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ABSTRACT

This paper discusses American long-term experience with changes in the distribution of income since the turn of the century. It supplies quantitative documentation of a pronounced secular swing in inequality. Inequality indicators were on the rise up to 1914, exhibited no trend to 1926 or 1929, and traced out a well known egalitatian leveling up to 1948. The paper uses a simple general equilibrium model to decompose the sources of these macro distributional trends. This approach supplies a concrete means by which to isolate the main causes of movements in the wage structure, factor shares, numbers in poverty, and size distribution statistics. Hypotheses regarding macro distribution performance over time can be readily classified as related to factor demand or factor supply. These two forces need not be in conflict, however. Contrary to conventional wisdom, the key forces appear to have come from the factor demand side rather than from the supply side. That is, the combined effects of demographic, immigration, and capital (human and non-human) formation forces are found to have been small when compared with factor demand. The latter includes sectoral imbalances in rates of technological change, exogenous changes in demand mix, and, less important, factor-saving biases in new technologies. (Author/JM)

THE SOURCES OF AMERICAN INEQUALITY, 1896-1948

Jeffrey G. Williamson

March 1975

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ABSTRACT

This paper attempts to explain American long-term experience with changes in the distribution of income since the turn of the century. It supplies quantitative documentation of a pronounced secular swing in inequality. Inequality indicators were on the rise up to 1914, exhibited no trend to 1926 or 1929, and traced out a well-known egalitarian leveling up to 1948. What explains this remarkable swing? The paper exploits a simple general equilibrium model to decompose the sources of these macrodistributional trends. Not only does this approach bring the analysis of long-term distribution trends back into macroeconomics, but it supplies a concrete means by which to isolate the main causes of movements in the wage structure, factor shares, numbers in poverty, and size distribution statistics. Contrary to conventional wisdom, the key forces appear to have come from the factor-demand side rather than from the supply side. That is, the combined effects of demographic, immigration, and capital (human and nonhuman) formation forces are found to have been small when compared with factor demand. The latter includes sectoral imbalances in rates of technological change, exogenous changes in demand mix, and, less important, factor-saving biases in new technologies.

THE SCURCES OF AMERICAN INEQUALITY, 1896-1948

> Although cyclical behavior of income inequality has been plausibly linked to aggregate indices of demand . . . economic explanations of secular change in income inequality are less satisfactory. . . . The lack of sufficiently long, appropriately defined time series may account in part for this unsatisfactory state, but the absence of a theory of the size distribution of personal incomes has been the main difficulty. - T. P. Schultz

I. Recent Experience in Perspective

Until very recently, it was generally believed that a revolutionary change toward income equality had taken place in the United States by the end of World War II. Although Simon Kuznets himself was far too cautious to use the term "revolutionary," the changes in all income distribution statistics from the mid-1930s to the late 1940s are truly remarkable (Kuznets, 1953; Ornati, 1966). It is also the majority opinion that few if any of these extraordinary egalitarian gains have been dissipated since 1948 or 1950. Yet, the postwar decades certainly have recorded a very mixed performance. Census data on family income confirm a slight egalitarian trend. The share of the top 5 percent declined from 17.0 to 14.4 percent from 1950 to 1970, while the Gini coefficient fell from .375 to .353 over the same period (Henle, 1972, p. 22). This decline pales by comparison with that of the period 1939-1948, when the top 5 percent saw their share plunge from 23.5 to 17.6 percent, but it does represent a continuation of the egalitarian trend nonetheless. In contrast with the family (total) income data, the data on <u>individual earned</u> income suggest a gradual trend toward inequality over the same period. Paul Schultz reports this trend in the log variance statistic for almost every sex-age class, while in the aggregate, "income inequality . . . has apparently increased substantially . . . since the Second World War" (Schultz, 1971, p. 11). Federal payroll tax data suggest the same conclusion for the 1951-1969 period (Brittain, 1972, pp. 106-108), and other data do as well (Budd, 1970, p. 260; Gastwirth, 1972, pp. 311-312). Chiswick and Mincer (1972) are somewhat more sanguine, but even their data fail to support any egalitarian trend.

How do we account for the conflict between those studies using total family (pretax) income and those using individual earned income? The most obvious explanation, of course, is the enormous increase in government transfer payments since the 1940s, a trend that has accelerated since the mid-1950s. The rise in transfer schemes surely would account for different trends in pretransfer and posttransfer income distributions, but it is the pretransfer income distribution that we wish to explain here. Thus, in order to make progress on our analytical understanding of distribution trends, it is earnings data "unpolluted" by transfer schemes that deserve our scrutiny. Furthermore, given the possibility that transfers, and thus posttransfer incomes, have an impact on pretransfer earnings (Golladay and Haveman, 1974), there is much to be said for an academic retreat to earlier twentieth-century decades, when transfers were a trivial component of government activity, and where models of income distribution therefore can be submitted to less ambiguous tests.

But there is a second explanation for the conflict between the family income and individual earnings distribution trends. The share of wives working has increased sharply since the late 1940s and thus multiple employment has become increasingly typical of American urban families. Since secondary family workers normally receive low wages and often work only part time, postwar family income distributions are bound to trace out more egalitarian trends than individual income distributions.[1] No doubt it will prove far more difficult to sort out the impact of these secondary-worker labor supply effects on postwar income distributions than to isolate the influence of transfers. Both of these contemporary complexities, however, offer excellent justifications for historical analysis of American distribution experience <u>prior</u> to the 1940s. Perhaps we might learn more about the determinants of distribution by examining periods in which government transfers were insignificant and multiple employment in urban families was less typical.

Not only has the postwar "egalitarian trend" thesis been destroyed by recent analysis, but "Kuznets's revolution" is now popularly (and erroneously) characterized as a short-term affair of little secular importance. The empirical studies by Schultz, Chiswick, and Mincer have tended--through no fault of their own--to exaggerate short-run distribution cycles while suppressing long-run trends.

> Apparently most, if not all, of the reduction since 1939 in the inequality of annual earnings . . . in the United States can be attributed to the reduction in postwar unemployment and the improved management of aggregate demand.[2] (Schultz, 1971, p. 28)

Schultz makes this inference indirectly by comparing aggregate individual earnings distribution statistics with those for full-time workers. The latter declined only modestly between 1939 and 1967. Thus the "revolution" appears to be quite adequately explained by return to full employment. Furthermore, short-term variations in income distribution since World War II can also be explained by cycles in aggregate demand

(Schultz, 1969; Metcalf, 1972). Chiswick and Mincer (1972) supply more direct evidence on the World War II episode. They develop an individual earnings model that introduces weeks worked as an explicit variable in the human capital function. They find that the model "achieves high explanatory power in the analysis of annual-income inequality in the period 1949-69" (p. S56). Lack of data makes the estimation of the model on prewar observations impossible, but if the estimated parameters are assumed to apply to 1939 as well, then we can decompose the sources of the post-1939 egalitarian trends. That is, the human capital model exploited by Chiswick and Mincer implies that the log variance statistic is the proper measure of inequality, and this statistic can be readily decomposed into meaningful component parts. The decomposition (Chiswick and Mincer, 1972, Table 4, p. S53) is sufficiently precise to assign relative magnitudes to the causes of the higher 1939 inequality compared with 1965. Among males aged 20-64, the changing age-education distribution was tending to produce greater inequality in 1965. These key human capital variables contribute nothing to the observed income leveling. It is not a changing distribution of human capital (or, presumably, nonhuman capital) that explains the remarkable egalitarian trend after 1939. Rather, it is the shifting annual earnings structure that is doing the trick. Given factor ownership, the earnings distribution is the product of two forces: (1) the incidence of factor unemployment and (2) the wage (factor rent) structure. The former plays the main role in the short run:

> Most of the observed difference in inequality between 1939 and 1965 is explained by changes in employment conditions. The remainder is a decline in the inequality of wage rates. . . . (Chiswick and Mincer, 1972, p. S57. Emphasis added.)

But is it not time to redirect our attention to the long run, and to look more carefully at those episodes prior to Great Depressions and Total War?

Table 1 surveys some indices relevant in gauging the longer-term income-leveling experience in America. We must be content with very imperfect indicators prior to 1935/1936. The historical documentation that does exist confirms without a doubt a marked leveling of earned incomes. Furthermore, these must be viewed as secular changes since 1929 and 1948 are roughly comparable full-employment years.[3] Table 1 and Figure 1 both document two decades of unambiguous long-term egalitarian trends, quite independent of government transfers. The income share of Kuznets's top 5 percent declined by one-third, while the percent in poverty very nearly halved. The other indices trace out less dramatic paths, but the magnitudes are quite impressive nonetheless. Column (4) of Table 1, for example, presents the percentage share of unskilled (raw) wages in national income originating. This factor-share statistic turns out to be a far better predictor of size distribution movements than conventional wages or profit shares.[4] Subtracting column (4) from unity yields an "expanded" property (nonhuman and human) income share, and this share declines by 15 percent in the twenty years following the Great Crash. As should be apparent in Figure 1, this decline almost exactly matches the diminution registered by the Goldsmith-OBE top fifth's share in income.

This paper hopes to uncover some of the sources of this income leveling during the Great Depression and World War II. Certainly much has been written about the issue, but most of it, in Schultz's words,

Table 1. Some Distribution Indicators: 1929-1948

Year	(1) Unemployment Rate	(2) Kuznets's Top 5 Percent Income Share	(3) Goldsmith and OBE Top Fifth Income Share	(4) Unskilled-Wage Share, Economy	(5) Skilled-Wage Ratio Index, Industry	(6) Wage-Dispersion Index, Manufacturing	(7) Percent in Poverty
1929	.055	.264	.544	.198	189.3	.160	26
1935	.195	.237	.517	-	188.0	.162	27
1936	.166	.244		-	191.7	.155	
1939	.160	.235	-	-	183.3	.175	
1941	.099	.219	.488	-	--	.171	17
1947	.039	.174	.460	-	-	.116	15
1948	.038	.176	-	.330	177.3	.108	-

Sources:
(1) Civilian labor force. 1929-1939, Coen, 1973, Table 2, p. 52. 1941-1948, Lebergott, 1964, p. 512.
(2) U.S. Bureau of the Census, 1960, p. 167.
(3) Ibid., p. 166.
(4) Calculated from U.S. Department of Commerce, Office of Business Economics, 1966. See text and Williamson (1974a).
(5) Williamson, 1974b, Table 11, p. 44, nonfarm selective.
(6) Coefficient of variation, average hourly earnings, NICB manufacturing data. Rees and Hamilton, 1971, Table 31.3, p. 487.
(7) Percent of households below "minimum subsistence" level. Ornati, 1966, Table A, p. 158.

