between 21 and 56 per cent of total construction (see Table 2-2). A substantial part of nonresidential building is of a complementary type (shops, offices, utility connections, places of worship or play). It has been estimated that the volume of such complementary building in recent years is about 75 per cent of the volume of residential building [185, pp. 465–473]. Most of the major influences at work in building cycles relate directly to residential markets. Mortgage markets chiefly apply to residential building; the used market in realty is most active with regard to residential properties.

It is recognized, however, that there is variation in the relative importance of the activities that shape the course of building

TABLE 2-2
Residential Building as Per Cent of Total Building or Total Construction[a]

		Residential Building as Per Cent of:	
Country	*Years*	*Total Building*	*Total Construction*
U.S.	1850–1910	49.0	
	1910–1940	53.8	
Italy	1870–1898		46.6
	1898–1918		56.1
Australia	1861–1895		31.5
	1895–1918		21.3
	1918–1932		21.6
Canada	1901–1910		32.6
	1911–1920		30.1
	1920–1930		33.4
Sweden	1925–1930		42.9
England	1907	62.9[b]	35.9[c]

SOURCE: U.S. [110]; Italy [143, pp. 266–267]; Australia [44, pp. 391, 397, 403]; Canada [35, p. 38]; Sweden [171, pp. 177, 237]; England [46, p. 110].

[a] The specification of "construction" as contrasted with "building" varies with different sources, but generally "construction" series include all building plus road building, canal and railroad building, and related types of heavy construction.

[b] New residential construction to new building.

[c] New residential construction to total new construction.

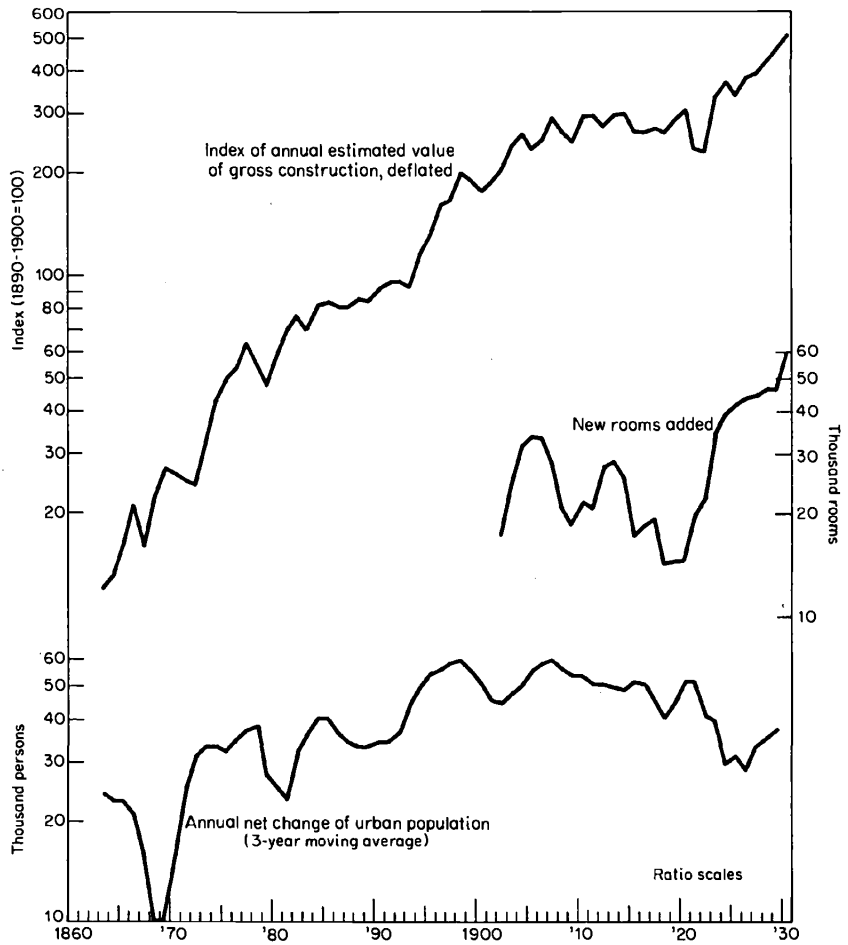
cycles—rents, land value, development, vacancies, cost of building, real estate market. Nonresidential building occasionally becomes dominant, as during 1917–19, so that real estate markets for such periods are quite poorly measured by residential building alone. But these times have been exceptional and allowance may readily be made for them. The relationship of residential to total building has varied within a narrow range over long periods; and the role of rental markets in real estate market behavior has been surprisingly uniform. There are obvious advantages to settling on a reference scale that can be objectively determined and easily measured. Hence, in this work "reference" chronologies for analysis of interrelated long swings of different time series were obtained, with few exceptions, from the chronology of turning points of residential building.