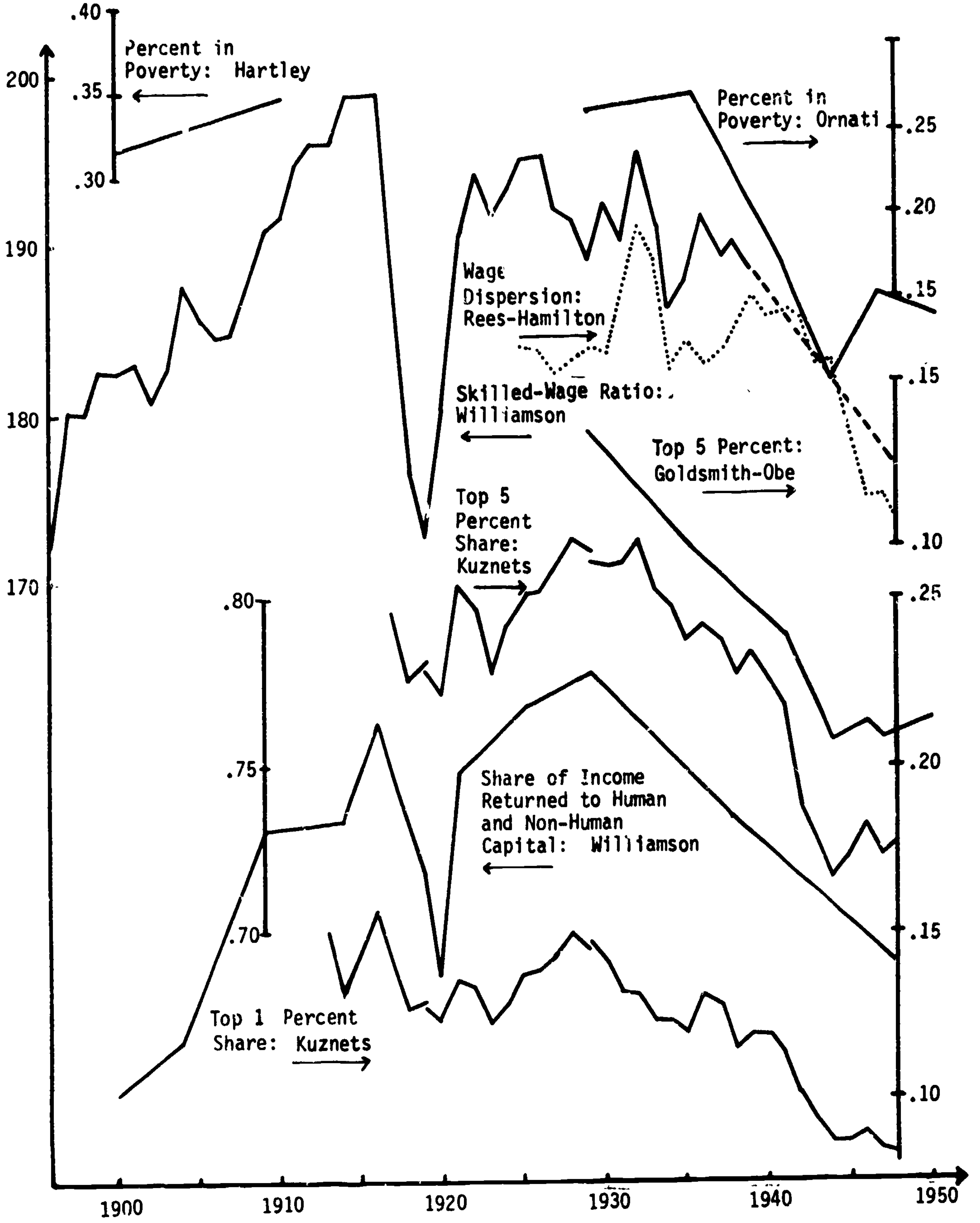

Figure 1. Trends in Wage Structure and Income Distribution, 1896-1948

is "unsatisfactory [due to] the absence of a theory" (1971, p. 27). We shall try our own hand at speculative modeling, but the resulting quantitative decomposition of the sources of income leveling will not be restricted solely to 1929-1948. This is only one episode in an extraordinary variety of distribution experience exhibited by the American economy since the turn of the century (Figure 1). The thirteen years from 1916 to 1929 appear to be a watershed, marking a peak level of inequality in American history.[5] From the late 1890s to 1914, every available inequality index surges upward. Hartley (1969, p. 19) finds the percent in poverty rising from 31.6 to 34.8 percent in the decade following 1900. Over the same period, an index of the income share returned to human and nonhuman capital rose from 65.2 to 73.2 percent; by 1916 it had reached an all-time peak of 76.3 percent. The skilled-wage ratio traces out an equally spectacular climb, rising by some 15 percent between 1896 and the 1914-1916 plateau (Williamson, 1974b, Table 11, p. 44). While each of these (provisional) series is of doubtful quality for the pre-World War I period, their consistency is, nonetheless, overwhelming. Furthermore, the pattern must be viewed as a _secular_ inequality trend, independent of cycles in aggregate demand, since civilian labor force unemployment rates averaged 4.6 percent from 1899 to 1901 and 5.3 percent between 1909 and 1913. Six years of world war and recovery produced a very sharp reversal in this inequality trend. In contrast to World War II, the impressive income leveling between 1914 and the early 1920s cannot be explained solely, or even primarily, by the achievement of full employment. The sharpness of the 1914-1920 leveling of incomes was almost matched by the well-known inegalitarian trend across the 1920s, so no unambiguous change in distribution can be discerned from 1914 to 1929.

What were the sources of American distributional behavior from the mid-1890s to the late 1940s? Since movements in overall inequality seem to have paralleled movements in the wage structure and factor shares, would not an accounting of the latter shed considerable light on the former? If so, can we disentangle the impact of factor demand from factor-supply forces? What forces have contributed to these shifting factor-demand conditions? The level of aggregation may appear to be quite high, but answers to these questions, it seems to me, warrant highest priority before moving to greater disaggregative detail.

II. Factor Demand vs. Factor Supply

Hypotheses regarding macrodistribution performance over time can be readily classified as related to factor demand or factor supply. These two forces need not be in conflict, however. There is no need to reject the importance of demand forces given the documentation of potent supply forces. Indeed, we shall see that the extraordinary twentieth-century variation in the American distribution of income can only be explained by the coincidence of these forces.

The factor-supply thesis has always been popular, although few have applied the thesis rigorously to the facts of American history. For example, increasing inequality trends in the post-World War II years--as well as stability or even stretching in the wage structure (Henle, 1972, p. 23; Rees and Hamilton, 1971)--coincide with a rapidly expanding supply of low-skill labor, such as women and teenagers. It seems plausible, therefore, to trace the postwar inequality experience to demographically induced factor-supply forces (Schultz, 1971). Labor supply conditions can also be utilized to help account for wartime income leveling since the young and unskilled are withdrawn from the civilian labor force in large numbers.

The factor-supply thesis seems to focus on labor supply, particularly unskilled labor. Its most verbal adherents, however, are to be found among those analysts interested in accounting for long-term American inequality experience prior to 1948. It has long been apparent, for example, that the peak spread in the wage structure on the eve of World War I coincided with a peak inflow of unskilled "new" European immigrants. Documentation was not of the quantitative type presented in Figure 1, but the inequality trends were well appreciated at the time and were grist for the alarmist political mills of that era. This was an angry age questing for social justice.[6] It was also an age that appealed to deteriorating social indicators for the rationalization of nativist (that is, racist) policy. Quantitative interest in the period gradually diminished, the last flicker of it being Rees's (1961) revision of Douglas (1930), a revision that finally succeeded in documenting <u>some</u> real-wage improvement over the period. Whether then or now, all analysts seem to agree that surging immigration played a key role in producing rising numbers in poverty, surging skill premiums, stable unskilled real wages, and swollen profit shares.

The subsequent reversal in American policy toward immigration must therefore be treated as a watershed in American inequality experience. Somewhat surprisingly, the obvious association between immigration and inequality was not fully exploited until quite recently. The association between immigration and the wage structure has been a focus of labor economists for some time. Keat (1960), Ober (1948), Reder (1955), and others have all argued that the reversal in American immigration policy must account for a "large" portion of the subsequent narrowing in the wage structure. But how much? Lindert (1974) argues with force and skill that these demographic forces account for the vast majority of American macrodistribution experience since the turn of the century--indeed, since 1820--but even he relies on association rather than estimation. Lindert certainly keeps good company, since a similar thesis has been applied to postwar Europe by Kindleberger (1967),[7] and it has always been a popular device for understanding "labor surplus" economies (Lewis, 1954; Kelley and Williamson, 1974).

Monocausal theories tend to be fragile, and historical explanations of American twentieth-century distributions are no exception. It turns out that these secular-demographic forces have always been reinforced by systematic long-term factor-demand forces. These factor-demand conditions are much more complex and difficult to isolate, which perhaps explains their relative absence in the literature.[8] In a statistical sense, a decline in the relative demand for unskilled labor can be induced by either a rapid diminution in unskilled-labor requirements (compared with skills, machines, and land) per unit of value added everywhere in the economy, or the relative contraction of activities utilizing unskilled labor intensively, or some combination of the two. To observe such changes *ex post* is, of course, to minimize their true influence, since a shift in output mix that favors machines and human capital will induce high machine user-cost and a stretching in the wage structure, both of which will induce firms to replace skills and machines with unskilled manhour inputs wherever possible. Nevertheless, ex post calculations of unskilled-labor-saving rates should yield some helpful insights into the role of factor demand on numbers in poverty, the unskilled-wages bill, and the share of income accruing to the lowest fractions of the population.