In each region or area specific chronologies for residential building were matched to other types of building, real estate market, or demographic activity. Local residential building series were in turn analyzed against the national reference chronology, fixed in relation to turns in aggregate residential building, thus yielding a measure of synchronization of local cycles with each other. For some American series of building material prices and costs, a reference chronology related to turns in aggregate construction was used. This chronology was developed in the work paralleling our own by Moses Abramovitz.[6]

We were not able to compose a satisfactory reference chronology for Sweden, for reasons that are worth noting. In Chart 2-3 available measures of construction, building, and related activities are presented for Sweden. Gross deflated construction exhibits no clear long-wave pattern though smoothed first differences or annual rates of change would show a low in 1896, a peak around 1912, a trough around 1922, and a peak in 1930. Residential building could be read to show a peak in 1905–6, a trough in 1918–20, and a peak in 1930. Alternatively, we could find three major movements in 1900–1909, 1909–20 and 1920 on. Information before 1900 was unreliable except for urban population change. A three-year moving average of increments in town population exhibits clear-cut major cycles of a mean duration of nine years, with an overlapping longer pattern (peaks in 1884 and 1915) averaging 27.5 years. The composite of village added to town increments changes the pattern somewhat.

CHART 2-3

New Rooms Added, Gross Value Total Construction Deflated and Annual Increments, Urban Population, Sweden, 1863–1930



The major cycle is thinned out after 1904 and the longer-wave pattern has nearly disappeared. At best, a whole spectrum of vaguely outlined long swings including a suggestion of a long sixty-year movement from 1870 to 1930 is indicated, none of it however very readily apparent or solidly established.[7]

E. LONG-SWING PATTERNS

Selection of long-swing chronologies was only the first step in a procedure designed to achieve the statistical isolation, mea-

surement, and representation of long swings. The chronologies establish the *duration* of long swings and the *proportion of expansion to contraction* but little else. We knew that long-term secular trends were at work in our series along with short-term fluctuations of the business cycle. These would weave an irregular course during long-swing movements, which would tend to be tilted upward by secular growth trends.

The isolation of cyclical components from time series, or time series decomposition, is a field of professional expertise cultivated in the 1920's when statistical business-cycle analysis became practically a specialized field.[8] Adjustment for trend has been called the "fundamental logical problem of time series decomposition" [94, p. 8]. Debates over trend adjustment and its effect on cyclical measures have long divided cycle practitioners into two basic camps: those who do and those who don't. Those "who do" take the trends out of the time series by many means ranging from fixed term moving averages, freehand drawing, imposition of mathematical equations devised to achieve a close "fit," conversion to smoothed link relatives or to percentage rates of change for overlapping periods. Common to all methods of trend elimination is the presupposition that the force of growth is separate from fluctuation and that the economic system tends to grow by a smooth, continuous movement and then to oscillate around that movement.[9] In all these ways upward trend is converted into a level plane around which cyclical fluctuations occur.

Conversely, the school "that doesn't," believes with Schumpeter that economic development has a mixed dynamic of *creation* and innovation, and that "evolution is essentially a process which moves in cycles," so that the trend "is nothing but the result of the cyclical process or a property of it . . ." [229, I, p. 206]. Those who accept this in itself unprovable hypothesis necessarily oppose trend elimination from cyclical contours so that these contours can "reproduce *the form of development* common to the industrial activities of nations whose economic life has been organized on a business basis."[10] To this fundamental objection in principle there is joined a lesser objection arising from the distorting effects of trend adjustment on measures of cyclical behavior, causing cycles to be multiplied or reduced in number and modified in form, amplitude, and timing.