For the moment, let us focus our attention solely on output mix. What has been the impact of changing output composition on the aggregate demand for unskilled labor? The following notation will prove helpful in measuring the "composition effect":

V_{it}: real net output, sector i, year t

L_{it}: total unskilled labor employed, sector i, year t

ℓ_{it}: unskilled-labor input coefficient, sector i, year t ($\ell_{it} = L_{it}/V_{it}$)

v_{it}: share of value added in total national income originating, sector i, year t ($v_{it} = V_{it}/\sum_i V_{it}$)

$\hat{V}_{it}$: real net output under balanced growth assumptions, sector i, year t, ($\hat{V}_{it} = v_{io} \sum_i V_{i1}$).

The available data base restricts our analysis to the full-employment episodes after 1909. The rate of unskilled labor saving attributable to "composition effects" can be estimated by one of two indices:

$$I_P(\text{Paasche}) = \frac{\sum_i \ell_{i1}V_{i1} - \sum_i \ell_{i1}\hat{V}_{i1}}{L_1} = \frac{\sum_i \ell_{i1}(V_{i1} - \hat{V}_{i1})}{L_1}$$

$$I_L(\text{Laspeyres}) = \frac{\sum_i \ell_{io}V_{i1} - \sum_i \ell_{io}\hat{V}_{i1}}{L_1} = \frac{\sum_i \ell_{io}(V_{i1} - \hat{V}_{i1})}{L_1}$$

For the same level of aggregate demand, these indices measure the extent to which the current output mix uses more or less unskilled labor than that of the earlier period (for given input-output coefficients in each sector). I_P uses current technologies (ℓ_{i1}) in the calculation while I_L uses past technologies (ℓ_{io}).

Obviously, agriculture is the most intensive major user of unskilled labor. Thus, the continued long-term demise of agriculture insures that $\{I_P, I_L\} < 0$ for <u>all</u> periods. What is at issue is the magnitude of that unskilled-labor-saving rate. Does it exhibit considerable secular variability? Does the variance closely correspond with the distribution experience documented in Figure 1? It does indeed! Table 2 supplies the documentation. Unfortunately, the data come in a form that makes it impossible to explore the pre-1914 and the World War I years separately. The 1909-1919 decade straddles portions of both episodes, but Figure 1 suggests relative stability or perhaps even decline in both the wage structure and the available income inequality statistics. In any case, one is impressed by the extraordinary variance in the rate of unskilled labor saving induced by secular shifts in output composition. Relative to the twentieth century as a whole, the 1929-1948 income leveling coincided with an unusually low rate of unskilled labor saving attributable to "composition effects." The

Table 2. Output Mix and Unskilled Labor Saving: United States, 1909-1948

Period	Rate (%)			
	I_P		I_L	
	Total	Per annum	Total	Per annum
1909-1919	-5.81	-0.61	-5.58	-0.58
1919-1929	-18.36	-2.05	-18.23	-2.04
1929-1948	-8.74	-0.48	-12.04	-0.68

Note: The underlying data are in constant prices. See Williamson (1974c) for method and sources. The 1909-1919 calculation utilizes seven sectors: agriculture, mining, manufacturing, construction, trade, electricity plus gas, and transportation plus communications. The 1919-1929 calculation also uses seven sectors but transportation is alone while communications and public utilities are combined. For 1929-1948, there are nine sectors involved: agriculture, mining, durable manufactures, nondurable manufactures, construction, trade, transportation, finance plus services, and the combination of communications, electricity, gas, and sanitary services.

opposite is true of the 1920s. Not only do the secular movements in I closely correspond with inequality trends, but their magnitudes are very large too.

The reader will note scarce mention yet of that old chestnut, the factor-saving bias of technical change. Shouldn't the (unskilled) labor-saving bias of new technologies play a role in our macrodistributional accounting? If they are quantitatively relevant, they certainly should play a role. Econometric literature of the 1960s had, after all, accumulated impressive confirmation of a strong labor-saving (but not necessarily unskilled-labor-saving) bias in twentieth-century technical change. David and van de Klundert (1965), Brown (1966), Morishima and Saito (1968), and others all found that entrepreneurs "in the aggregate" have continuously adopted production methods that raised the marginal product of capital more than that of labor. Far more relevant to the problem at hand, however, is Brown's finding of an epochal break in the bias around 1907-1920; the 1920s were years of very strong labor saving (and thus of increased skilled-wage premiums, declining unskilled-wages shares, and trending inequality). Morishima and Saito also found strong labor-saving technical change. Figure 2 reproduces an index of "labor-saving drift" estimated by Morishima and Saito. This index, labelled M_t, can be regarded as a proxy for the impact of labor saving on the wages share.[9] The general drift toward labor saving for the twentieth century as a whole seems to confirm conventional historical wisdom regarding the factor-saving bias. Of far greater interest, however, are the three striking phases that trisect the years 1909-1948. The first decade, although subject to considerable instability, exhibits

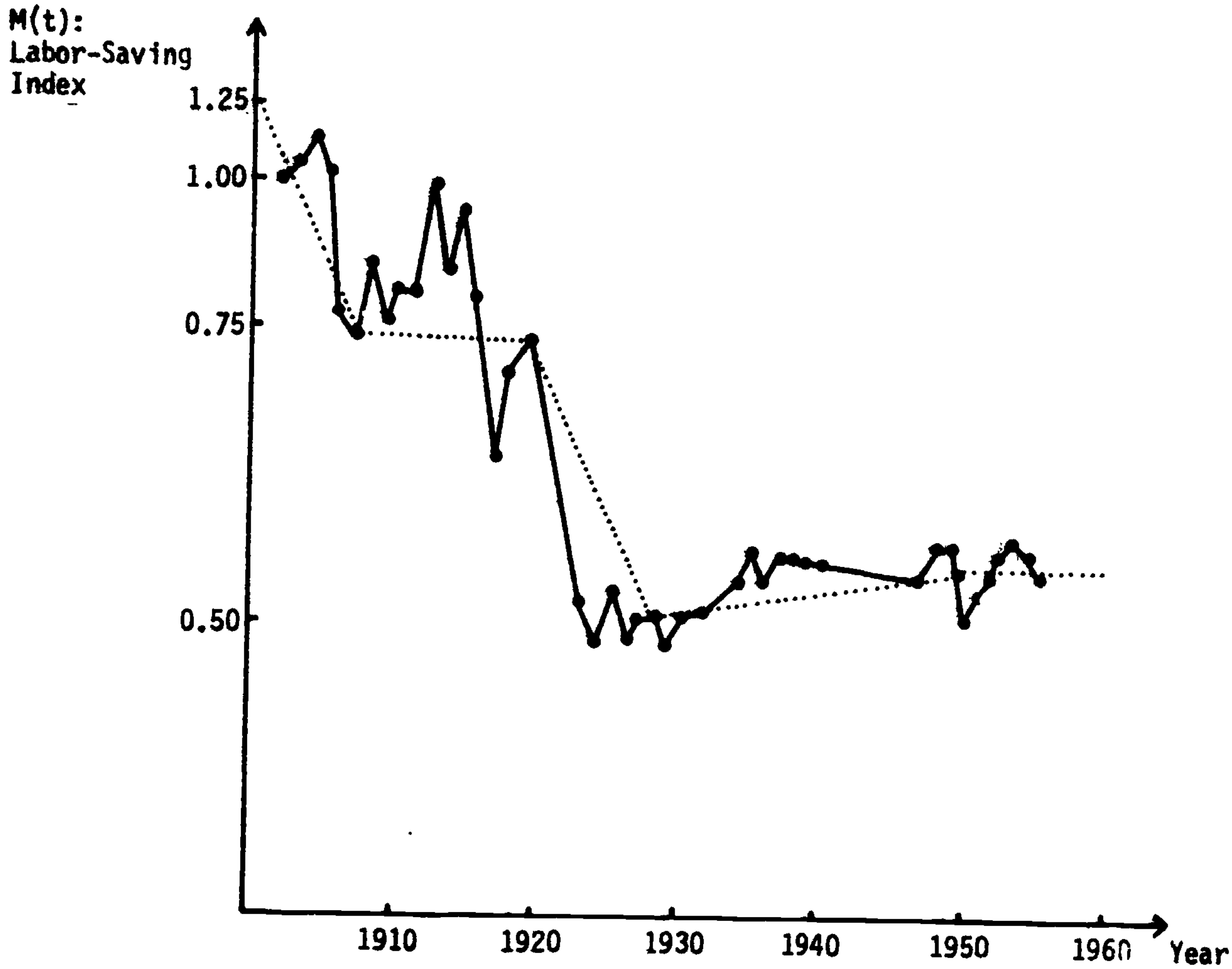

Figure 2. Twentieth-Century Drift Toward "Labor Saving": Morishima and Saito (1968), U.S. Domestic Economy

only a very modest rate of labor-saving drift. The 1920s, on the other hand, reflect the extraordinary rates of labor saving that have always played such a dominant role in traditional histories of the "New Era."[10] The period following 1929 is most assuredly different since there appears to be evidence of "capital saving" coinciding with the Great Depression and World War II, precisely the episode of income leveling, rising unskilled-wages shares, and a collapsing wage structure. David and van de Klundert (1965, p. 383) used a different model but reached a similar, although not identical, conclusion. Their results are worth quoting at length:

> . . . the six decades since 1899 might be thought of as encompassing three major periods. . . .
>
> (a) 1900-1918, in which labor-saving technical changes took place more rapidly than the long-term trend rate of bias; . . .
>
> (b) 1919-1945, a longer interval over whose entire course no significant labor- or capital-saving bias emerged; . . .
>
> (c) 1946-1960, the postwar period, during which the rise in relative labor-efficiency was resumed at a rate even faster than that experienced prior to 1919.

Unfortunately, David and van de Klundert failed to take the obvious step; to look beneath their macroaggregation for the systematic underlying forces for these striking factor-saving trends.

Is it by chance that these econometric trends in labor-saving drift correspond almost exactly with the systematic variations in American output mix documented in Table 2? Morishima and Saito didn't think so. All of the observed so-called labor-saving effects prior to 1929 are attributable to the expansion of nonagricultural activities at the expense of agriculture. The level of output aggregation used by Morishima and Saito is far greater than that underlying Table 2, and their assumption of labor homogeneity is explicitly rejected by our approach, but the correspondence is comforting nonetheless. Furthermore, the majority of the rise in labor's share during the Great Depression was due to a change in industrial composition that was net labor using (Morishima and Saito, 1968, Table 4, p. 435). With the important exception of Morishima and Saito,[11] nowhere in these macroeconometric accounts is mention made of these dramatic secular changes in sectoral output mix.

This exercise should establish the credibility of the factor-demand thesis. Having said as much, the time is ripe to explore those forces that might account for these pronounced changes in output mix.

III. Macro Modeling Twentieth-Century America

> Such a statement is neither a fact nor a theorem, but rather a methodological prejudice, a prejudice about what is likely to be the most fruitful way of . . . organizing our knowledge.
> — Z. Griliches

The preceding pages should have underlined the complexity of the economic forces driving the twentieth-century American income distribution. Any attempt to model these seven decades must risk seeming naively heroic, but the issues are sufficiently important to warrant the gamble. The historical framework is a three-sector general equilibrium model that stresses unskilled labor requirements.[12] Its premises are unabashedly neoclassical since no other paradigm seems as helpful in accounting for the history of wage structures and wage-income distribution. A popular alternative paradigm suggests that the primary determinants of relative wages are institutional and social factors (Thurow and Lucas, 1972). I have not been impressed by this alternative paradigm's ability to predict historical change in the wage structure, however, and the neoclassical approach seems to me to be more attractive. Debate over formal modeling should not becloud, however, our key finding that American experience with inequality can be decomposed into measureable exogenous macro variables. The model used below yields useful insights and valid predictions even if individual assumptions of the formal model may be challenged.

Structural Attributes

Any accounting of American performance since the turn of the century must highlight the large urban service sector, while little appears to be lost by aggregating over all manufacturing sectors. The civilian economy is disaggregated into three final-product sectors: agriculture plus mining (A), manufacturing (M), and services (C), the latter excluding military and relief, but including all other government activities, construction, utilities, transportation, communication, trade, and personal services. Each sector is vertically aggregated so that all of its commodity inputs are decomposed into factor returns. Thus,

$$A = A[L_A, N]$$

$$M = M[L_M, K_M]$$

$$C = C[L_C, K_C]$$

where L_j represents unskilled labor, N represents land (including improvements and farmer's skills), and K_j represents the aggregate of human and nonhuman capital. It should be emphasized that our framework highlights labor heterogeneity, and this analytical characterization possesses three advantages: (1) the unskilled-labor share is an excellent predictor of size distribution performance from 1914 to 1948 (Williamson, 1974a); (2) human (skill) accumulation and physical capital accumulation move at very different rates after 1914, and some effort must be made to allow for this disparate wealth-accumulation experience in our formal models; and (3) this factor-input characterization finesses the empirical difficulties associated with imputing labor and property income to entrepreneurs, difficulties especially rampant in sectors A and C. This third advantage warrants amplification.

Macro analysts have clung with remarkable tenacity to a distributional trilogy—returns to land, labor, and capital. This convention has produced an enormous empirical literature that has attempted to document the "wages share." The treatment of entrepreneurial income becomes an almost insurmountable roadblock to drawing clear quantitative borderlines between these three factors. Entrepreneurial income is, after all, the aggregate of returns from all three inputs, and unincorporated enterprise dominates a huge portion of the early-twentieth-century American economy. Indeed, the sectors in which the "wages imputation" problem is unusually severe—agriculture, private services, and trade—amount to 48.1 percent of total net income originating in 1919 and 44.0 percent in 1929.

Our model proposes an alternative factor-returns division between <u>unskilled</u> labor and capital (human as well as nonhuman). Not only does this approach minimize imputation problems, but it also is more attractive in light of recent developments in theory. It has long been argued that the rate of return to human capital in America is closely linked to the rate of return to physical capital and that skilled labor and capital are complements. If the full-employment return (or rent) on a dollar of human capital is a stable fraction of that on a dollar of machines, what do we lose by their aggregation? Furthermore, this characterization is consistent with recent research on the production function. Aggregating labor over different skills is apparently a serious error, while aggregating over capital and skilled labor is hardly a sin at all! (Berndt and Christensen, 1973, p. 21).

Cost Equations

In contrast with the monopoly-power, industrial-concentration approaches to the 1920s and even the pre-World War I period, we shall see how far neoclassical assumptions will take us in explaining history. Those readers who find the competitive assumptions unattractive should consider that "rates" of monopoly drift only slowly over time. Relatively stable monopoly structure poses no problem whatsoever for the model that follows. Commodity prices are therefore taken to exhaust factor payments per unit of product:

$$P_A = a_{LA}w + a_{NA}d = 1,$$

$$P_M = a_{LM}w + a_{KM}q,$$

$$P_C = a_{LC}w + a_{KC}q.$$

Agricultural (and mining) output is treated as a numeraire, so P_M and P_C denote the relative prices of manufactures and services. The a_{ij} are variable input coefficients and w, q, and d denote respectively the unskilled-wage rate, the rental rate on machines and skilled labor, and the land rental rate. These price equations can be expressed in percentage rates of change:

$$0 = \overset{*}{a}_{LA}\,\theta_{LA} + \overset{*}{w}\theta_{LA} + \overset{*}{a}_{NA}\theta_{NA} + \overset{*}{d}\theta_{NA}$$

$$\overset{*}{P}_{M} = \overset{*}{a}_{LM}\theta_{LM} + \overset{*}{w}\theta_{LM} + \overset{*}{a}_{KM}\theta_{KM} + \overset{*}{q}\theta_{KM}$$

$$\overset{*}{P}_{C} = \overset{*}{a}_{LC}\theta_{LC} + \overset{*}{w}\theta_{LC} + \overset{*}{a}_{KC}\theta_{KC} + \overset{*}{q}\theta_{KC}$$

where θ_{ij} denotes factor shares.

Since the historical literature and the econometric literature make so much of technical change as a prime mover of factor shares during the twentieth century, an effort must be made to introduce it into our model. Let

$$\overset{*}{a}_{ij} = \overset{*}{c}_{ij} - \overset{*}{b}_{ij}$$

where $\overset{*}{c}_{ij}$ represents the "conventional" factor-substitution response to relative factor prices and $\overset{*}{b}_{ij}$ represents exogenous factor-saving rates. That is, given relative factor prices, $\overset{*}{b}_{ij}$ measures the rate at which factor j is saved in the production of a unit of commodity i. With these new concepts, the price equation for agriculture can now be rewritten as:

$$0 = [\theta_{LA}\overset{*}{w} + \theta_{NA}\overset{*}{d}] - [\theta_{LA}\overset{*}{b}_{LA} + \theta_{NA}\overset{*}{b}_{NA}],$$

or alternatively, as

$$0 = \theta_{LA}\overset{*}{w} + \theta_{NA}\overset{*}{d} - \overset{*}{T}_{A} \qquad [1]$$

where $\overset{*}{T}_A$ is the weighted average of the rates of labor and land saving in agriculture, another way of saying "total factor productivity growth in agriculture." Similarly,

$$\overset{*}{P}_M = \theta_{LM}\overset{*}{w} + \theta_{KM}\overset{*}{q} - \overset{*}{T}_M \text{ ,} \qquad [2]$$

$$\overset{*}{P}_C = \theta_{LC}\overset{*}{w} + \theta_{KC}\overset{*}{q} - \overset{*}{T}_C \text{ ,} \qquad [3]$$

where $\overset{*}{T}_M$ and $\overset{*}{T}_C$ are total factor productivity growth rates in manufacturing and services, respectively.

Full-Employment Assumptions

The full-employment assumption is obviously inappropriate if applied to 1896, 1908, 1914, 1921, or the Great Depression. But it does appear to be the relevant description of American secular performance for the twentieth century as a whole. If rental prices rather than unemployment rates are assumed to bear the brunt of factor market adjustment then

$$N = a_{NA}A$$

$$K = a_{KM}M + a_{KC}C$$

$$L = a_{LA}A + a_{LM}M + a_{LC}C.$$

We fix the land in farms, but allow K to reflect capital formation in skills and machines, and L to reflect immigration, conscription, demobilization, fertility, mortality, and changes in labor-force participation. In rates of change, these full-employment equations then become

$$\overset{*}{N} = \lambda_{NA}A + \lambda_{NA}\overset{*}{a}_{NA} = 0$$

$$\overset{*}{K} = \lambda_{KM}\overset{*}{M} + \lambda_{KM}\overset{*}{a}_{KM} + \lambda_{KC}\overset{*}{C} + \lambda_{KC}\overset{*}{a}_{KC}$$

$$\overset{*}{L} = \lambda_{LA}\overset{*}{A} + \lambda_{LA}\overset{*}{a}_{LA} + \lambda_{LM}\overset{*}{M} + \lambda_{LM}\overset{*}{a}_{LM} + \lambda_{LC}\overset{*}{C} + \lambda_{LC}\overset{*}{a}_{LC} .$$

The share that sector j employs of a given input i is λ_{ij}. Recalling that $\overset{*}{a}_{ij} = \overset{*}{c}_{ij} - \overset{*}{b}_{ij}$, we have from the "land" equation

$$\lambda_{NA}\overset{*}{A} + \lambda_{NA}(\overset{*}{c}_{NA} - \overset{*}{b}_{NA}) = \overset{*}{A} + \overset{*}{c}_{NA} - \overset{*}{b}_{NA} ,$$

since $\lambda_{NA} = 1$. Furthermore, $\overset{*}{b}_{NA}$ is the rate of land saving for the economy as a whole, call it Π_N. So

$$0 = \overset{*}{A} + \overset{*}{c}_{NA} - \Pi_N. \qquad [4']$$

The "capital" equation can also be expanded to include exogenous factor saving:

$$\overset{*}{K} = \lambda_{KM}\overset{*}{M} + \lambda_{KC}\overset{*}{C} + \lambda_{KM}\overset{*}{c}_{KM} + \lambda_{KC}\overset{*}{c}_{KC} - \Pi_K, \qquad [5']$$

where Π_K measures the economy-wide rate of capital saving. Similarly,

$$\overset{*}{L} = \lambda_{LA}\overset{*}{A} + \lambda_{LM}\overset{*}{M} + \lambda_{LC}\overset{*}{C} + \lambda_{LA}\overset{*}{c}_{LA} + \lambda_{LM}\overset{*}{c}_{LM} + \lambda_{LC}\overset{*}{c}_{LC} - \Pi_L, \qquad [6']$$

where Π_L measures the economy-wide rate of labor saving.