Neither the case for or against trend elimination can be proven in any conclusive way. Each investigator must reach his own judgment as to whether the advantages of trend elimination—by way of facilitating a more clear depiction of the long-swing process in hazy or borderline cases—is worth the cost in distortion of cyclical measures and its tendency to obscure the idea that the trend itself is affected by the surging movements of long swings. My judgment follows that of Schumpeter, and Burns and Mitchell; and that is why in this work we do not follow the lead of Kuznets, Abramovitz, and Easterlin in using and relying upon trend-adjusted measures for generalized representation of and analysis of long swings. This judgment need not rule out trend adjustment in all instances, and some use of it will be found in this volume.[11]

This decision to include, as a general rule, the effects of trend growth on long-swing contours leaves unresolved a related question: how to separate from the long-swing contours the influence of short-term cyclical fluctuations. The need for such adjustment grows out of the fact that during most long building swings many complete business fluctuations will have run an irregular course. These fluctuations tend to obscure the slower long-swing rhythms, hampering visual comparison of many long swings with each other. Without some form of purification of long swings from these shorter fluctuations, we will have trouble identifying the very phenomenon we hope to explain.

To achieve this purification, two major types of adjusting methods have been practiced. The first, and most popular, involves a fixed-term moving average, a form of which, contrived by Simon Kuznets, involves a five-year moving average or aggregate reduced to a link relative over a ten-year span.[12]

A second type, designed by Moses Abramovitz, involves use of a chronology of peaks and troughs representing turning points of national business cycles ranging up to ten years, with an average period of about four years. Average annual values centered for the cycle period are entered on an overlapping basis, peak to peak and trough to trough. The resulting figures "may be regarded as approximations to series from which the influence of business cycles of ordinary duration and amplitude have been eliminated" [1, p. 22]. For most reference periods this scheme of adjustment would smooth out the larger portion of short cyclical fluctuation. But some phases of national business

cycles involving prolonged and severe contractions, such as occurred in 1873–79 and 1929–33, overlap with phases of a long-swing movement. These severe contractions embody a coalescence of the two movements or a single movement with multiple impulses or determinants. Application of the national reference schema with their prolonged contraction periods to such phases tends to dampen the amplitude of those particular long swings unduly and thus tends to give to long-swing patterns an undeserved and misleading kind of homogeneity.

The fact that long-swing and cycle movements may coalesce—and always do to some extent—suggests use of a smoothing technique which minimizes transformation of data and which is designed to avoid alteration of the shape and character of the long swings of recorded experience. We should remember that a good deal of smoothing is indirectly accomplished because much of our statistical information comes to us in the form of annual figures. Annual summation alone, in comparison with quarterly or monthly data, effects a significant degree of smoothing, which, as Burns and Mitchell showed, "hides many of the cycles revealed by monthly data, sometimes introduces spurious cycles and influences the amplitude, pattern, and other features of all cyclical movements" [41, p. 204]. The harmful effects of this smoothing are, perhaps, reduced for measures of simple construction work, which involves a concentration of "new starts" in early spring months and "completions" in fall or early winter. But many of our other activities—migration, marriage, buying a home, buying land, entering a mortgage loan—are spread out over the year and are significantly smoothed by yearly aggregation.

Because of the significant degree of smoothing already incorporated into our data, it was decided to use the mildest of the existing smoothing schemes devised for cyclical analysis. This scheme is that developed by the National Bureau of Economic Research for allocation of the stretch of experience between long-swing peaks and troughs into three segments of about equal length. Smoothing is effected by computation of a simple annual average for the segment, centered as a segment or stage "standing." A long-swing expansion phase of twelve years would involve two segments of three and one segment of four years duration, for each of which a smoothed (average) annual "standing" would be prepared. A typical contraction phase would also

be allocated into thirds, each of which would rarely extend over two years. As phase periods shorten, smoothing thus becomes reduced. But even for long phase periods *the effect of smoothing is basically felt only within a segment of experience*. Disturbance in a segment is not "spread" over behavior patterns for a broader period. A tendency for expansion or contraction to become accelerated or retarded will show up faithfully in the segment of experience where the tendency was felt. Experimentation with this form of smoothing, when extended over a finer set of intervals, showed little or no gain in fidelity of representation, though it is conceded that a certain tendency toward "angularity" for the nine-stage cycle pattern may result if peak or trough values are specially exaggerated [41, pp. 144–160].

Nine-stage annual standings were thus computed for the three turning point years and for the six intervening "cycle stages," yielding a smoothed contour line of a long swing.

Can these long swings thus purified of cyclical disturbance be detached from their time series progression, i.e., from the context of development and succession, and be grouped together, with similar long swings occurring earlier or later *or elsewhere* and transformed into some *average type* or *representative long swing*? Are the bonds of historical context so weak and is the homogeneity of process so great as to legitimize this procedure? Opinion differs here too, and most long-swing investigators are loath to take this final step, which cuts the umbilical cord between the long swing and its historical context. Swings have been presented chiefly in their time series connection, or as isolated historical experiences, but not as a generalized process.