By exploiting elasticity of substitution (σ^{j}_{ik}) expressions,[13] equations [4'], [5'] and [6'] can now be written as

$$\Pi_N = \overset{*}{A} - \theta_{LA}\sigma^{A}_{NL}\overset{*}{d} + \theta_{LA}\,\sigma^{A}_{NL}\overset{*}{w}\,, \tag{4}$$

$$\begin{aligned}\overset{*}{K} + \Pi_K = {} & \lambda_{KM}\overset{*}{M} + \lambda_{KC}\overset{*}{C} - (\lambda_{KM}\theta_{LM}\sigma^{M}_{KL} + \lambda_{KC}\theta_{LC}\sigma^{C}_{KL})\overset{*}{q} \\ & + (\lambda_{LM}\theta_{LM}\sigma^{M}_{KL} + \lambda_{KC}\theta_{LC}\sigma^{C}_{KL})\overset{*}{w}\,,\end{aligned} \tag{5}$$

$$\begin{aligned}\overset{*}{L} + \Pi_L = {} & \lambda_{LA}\overset{*}{A} + \lambda_{LM}\overset{*}{M} + \lambda_{LC}\overset{*}{C} + \lambda_{LA}\theta_{NA}\sigma^{A}_{NL}\overset{*}{d} \\ & - (\lambda_{LA}\theta_{NA}\sigma^{A}_{NL} + \lambda_{LM}\theta_{KM}\sigma^{M}_{KL} + \lambda_{LC}\theta_{KC}\sigma^{C}_{KL})\overset{*}{w} \\ & + (\lambda_{LM}\theta_{KM}\sigma^{M}_{KL} + \lambda_{LC}\theta_{KC}\sigma^{C}_{KL})\overset{*}{q}.\end{aligned} \tag{6}$$

The Components of Demand

Define own-price elasticities of demand as ε_j, cross-price elasticities as ε_{jk}, and income elasticities as η_j. The general form of our demand functions is

$$Q_j = S_j Y^{\eta_j} P_j^{\varepsilon_j} P_k^{\varepsilon_{jk}}$$

where all prices are relative to those of agriculture. There are three demand equations, but one of them is redundant. Let expenditures on agricultural products be the residual that satisfies the budget constraint. Then the growth in demand for services and manufactured commodities can be written as

$$\overset{*}{M} = \overset{*}{S}_M + \eta_M \overset{*}{Y} + \varepsilon_M \overset{*}{P}_M + \varepsilon_{MC} \overset{*}{P}_C ,$$

$$\overset{*}{C} = \overset{*}{S}_C + \eta_C \overset{*}{Y} + \varepsilon_C \overset{*}{P}_C + \varepsilon_{CM} \overset{*}{P}_M .$$

These $\overset{*}{S}_j$ will be an important part of our analysis of twentieth-century distribution trends. They represent shifts in final demand induced by war, return to "normality," the rise of government, and similar forces.

The percentage change in income can be written either in terms of final demand

$$\overset{*}{Y} = \phi_A \overset{*}{A} + \phi_M(\overset{*}{P}_M + \overset{*}{M}) + \phi_C(\overset{*}{P}_C + \overset{*}{C}),$$

where ϕ_j is a final-demand share in income, or in terms of national income at factor cost. We choose to utilize the former, so

$$\overset{*}{M} = \overset{*}{S}_M + \eta_M\{\phi_A \overset{*}{A} + \phi_M(\overset{*}{P}_M + \overset{*}{M}) + \phi_C(\overset{*}{P}_C + \overset{*}{C})\}$$
$$+ \varepsilon_M \overset{*}{P}_M + \varepsilon_{MC} \overset{*}{P}_C ,$$

or

$$\overset{*}{S}_M = (1 - \eta_M\phi_M)\overset{*}{M} - \eta_M\phi_A\overset{*}{A} - (\eta_M\phi_M + \varepsilon_M)\overset{*}{P}_M$$
$$- (\eta_M\phi_C + \varepsilon_{MC})\overset{*}{P}_C - \eta_M\phi_C\overset{*}{C} . \qquad [7]$$

Similarly,

$$\overset{*}{S}_C = (1 - \eta_C\phi_C)\overset{*}{C} - \eta_C\phi_A\overset{*}{A} - (\eta_C\phi_M + \varepsilon_{CM})\overset{*}{P}_M$$
$$- \eta_C\phi_M\overset{*}{M} - (\eta_C\phi_C + \varepsilon_C)\overset{*}{P}_C . \qquad [8]$$

Summary of the Model

The eight equations are summarized in matrix form in Appendix Table A.1. There are eight endogenous variables: commodity price relatives ($\overset{*}{P}_M$, $\overset{*}{P}_C$), commodity outputs ($\overset{*}{M}$, $\overset{*}{A}$, $\overset{*}{C}$), and, our prime interest, factor rents ($\overset{*}{w}$, $\overset{*}{q}$, $\overset{*}{d}$). In terms of the statistics presented in Figure 1, the model makes explicit predictions about the behavior of ($\overset{*}{q} - \overset{*}{w}$), the percentage change in the skill premiums over time. This prediction is especially important for the period 1896-1909, when annual distribution statistics are almost completely limited to the wage structure index. These endogenous variables can be readily manipulated to predict the behavior of income shares. In particular, the economy-wide unskilled-wages share is $\theta_U = wL/Y$ so that the rate of change in the unskilled-wages share--a statistic that serves very well as a size distribution proxy for the years following 1909--is simply

$$\overset{*}{\theta}_U = \overset{*}{w} + \overset{*}{L} - [\phi_A \overset{*}{A} + \phi_M\{\overset{*}{P}_M + \overset{*}{M}\} + \phi_C\{\overset{*}{P}_C + \overset{*}{C}\}] .$$

It is the presumption of this paper that endogenous changes in θ_U have driven size distribution trends since the 1890s.[14]

There are ten exogenous variables. Each of these plays an important role in the traditional literature. Eight of these can be classified as factor-demand forces. First, we have the sectoral total factor productivity growth rates ($\overset{*}{T}_A$, $\overset{*}{T}_M$, $\overset{*}{T}_C$) which have been documented by Kendrick. Aggregate total factor productivity growth has been shown to be a very large component of twentieth-century income growth, and endogenous secular income growth insures an output-mix change according to the η_j. In addition, unbalanced rates of sectoral total factor productivity growth imply changes in the endogenously determined relative price structure. This in turn induces output-mix changes according to the ε_j and ε_{jk}. Second, we have the factor-saving biases (Π_N, Π_K, Π_L), which are stressed in the econometric and historical literature. Much has been made of these biases, but we have few hard estimates of their magnitude.[15] Third, we have final-demand changes ($\overset{*}{S}_M$, $\overset{*}{S}_C$), which also directly influence output mix and thus, indirectly, factor demand. Some of these are government-induced medium-term influences associated with war, cold war, and peace. Some of these are induced by the long-run rise in government activity. They may also be influenced by the secular transformation of the capital goods industry from plant and equipment production (construction and durables) to human capital production (education, health, research, and development). We know a great deal about the qualitative nature and timing of these $\overset{*}{S}_j$, but little about their magnitude. Finally, we have two factor-supply forces. Factor-endowment changes include exogenous rates of human and physical capital accumulation[16] ($\overset{*}{K}$), as well as exogenous rates of unskilled-labor-stock growth ($\overset{*}{L}$), the latter influenced by historical experience with war mobilization, demobilization, baby booms, and immigration policy.

Appendix Tables A.2 and A.3 convert our model into the empirical "realities" of 1919 and 1929. The θ_{ij} and ϕ_j are taken from earlier papers and λ_{ij} can be derived directly from them.[17] Information on these initial structural conditions is of relatively high quality. I am less confident about the remaining parameters. Estimates of elasticities of substitution by sector are, of course, subject to considerable debate. The Cobb-Douglas specification clearly has been shown to be erroneous, although estimated elasticities are evidently significantly in excess of zero (Berndt and Christensen, 1973; Griliches, 1969). The most recent econometric research suggests the plausibility of $\sigma^A_{NL} = \sigma^M_{KL} = \sigma^C_{KL} = 0.5$. Equally arbitrary, although "reasonable," assumptions will be made on the demand parameters. The cross-price elasticities are set at zero ($\varepsilon_{MC} = \varepsilon_{CM} = 0$). Furthermore, we take

$$\eta_M = 1.3,\ \varepsilon_M = -1.3$$
$$\eta_C = 1.0,\ \varepsilon_C = -1.0.$$

The income elasticities conform to our usual notions regarding these two product types and the own-price elasticities follow inevitably. (For confirmation on interwar data, see Duesenberry and Kistin, 1953.)

IV. Decomposing the Sources of Inequality

The inverse matrices reported in Appendix Tables A.2 and A.3 can be idealized to appear as

$$\begin{array}{cccccc|c} \overset{*}{X}_1 & \overset{*}{X}_2 & \cdots & \overset{*}{X}_j & \cdots & \overset{*}{X}_n & \\ \hline m_{11} & m_{12} & \cdots & m_{1j} & \cdots & m_{1n} & \overset{*}{Z}_1 \\ m_{21} & m_{22} & \cdots & m_{2j} & \cdots & m_{2n} & \overset{*}{Z}_2 \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots & \vdots \\ m_{j1} & m_{j2} & \cdots & m_{jj} & \cdots & m_{jn} & \overset{*}{Z}_j \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots & \vdots \\ m_{n1} & m_{n2} & \cdots & m_{nj} & \cdots & m_{nn} & \overset{*}{Z}_n \end{array}$$

Each of these columns of (m_{ij}) can be viewed as weights to be used to decompose the "sources" of historical change in any endogenous variable, $\overset{*}{X}_j$. Using our general equilibrium model as a working hypothesis, the measured growth rate of some endogenous variable can then be decomposed into

$$\overset{*t}{X}_j = [\overset{*t}{Z}_1(m_{1j}) + \overset{*t}{Z}_2(m_{2j}) + \ldots + \overset{*t}{Z}_k(m_{kj})] +$$
$$+ [\overset{*t}{Z}_\ell(m_{\ell j}) + \overset{*t}{Z}_{\ell+1}(m_{\ell+1j}) + \ldots + \overset{*t}{Z}_n(m_{nj})]$$
$$+ \overset{*t}{R}_j, \qquad [9]$$

where $(\overset{*t}{Z}_1, \ldots, \overset{*t}{Z}_k)$ refers to <u>measureable</u> exogenous variables, $(\overset{*t}{Z}_\ell, \ldots, \overset{*t}{Z}_n)$ refers to <u>unobservable</u> exogenous variables, and $\overset{*t}{R}_j$ denotes <u>errors in variables</u>. The total historical impact of some exogenous variable, say, $\overset{*t}{Z}_k$, on some endogenous variable, say $\overset{*t}{X}_j$, is the product of the variable's change over time and the structural attributes of the economy, (m_{kj}).

No doubt our accounting of the sources of inequality will appear to be highly aggregative, but at least it will supply a method by which to distinguish the relative contributions of factor-demand and factor-supply forces to observed twentieth-century swings in inequality. To do so, this section will exploit the decomposition expression given in [9]. The available historical data make it possible, at least initially, to decompose the right-hand side of [9] into just two components: (1) the impact of measured factor-stock growth rates $(\overset{*}{K}, \overset{*}{L})$, the combination of which unambiguously exhausts factor-supply influence on distribution; and (2) a residual. This residual

$$[\overset{*t}{Z}_\ell(m_{\ell j}) + \overset{*t}{Z}_{\ell+1}(m_{\ell+1j}) + \ldots + \overset{*t}{Z}_n(m_{nj})] + \overset{*t}{R}_j$$

may be large or small, but it is composed only of errors in variables and factor-demand forces. These unobserved factor-demand forces can, at least conceptually, be separated into three parts. The first of these is the exogenous shifts in product demand, the $\overset{*}{S}_j$. The second is the exogenous factor-saving biases at the industry level. The necessary historical information being unavailable, it is not possible to supply independent estimates of these two demand forces. It is feasible, however, to shed some (feeble) light on the third of these demand forces, namely, the impact of measured rates of total factor productivity growth by sector under assumptions of neutrality within each sector. The estimates are especially fragile, given poor data on $\overset{*}{T}_j$, so their unveiling will be discretely postponed to later pages in this section.

Table 3 presents the key historical data. Every entry there is a per annum rate of change. Rows 2.1 and 2.2 present the "distribution facts" that we shall attempt to explain--the rate of change in unskilled labor's share, $\overset{*}{\theta}_U$, and the rate of change in the wage ratio index, $\overset{*}{w} - \overset{*}{q}$. The time periods are selected to capture the main dimensions of America's long-term inequality swing from 1896 to 1948. The potent short-term influence of World War I, for example, is ignored. Furthermore, the reader will note three capital-stock growth rates presented in the table. The human capital index is based on Denison's labor quality series. For consistency, the physical-capital-stock series is also Denison's (at least after 1909--Kendrick is our source before that date). Prior to 1914, the two moved almost exactly alike and thus our analysis is not influenced by the choice of one over the other. After World War I, however, these two capital-stock growth rates behaved

Table 3. Estimates of $\overset{*}{Z}_j$ and $\overset{*}{X}_j$: 1896-1948

Variable	Periods					
	1896-1914	1914-1929	1929-1948	1899-1909	1909-1919	1919-1929
1. $\overset{*}{Z}_j$ Estimates:						
1.1 Total factor productivity growth						
$\overset{*}{T}_A$	+.55	+.32	+1.89	-.24	-.28	+1.24
$\overset{*}{T}_M$	+.72	+2.77	+1.73	+.72	+.29	+5.31
$\overset{*}{T}_C$	+1.27	+3.19	+2.15	+2.20	+2.44	+0.09
1.2 Economy-wide bias under neutrality						
Π_N	+.55	+.32	+1.89	-.24	-.28	+1.24
Π_K	+1.05	+3.02	+2.03	+1.61	+1.59	+2.16
Π_L	+.89	+2.21	+1.99	+1.03	+.98	+2.02
1.3 Factor stocks						
$\overset{*}{L}$	+2.73	+1.64	+1.09	+2.83	+1.68	+1.56
$\overset{*}{K}$ (physical)	+3.20	+3.22	+1.06	+3.36	+2.93	+3.39
$\overset{*}{K}$ (human)	+3.30	+2.35	+2.15	+3.40	+2.24	+2.34
$\overset{*}{K}$ (total)	+3.24	+2.95	+1.40	+3.38	+2.70	+3.07
2. $\overset{*}{X}_j$ estimates:						
2.1 Unskilled labor's share: $\overset{*}{\theta}_U$	na	-1.20	+2.73	-2.93	+.54	-2.46
2.2 Wage structure: $\{\overset{*}{w} - \overset{*}{q}\}$	-.82	+.34	+.34	-.45	+1.03	-.95

Note: All numbers given are percentages.

Table 3 (continued)

Sources: The $\overset{*}{T}_j$ are calculated from Kendrick (1961): $\overset{*}{T}_A$ from Table B-I, pp. 362-364; $\overset{*}{T}_M$ from Table D-I, p. 464, where 1896-1914 is 1899-1909 and 1914-1929 is 1909-1929; $\overset{*}{T}_C$ is derived from the identity $\overset{*}{T}_{PDE} = \overset{*}{T}_A\phi_A + \overset{*}{T}_M\phi_M + \overset{*}{T}_C\phi_C$, where $\overset{*}{T}_{PDE}$ is for the private domestic economy (Commerce concept), Table A-XXII, pp. 333-335. The Π_i are derived according to neutrality assumptions, where $\Pi_K = \lambda_{KM}\overset{*}{T}_M + \lambda_{KC}\overset{*}{T}_C$, $\Pi_N = \overset{*}{T}_A$, and $\Pi_L = \lambda_{LA}\overset{*}{T}_A + \lambda_{LM}\overset{*}{T}_M + \lambda_{LC}\overset{*}{T}_C$. $\overset{*}{L}$ is from Denison (1962, Table 11, p. 85) for 1909-1948 and from Kendrick (1961, Table A-XXII, p. 333) for 1896-1909. $\overset{*}{K}$ (Human) is the sum of $\overset{*}{L}$ and Denison's (1962, Table 11, col. (2) x col. (3), p. 85) quality index growth; for 1896-1914 and 1899-1909, 1909-1914 is used for the quality index. $\overset{*}{K}$ (Physical) is from Denison (1962, Table 14, p. 141, "variable weights") for 1909-1948, and from Kendrick (1961, Table A-XXII, p. 333) for 1896-1909. $\overset{*}{K}$ (Total) is a weighted average of these two capital-stock components. The weight is variable and is constructed by applying our growth rates to Schultz's (1962, Table 1, p. 6) 1929 benchmark, where educational capital in the labor force plus on-the-job training accounted for 29.8 percent of the "total" capital stock. $\overset{*}{\theta}_U$ is taken from Williamson (1974c, Table 2.4, p. 13) for 1909-1929; calculated from the Survey of Current Business (U.S. Department of Commerce, Office of Business Economics, 1966) for 1929-1948; the 1899-1909 figure actually refers to 1900-1909 and is a crude estimate derived from Lebergott (1964, Table A-18, p. 525) and Kendrick (1961, Table A-IIb, pp. 296-297, and Table A-XXII, pp. 333-334) linked to the 1909-1929 series. The source for $(\overset{*}{w} - \overset{*}{q})$ is Williamson (1974b, Table 11, p. 44).

very differently: The stock of skills accumulated at a much lower rate than did machines in the 1920s, while it is well known that the reverse has been the case since 1929. Schultz's 1929 benchmark estimates of human and reproductible physical capital are used to get a weighted average of these rates.[18] The resulting "total" capital-stock growth rates shall be used in all subsequent analysis.

The results of the decomposition exercise are presented in Tables 4 and 5. The first of these explores the sources of wage-structure changes, and the second that of the unskilled-wages share. The wage-structure data are more abundant, allowing an extension of the analysis to 1896, so let us start with Table 4. During the secular rise in inequality from 1896 to 1914, as well as during the egalitarian drift from 1929 to 1948, supply and demand forces were working in concert. On the upswing, both were acting to produce a rise in the skill premium and a stretching in the wage structure. Although conventional accounts of this episode focus almost solely on the secular wave of unskilled European immigration, it appears from Table 4 that demand forces were the more fundamental cause of the last great inequality surge in America; roughly seven-tenths of the observed ($\overset{*}{w} - \overset{*}{q}$) can be attributed to demand (-0.57 out of -0.82 percentage points per annum). A more accurate interpretation of the period seems to be the following: Immigration was seen as the key cause of social crisis, which could be eliminated only by restrictive legislation, only because demand forces were unusually unfavorable to unskilled labor while favorable to skilled labor and physical capital.[19] Indeed, without those unfavorable demand forces, the inequality trends would have been less pronounced and the

Table 4. Decomposing the Sources of Change in the American Wage Structure, 1896-1948

Rates	1896-1914	1914-1929	1929-1948	1899-1909	1909-1919	1919-1929
Fact $(\overset{*}{w} - \overset{*}{q})$	-.82	+.34	+.34	-.45	+1.03	-.95
Supply	-.25	+1.47	+.11	-.22	+.99	+1.83
Labor $(\overset{*}{L})$	-5.48	-3.29	-2.16	-5.68	-3.37	-3.13
Capital $(\overset{*}{K})$	+5.23	+4.76	+2.27	+5.46	+4.36	+4.96
Demand	-.57	-1.13	+.23	-.23	+.04	-2.78

Changing Rates	1896-1914 to 1914-1929	1914-1929 to 1929-1948	1899-1909 to 1909-1919	1909-1919 to 1919-1929	1919-1929 to 1929-1948
Fact $\Delta(\overset{*}{w} - \overset{*}{q})$	+1.16	0	+1.48	-1.98	+1.29
Supply	+1.72	-1.36	+1.21	+.84	-1.72
Labor $\Delta(\overset{*}{L})$	+2.19	+1.13	+2.3[illegible]	+.24	+.97
Capital $\Delta(\overset{*}{K})$	-.47	-2.49	-1.1[illegible]	+.60	-2.69
Demand	-.56	+1.36	+.27	-2.82	+3.01

Note: All numbers given are in percent per annum.