We took this step, designed to make possible the preparation of some average or representative long-swing pattern, partly because cogent grounds could be given for believing that the process of long-swing fluctuation in urban development—and it is this phase of long-swing fluctuations which is here under review—was even more homogeneous than are the fluctuations in building activity associated with business cycles, and hence is possibly more suitably treated by the smoothing and averaging process which is now contemplated. Burns found evidence (see Table 2-3) that, so far as amplitude and duration were concerned, long cycles in American building activity were more homogeneous than the short ones associated with business

TABLE 2-3
Coefficients of Variation for Duration and Amplitude, Specific Full Cycles, Long and Short, Selected American Series, 1878–1933

	Coefficients of Variation for Full Cycles			
	Duration		*Amplitude*	
Area	*Long*	*Short*	*Long*	*Short*
Per capita permits, "All Cities"	13	48	31	64
Adjusted indexes of permits, "All Cities"	13	48	26	42
New England cities	41	36	16	47
Middle Atlantic cities	13	36	26	47
South Atlantic cities	11	43	17	36
East North Central cities	13	35	13	29
West North Central cities	16	34	11	45
South Central cities	12	32	31	45
Western cities	15	37	11	40
Total or new building permits				
Manhattan	19	36	24	62
Brooklyn	15	48	22	33
Chicago	11	41	21	42
Detroit	35	44	59	51
St. Louis	13	30	10	42
Subdivision activity				
Chicago	17	57	11	37
Pittsburgh area	16	33	18	21

SOURCE: Burns [39, Table 20].

cycles, as attested to by lower coefficients of variation. The forms of behavior assumed by the real estate market over the years of our survey, which exclude the period when governmental controls over residential building or housing markets were predominant, were in all probability widely diffused among the growing cities in North America, England, France, and Sweden. The distinction between owner-occupancy and rental submarkets, the relatively slow response of housing supply to changes in demand, the tendency of ultimate site values to appreciate,

the dependence of house buying on long-term mortgage finance, the immobility of structures, the uncertainty in forecasting future market conditions, the psychology of land speculation, the sticky behavior of rents and building costs, the recruiting of a labor force from young migrants enticed from villages and farms—all these were structural features of urban market behavior, whether located in the new or the old world, or in the later eighteenth, nineteenth, and early twentieth centuries.

The requirement of homogeneity to give meaning to our statistical procedure does not specify complete uniformity in structure or process. Differences among cycle patterns or duration and amplitude show up in the measures of dispersion or in the individual cycle patterns themselves. Analysis can differentiate as well as reconcile. Such analysis is only valid if reasonable homogeneity is assumed, and this assumption is itself a hypothesis to be explored in our investigation.

On this working assumption of homogeneity, for each analyzed time series an average cycle pattern was computed *by averaging* the cycle relatives for the stage standing and the length of the interval between the stages. The sense of growth through *successive* swings has been eliminated in this measure, but *process of development or growth occurring during swings* has been retained in the relatively prolonged expansion and upward tilt of the cycle pattern. Where the form of movement of the individual cycles has been markedly discrepant, an average cycle pattern is always presented in this work, together with measures of deviation or the component patterns themselves.

Average patterns have been prepared, with few exceptions, only for a given area or region. With only one exception, we have not gone beyond this, because our surveyed areas were geographically scattered and were subjected to different environmental influences. The averaging of consecutive swings for a given area, but not between areas, implies belief that continuity within a community or area is greater than comparability with other communities. This belief is, of course, only a hypothesis to be supported or rejected according to the evidence.

These "average" patterns, as indicated earlier, take two forms: specific and reference. A specific pattern is one for which the peaks and troughs are those of a given series; a reference pattern uses a chronology of peaks and troughs which is usually that of residential building in the same area or, for a local

residential building series, residential building for the region in which the area is located, and with which, presumably, it is integrated. Comparison between specific and reference cycle patterns throws light on the degree and nature of conformity of fluctuations in the surveyed activity to parallel fluctuations in residential building proper. Comparison between specific and reference patterns for residential building activity throws light on the degree and nature of local conformity in building fluctuation to the course of fluctuation in the larger region.