The $\overset{*}{Z}_j$ and $\overset{*}{X}_j$ are taken from Table 3, and $\overset{*}{K}$ refers to "total" capital growth. The 1929-1948 calculation uses 1929 weights (Table A.3); all others use 1919 weights (Table A.2).

Table 5. Decomposing the Sources of Change in the American Unskilled-Wages Share, $\overset{*}{\theta}_U$, 1909-1948

Rates	1900-1909	1909-1919	1919-1929	1914-1929	1929-1948
Fact ($\overset{*}{\theta}_U$)	--2.93	+.54	-2.46	-1.20	+2.73
Supply	-0.37	+.12	+.38	+.26	-.09
Labor ($\overset{*}{L}$)	-1.97	-1.21	-1.13	-1.19	-.86
Capital ($\overset{*}{K}$)	+1.60	+1.33	+1.51	+1.45	+.77
Demand	-2.56	+.42	-2.84	-1.46	+2.82

Changing Rates	1914-1929 to 1929-1948	1900-1909 to 1909-1919	1909-1919 to 1919-1929	1919-1929 to 1929-1948
Fact $\Delta(\overset{*}{\theta}_U)$	+3.93	+3.47	-3.00	+5.19
Supply	-.35	+0.49	+.26	-.47
Labor $\Delta(\overset{*}{L})$	+.33	+0.76	+.08	+.27
Capital $\Delta(\overset{*}{K})$	-.68	-0.27	+.18	-.74
Demand	+4.28	+2.98	-3.26	+5.66

Note: See notes to Table 4

immigration flood more palatable, perhaps even resulting in postponement of the flurry of social legislation passed after 1896 and before 1914. Similar results are forthcoming when the period is truncated to the decade following 1899. The rise in the skill premium was less pronounced during this shorter period, failing as it did to include the last surge from 1909 to 1914. Nor is it a less rapid growth in unskilled-labor supply that explains the result, since the opposite is the case. Once again, it is demand that accounts for the disparity between the 1896-1914 and the 1899-1909 performance in $(\overset{*}{w} - \overset{*}{q})$.

Turn now to the egalitarian "revolution" between 1929 and 1948. A symmetric result emerges: Both demand and supply forces are working in concert, and once again demand influences account for almost seven-tenths of the observed long-term collapse in the wage structure (+0.23 of the +0.34 percentage points). Of course, one could argue that the unskilled-labor supply alone was exerting very powerful forces far in excess of demand. After all, $\overset{*}{L}$ declined by 1.6 percentage points between these two periods (from 2.73 to 1.09 percent). True, but at the same time $\overset{*}{K}$ declined by 1.8 percentage points, and surely no economist really believes that labor-force growth and capital (human and physical) accumulation take place independently!

We conclude that during both of these crucial periods, 1896-1914 and 1929-1948, supply and demand forces were working in collaboration to produce an unusually dramatic twentieth-century swing in equality. Furthermore, it appears that demand was, if anything, the "prime mover." Now, what about the confusing, volatile, and transitory years through World War I and the Roaring Twenties? When the fifteen years 1914-1929 are taken together one can certainly conclude that supply forces by themselves were doing all the work in contributing to the wage narrowing. Indeed, had demand played a more passive—rather than negative—role, the "revolutionary" decline in inequality might have occurred far earlier in American twentieth-century history. Perhaps, but if so then demand would be accorded an even greater role in accounting for the extraordinary income leveling that in fact took place following 1929. In any case, it seems to me more helpful to examine these intervening years as two separate episodes, first the War and then the Twenties. When we do, we find supply forces consistently making a positive contribution to income leveling, falling skill premiums, and rising relative unskilled wages (+0.99 in 1909-1919 and +1.83 in 1919-1929); it was the wide variance in demand forces that produced first the wartime income leveling and second the inequality trend of the Twenties.[20]

So much for the structure of factor rents in America after 1896. Now, what about factor <u>shares</u> in general, and the unskilled-wages share, in particular? The answers can be found in Table 5, where the historical trends in θ_{u} are decomposed. Nothing in that table conflicts with our conclusions thus far. On the contrary, the results are even stronger.[21] During the 1909-1919 decade, demand forces accounted for an overwhelming eight-tenths (+0.42 out of +0.54 percentage points) of the historical rise in the unskilled-wages share. Although the historical "facts" are much more shaky for 1900-1909, similar results are forthcoming even from this "classic labor surplus" period in American history. In every other period analyzed, demand forces account for <u>all</u> of the observed changes in the unskilled-labor share! While the unskilled-wages share was rapidly eroding during the 1920s, supply forces were tending to tug in the opposite direction. During the "revolutionary" income-leveling episode when the unskilled-labor share was rising at the fast clip of 2.73 percent per annum, supply forces in general and unskilled-labor supplies in particular were tending to reduce that share. In both the medium term and the long run, demand seems to be the dominant force behind America's twentieth-century distributional trends.

What might these demand forces have been? If we wish to understand the causes of American inequality experience during the twentieth century or earlier, we must learn far more about the components of change on factor demands. To repeat, there are three such components: (1) exogenous shifts in demand, $\overset{*}{S}_j$, induced by government policy, war, peace, etc.; (2) exogenous changes in the bias of technical progress at the industry level; and (3) unbalanced rates of total factor productivity growth by sector. The last of these forces has a very long and respected tradition in accounting for long-term structural change (Kuznets, 1966, ch. 3; Kelley, Williamson, and Cheetham, 1972, chs. 1 and 2) and thus, presumably, it should also help account for the "compositional effects" documented in section II. Table 3 presents some very tentative estimates of the unbalanced total factor productivity growth rates, $\overset{*}{T}_j$, among our three sectors. Kendrick's $\overset{*}{T}_j$ are of doubtful quality and usefulness to us because the "service" sector (C) is limited primarily to public utilities, transportation, and construction--sectors that exhibit much more rapid productivity advance than trade, government, and personal services. Thus, the figures grossly understate the degree of technological imbalance and its variance over time. On these grounds alone, all of the calculations that follow understate the impact of technological imbalance on distribution. In any case, as the source notes to Table 3 point out, even $\overset{*}{T}_M$ is of doubtful quality except for the periods dated 1909-1919, 1919-1929, and 1929-1948. If we restrict our attention to these periods alone, the crude correspondence between inequality trends and "technological imbalance" is striking. Between 1929 and 1948, the values of $\overset{*}{T}_A$, $\overset{*}{T}_M$, and $\overset{*}{T}_C$ are bunched very closely together. The period following 1929 seems best characterized therefore by balanced technological progress. As such, changes in economic structure would have been produced primarily by conventional Engel effects rather than through relative price changes. In contrast, the 1920s were years of enormous disparities between sectoral $\overset{*}{T}_j$—very high in manufacturing and modest in agriculture. Manufacturing surely was encouraged as a result, and agriculture's demise accelerated, precisely the forces that would contribute to a relatively slack demand for unskilled labor and to inequality trends. What appears to be a plausible correlation is confirmed in calculation,[22] even though the $\overset{*}{T}_C$ estimates insure an understatement of the impact of "technological imbalance." While the value of $(\overset{*}{w} - \overset{*}{q})$ changes from -.95 to +.34 between 1919-1929 and 1929-1948, the contribution of technical change under neutrality is -.85 and -.31. In other words, while $\Delta(\overset{*}{w} - \overset{*}{q})$ was +1.29 percentage points between the two periods, the diminished negative impact of technical change accounted for +.54 percentage points or four-tenths. The figure is the same when earlier years are considered. Between 1909-1919 and 1919-1929, $\Delta(\overset{*}{w} - \overset{*}{q})$ was -1.98 percentage points while the increased negative impact of technical change accounted for

−.80 percentage points. The "unbalanced rate of technical change" thesis appears to be an attractive one, well worth more careful attention.

If the empirical documentation is weak for the sectoral rates of productivity growth, it is simply nonexistent for exogenous product-demand shifts. Nevertheless, there is a mountain of circumstantial evidence that points to exogenous shifts in product-demand mix as a key mover of American distribution both in the short run and in the long run. The first kind of evidence is supplied by Appendix Tables A.2 and A.3, where the relative sensitivity of, say, $(\overset{*}{w} - \overset{*}{q})$ to changes in various exogenous variables can be seen directly. The "structural elasticities" are among the largest. Furthermore, we note with some interest that the sizes of the structural elasticities for $\overset{*}{S}_M$ and $\overset{*}{S}_C$ <u>increase</u> between 1919 and 1929. That is, the economy's wage structure was becoming increasingly sensitive to given demand shifts as the 1920s wore on. The second kind of evidence is supplied by the high correlation between qualitative indicators of $\overset{*}{S}_j$ and income distribution statistics. Consider first the wartime episode ending with 1919, and then the subsequent decade of readjustment to normality terminating with 1929.

The wartime demands in America, during both our periods of neutrality and then belligerency, were heavily biased toward manufactures.[23] The "arsenal of democracy" responded to the military requirements of the Great War and private services suffered most as a result. The outstanding example, of course, was construction, but other private service sectors also suffered by the changing mix of demands. On the other hand, there is no evidence that there was a shift in demand against agriculture in response to the war. On the contrary, food exports boomed up to 1919-1920, although cotton never recovered its peak 1912 export level during the war. All of these conditions reverse after 1919-1920. The 1920s reflect a return to the prewar output mix, with construction booming, urban services expanding, and agriculture undergoing a very painful contraction. Now, armed with the data in Appendix Table A.2, which shows $\theta_{LA} > \theta_{LM} > \theta_{LC}$, it seems apparent that these $\overset{*}{S}_j$ may be sufficient to explain much of the observed distribution change, 1909-1929.