Comparison of cycle patterns for different activities in the same area throws light on the different degrees of their participation in long-swing fluctuations and the rhythm of that participation. All of these graphic comparisons are facilitated by uniform scaling of graphs in terms of cycle duration, usually represented in months to and from a peak (in the case of a trough-to-trough version of a "positive" cycle) or from a trough (in the case of a peak-to-peak version of an "inverted" cycle). With duration measured on the horizontal axis, cycle amplitude is represented on the vertical axis in the form of index relatives of cycle standings around a "cycle base" represented by the standing of one hundred. One per cent on the amplitude scale thus equals one month of cycle duration, so that on all charts, unless otherwise noted, a slope of 45 degrees represents a change at the monthly rate of 1 per cent per month or a doubling of the level of value over approximately eight years.

Successive cycle patterns for each series on a specific and reference base have been graphed and, where helpful, these graphs are introduced into the chapters following. Average patterns for each series have been grouped together in two different ways: (a) relating the same or similar activities in *different* areas, or (b) relating *different activities* in a *given area.* The activity patterns in different areas are shown in the chapters to follow, when the particular activity is described and analyzed. The area profiles—collections of average patterns for an area—were consulted in the analysis wherever the reference was appropriate, but in the main these area profiles are unpublished.

These cycle pattern charts, of course, speak a special language best understood after training or experience with them. Readers for whom this language is obscure or unfamiliar are advised to read over the relevant chapters of the standard monograph on cyclical patterns [41] or a later summary presentation by Mitchell

[193]. As Mitchell observed when he introduced a corresponding collection of cycle patterns, "the nature of the activities represented and thinking of reasons why these activities differ from or resemble one another in cyclical behavior, should make up an 'interesting' exercise and should whet the appetite for the analytic chapters to follow" [193, p. 31].

F. OTHER MEASURES

The statistical measures of long swings are not exhausted with preparation of graphic cycle patterns. The strength of the graphic presentation is its suggestion of influences too subtle to show up in simple numerical measurements. But these influences need an undergirding of fact reduced to appropriate measures of dispersion, amplitude, secular change, duration, and timing. From the original series or the cycle patterns these were all computed and are presented in later chapters when the activities concerned are reviewed. Only with regard to measures of timing or determination of lead and lag were special difficulties encountered; accordingly, a variety of timing measures was used. One method resorts to a simple comparison of the difference, if any, between corresponding turns of matching reference and specific chronologies. We would thus relate reference turns in residential building in Chicago with the corresponding turns in a Chicago marriage or real estate activity series. But a bias in locating either set of turning points will affect the result unduly, since comparatively few turning points are available even in very long time series. The other standard method measures timing of characteristic lead or lag by behavior of reference series with leads or lags calculated in "stages" of a cycle. These "stage" leads and lags may be converted into years by use of measures of average cycle stage duration. We found that in building activity, reference cycle patterns come out with somewhat longer lags (of two or more months) than were exhibited by direct comparison of turning points. With nonbuilding series the position of the two measures was reversed. A good deal of variation was indicated in particular cases.

In view of this divergence, a third measure of lead-lag was utilized by use of correlation analysis. If the reference and the specific time series, smoothed of short cyclical fluctuations by a moving average, are correlated with a variety of leads and lags

serially arranged, the resulting series of correlation coefficients graphically laid out in a "correlogram" will exhibit timing characteristics of the correlated series. A formula was devised by which the schedule of correlation coefficients could be corrected for secular trend running through the correlated series. The correlogram takes account of all paired experience, including stretches of years that run beyond our initial and terminal turning points. The form of movement and level of the correlogram will indicate the closeness of the association and affords another measure of duration. A full study of the results of the three methods is provided in Appendix F. We concluded that an unambiguous and correct measure of lead and lag is not to be had with any available measure, and that various techniques were to be considered and utilized in the light of the particular circumstances.

NOTES

1. For a general survey see [285].

2. Insularity arises from a tendency to regard the American economy as essentially self-contained and as the primary generator of long-swing rhythms. See [78, Ch. 2; 289, pp. 205, 215 f.].

3. ". . . the specific set of relations and response mechanisms which were characteristic of pre-1914 'long swings' in growth are unlikely to be characteristic of future long swings" [3, p. 350]. The relations and mechanisms only in part overlap with those stressed in this work and presuppose a far-reaching set of empirical findings regarding the phasing of rates of growth of employment, labor force, capital formation, and demand for output. There is also presupposed "as a general rule and in a rough way" an inversion of "European" and "American" waves of industrial growth (p. 354). Brinley Thomas who spawned the inversion hypothesis for the pre-1914 period applied it only to the United Kingdom and a limited set of "overseas developing countries" (U.S., Canada, Argentina, Australia), a contention he has sought to reaffirm in the light of recent research [246, Ch. 4]. Application of the inversion concept to Europe "as a whole" runs into difficulties in the light of our empirical findings as set forth in Chapters 7 and 8 below. With arguments more closely related to those developed here, Homer Hoyt argued that "a fundamental change in the structure of our national economy" has mitigated the severity or eliminated both major business cycles and also "major real estate cycles" [135, p. 7].

4. An immense program of public works which pivoted on the creation of a new network of Paris boulevards reached a clear-cut peak in 1866. "The number of expropriations for public works, which reached a peak of more than 800 in 1866, fell to 8 in 1870" [211, p. 61]. For a broad sketch of this boom in its larger aspects, see [48].

5. [41, p. 78 ff.]. On the 1847 peak and for a treatment of its French origins and greater severity, see [74, pp. 81 ff. 366 ff.]. and [163]. These studies go a long way to confirm the contemporary observations of Marx regarding the sharpness of the conjunctural movement of 1846–47 and its political consequences.

6. See Table 1-1, note *a*.

7. For a contrary interpretation of this data, see [287, pp. 17–38].

8. A very useful and judicious summary of this literature through the middle twenties was presented by Wesley Clair Mitchell [192, Ch. 3]. For a recent summary by a participant in the early debate, see Oscar Lange [164, pp. 19–65]. For a comprehensive early survey, see Altschul [7, pp. 60–90] and a monograph supervised by Altschul [215].

9. "Trend adjustment," declared Joseph Schumpeter, in [229, Vol. I, p. 203], assumes that "our material reflects, as a matter of economic fact, first a smooth and a steady movement, and second fluctuations around it which are due to random shocks or disturbances that behave as if they were random shocks . . . this implies a definite theory of economic evolution . . . the Marshall-Moore theory of organic growth" (see the entire Chapter 5, "Time Series and Their Growth"). This concept of organic growth has been given concrete form by Simon Kuznets, who has in a recent work recognized "that forces that mold and determine the long-term trend resist, as it were, any counterforces that tend to alter the trend" [161, p. 44]. This "resistance" of the trend follows from a supposed tendency to negative correlation of disturbances. "If by some accident, the output of a commodity rises steeply above its secular level, we would expect . . . a relative decline in prices of that commodity," a subsequent fall in output in response to the price decline, "and offsetting of the original 'disturbance' " [161, p. 363]. Kuznets applies this familiar logic of "partial equilibrium" to aggregate output and demand so that a "severe depression" is thus bound to be offset by a "strong expansion" with a kind of "negative serial correlation" or a "cancelling reaction" [161, pp. 365, 424]. His argument is the more startling since the long swings are in good measure grounded on swings in overseas immigration which can by no means be regarded as a *predestined quantity*, especially since the *direction of emigration* between *countries* or *areas* of settlement is surely open to modification and for most rural Europeans seeking to move there was a plausible choice between movement to growing urban centers on the Continent and overseas. The metaphysic of the Kuznets position rules out extended stagnations or slowdowns of a Keynesian variety.

10. "It is fairly common for statisticians to assume that the elimination of the secular trend from a time series indicates what the course of the series would have been in the absence of secular movements, and that the graduation of a time series, whether in original or trend-adjusted form, indicates what the course of the series would have been in the absence of random movement. There is no warrant for such simple interpretations. . . . When a continuous 'trend factor' is eliminated from the data, it is therefore difficult to say what influences impinging on the activity have been removed and what influences have been left in the series" [41, pp. 38, 39].

11. The technique of trend adjustment practiced by this school involves

transformation of original series, often aggregated and averaged over stretches of years, into link relatives which converts *trend* into a *level plane* around which cyclical fluctuations occur. Kuznets, Abramovitz, and Easterlin vary in the degree of reliance upon trend adjustment in the actual course of analysis and degree of smoothing involved. Kuznets is boldest in use of smoothing with calculation of link relatives over decade intervals. Abramovitz employs smoothing only over relatively short (reference cycle) periods to supplement use of unadjusted annual data for purposes of selecting chronologies. Conversions to link relatives (growth rates) are smoothed only over the same short periods; and these conversions are analyzed primarily to resolve doubts raised by behavior over periods where evidence for long swings is questionable. Easterlin, who has dedicated his work to Kuznets, follows him more closely in this regard.

12. Kuznets [161]. It has been shown that use of such a radical smoothing device with averaging terms which do not conform to short cyclical rhythms will convert any form of disturbance into a wavelike form, and will generate special long rhythms arising out of shifting periods or amplitudes. See the incisive criticism in [20].