Although this characterization of demand-mix changes associated with World War I and the Twenties is consistent with qualitative histories, quantitative documentation is another matter. Observed changes in output mix are easy to identify, but we cannot with certainty argue that they were produced by exogenous changes in demand. There can be no doubting, however, the enormous magnitude of these mix changes. When national income is defined to exclude government, domestic services, and real estate, Kuznets's current-price shares exhibit the following trends from 1919 to 1929: Agriculture and mining combined decline from 23.3 to 14.8 percent; manufacturing declines from 31.2 to 29.5 percent; and services rise from 45.4 to 55.7 percent. Constant-price shares exhibit similar, though less extreme, trends following 1919: Agriculture and mining combined decline from 23.3 to 20.7 percent; manufacturing declines from 31.2 to 26.6 percent; and services rise from 45.5 to 52.7 percent. For the period from 1913 (or 1909) to the Armistice, these dramatic sectoral growth performances—at least relative to secular trends—are reversed.

A similar argument could easily be made in tracing out $\overset{*}{S}_j$ from 1929 to 1948, but that would only replicate the "compositional analysis" presented in Table 2. Perhaps it might be less repetitive and more informative to consider the plausibility of the following experiment: Imagine a policy mix, a (cold) war stance, and a rise in government that favored agriculture, mining, and manufacturing but penalized private services of all types. Suppose this qualitative description translated quantitatively into $\overset{*}{S}_M = +1.0$ percent and $\overset{*}{S}_C = -1.0$ percent. These very modest exogenous demand shifts would have resulted (see Appendix Table A.3) in $\overset{*}{\theta}_U = +.44$, compared with an observed rate (Table 5) of 2.73 percent. There seems little doubt that exogenous changes in product demand are prime candidates to account for the income leveling after 1929.

It seems to me that one can easily develop a plausible decomposition of the demand forces that--when combined with labor supply--must have been responsible for the twentieth-century secular swing in American inequality. Much more remains to be done, of course. Not only does this statement apply to the 1896-1948 period, but a more disaggregated modeling of the post-World War II period is warranted. The research reported here certainly suggests some promise for bringing the study of secular distribution changes back to the macro level.

Table A.1. Equations [1] - [8] in Matrix Form

	$\overset{*}{w}$	$\overset{*}{d}$	$\overset{*}{q}$	$\overset{*}{P}_M$	$\overset{*}{P}_C$	$\overset{*}{A}$	$\overset{*}{M}$	$\overset{*}{C}$	Endogenous / Exogenous
[1]	θ_{LA}	θ_{NA}	0	0	0	0	0	0	$\overset{*}{T}_A$
[2]	θ_{LM}	0	θ_{KM}	-1	0	0	0	0	$\overset{*}{T}_M$
[3]	θ_{LC}	0	θ_{KC}	0	-1	0	0	0	$\overset{*}{T}_C$
[4]	$\theta_{LA}\sigma^A_{NL}$	$-\theta_{LA}\sigma^A_{NL}$	0	0	0	+1	0	0	Π_N
[5]	$(\lambda_{KM}\theta_{LM}\sigma^M_{KL}$ $+\lambda_{KC}\theta_{LC}\sigma^C_{KL})$	0	$-(\lambda_{KM}\theta_{LM}\sigma^M_{LK}$ $+\lambda_{KC}\theta_{LC}\sigma^C_{KL})$	0	0	0	λ_{KM}	λ_{KC}	$\overset{*}{K} + \Pi_K$
[6]	$-(\lambda_{LA}\theta_{NA}\sigma^A_{NL}$ $+\lambda_{LM}\theta_{KM}\sigma^M_{KL}$ $+\lambda_{LC}\theta_{KC}\sigma^C_{KL})$	$\lambda_{LA}\theta_{NA}\sigma^A_{NL}$	$(\lambda_{LM}\theta_{KM}\sigma^M_{LK}$ $+\lambda_{LC}\theta_{KC}\sigma^C_{KL})$	0	0	λ_{LA}	λ_{LM}	λ_{LC}	$\overset{*}{L} + \Pi_L$
[7]	0	0	0	$-(\eta_M\phi_M+\epsilon_M)$	$-(\eta_M\phi_C+\epsilon_{MC})$	$-\eta_M\phi_A$	$(1-\eta_M\phi_M)$	$-\eta_M\phi_C$	$\overset{*}{S}_M$
[8]	0	0	0	$-(\eta_C\phi_M+\epsilon_{CM})$	$-(\eta_C\phi_C+\epsilon_C)$	$-\eta_C\phi_A$	$-\eta_C\phi_M$	$(1-\eta_C\phi_C)$	$\overset{*}{S}_C$

Table A.2. Inverse Matrix: 1919 Structural Conditions

$\overset{*}{w}$	$\overset{*}{d}$	$\overset{*}{q}$	$\overset{*}{P}_M$	$\overset{*}{P}_C$	$\overset{*}{A}$	$\overset{*}{M}$	$\overset{*}{C}$	Endogenous / Exogenous
.445	1.302	.081	.179	.169	.151	-.060	-.036	$\overset{*}{T}_A$
.413	-.224	.603	-.448	.557	-.112	.731	-.443	$\overset{*}{T}_M$
.142	-.077	.316	.269	-.726	-.039	-.671	.480	$\overset{*}{T}_C$
.936	-.508	.702	.765	.758	.746	-.038	-.024	Π_N
.606	-.329	-1.009	-.576	-.620	-.165	.895	.732	$\overset{*}{K} + \Pi_K$
-1.274	.629	.732	.194	.248	.346	.332	.201	$\overset{*}{L} + \Pi_L$
.891	-.484	1.412	1.272	1.286	-.242	.625	-.304	$\overset{*}{S}_M$
1.228	-.667	2.114	1.876	1.900	-.334	-.552	.550	$\overset{*}{S}_C$

<u>Source</u>: The matrix inverted is given in general form in Table A.1. The 1919 structural conditions apply to θ_{ij}, ϕ_j and λ_{ij}. See text and Williamson (1974a; 1974c) for data sources on these initial conditions. In addition to the initial conditions below, we take $\sigma^j_{ik} = 0.5$, $\varepsilon_{MC} = \varepsilon_{CM} = 0$, $\eta_M = 1.3$, $\eta_C = 1.0$, $\varepsilon_M = -1.3$ and $\varepsilon_C = -1.0$.

$\theta_{LA} = .352$	$\theta_{KM} = .732$	$\lambda_{LA} = .298$	$\phi_M = .312$	$\lambda_{KM} = .398$
$\theta_{NA} = .648$	$\theta_{LC} = .241$	$\lambda_{LM} = .304$	$\phi_A = .233$	$\lambda_{KC} = .602$
$\theta_{LM} = .268$	$\theta_{KC} = .759$	$\lambda_{LC} = .398$	$\phi_C = .455$	

Table A.3. Inverse Matrix: 1929 Structural Conditions

$\overset{*}{w}$	$\overset{*}{d}$	$\overset{*}{q}$	$\overset{*}{P}_M$	$\overset{*}{P}_C$	$\overset{*}{A}$	$\overset{*}{M}$	$\overset{*}{C}$	Endogenous / Exogenous
.414	1.343	.129	.182	.178	.172	-.033	-.021	$\overset{*}{T}_A$
.467	-.273	.644	-.388	.614	-.137	.862	-.339	$\overset{*}{T}_M$
.119	-.070	.227	.207	-.792	-.035	-.829	.360	$\overset{*}{T}_C$
.891	-.521	.712	.745	.742	.739	-.021	-.013	Π_N
.797	-.466	-.826	-.527	-.550	-.234	1.006	.797	$\overset{*}{K} + \Pi_K$
-1.300	.760	.678	.314	.342	.381	.229	.148	$\overset{*}{L} + \Pi_L$
1.293	-.756	1.882	1.774	1.782	-.379	.715	-.227	$\overset{*}{S}_M$
2.971	-1.737	4.462	4.18[illegible]	4.208	-.871	-.670	.464	$\overset{*}{S}_C$

<u>Source</u>: See Table A.2. The 1929 structural conditions apply to θ_{ij}, ϕ_j, and λ_{ij}. See text for data sources on these initial conditions, and Williamson (1974a; 1974c) for calculating methods. The structural conditions are

$\theta_{LA} = .369$ $\theta_{KM} = .816$ $\lambda_{LA} = .234$ $\phi_M = .261$ $\lambda_{KM} = .295$

$\theta_{NA} = .631$ $\theta_{LC} = .170$ $\lambda_{LM} = .242$ $\phi_C = .613$ $\lambda_{KC} = .705$

$\theta_{LM} = .184$ $\theta_{KC} = .830$ $\lambda_{LC} = .524$ $\phi_A = .126$

NOTES

The research reported in this paper has benefited immeasureably by the constant criticism, discussion, debate, and unselfish contribution of my colleague, Peter Lindert. His own work on fertility, as well as our collaboration with ongoing distribution projects, has been exciting and rewarding to me. I also wish to acknowledge the research assistance of Leo De Bever, Joan Hannon, and Jim Roseberry. The ideas in this paper have been sharpened as well by seminar participants at Duke, Iowa, Queens, and Wisconsin.

[1] Indeed, the surge of multiple employment, which in part accounts for egalitarian family income trends, may also serve to explain some portion of the inegalitarian trend in individual incomes. Given the wage structure, these secondary workers (teenagers as well as wives) enter at low wage levels and produce increased measured inequality. A more relevant impact results when the assumption of a rigid wage structure is relaxed. A relative glut of unskilled secondary workers stretches the wage structure and imparts additional inequality. The impact may even be sufficiently strong to produce greater inequality among primary workers (males aged 25-64).

[2] Kuznets discovered the distribution revolution but did not popularize it. Nor did he argue that the enormous reduction of unemployment after 1939 was an insignificant part of the explanation. Indeed, twenty years ago he told us that as much as 40 percent of the observed egalitarian movement from 1939 to 1944 could be explained by the elimination of unemployment (Kuznets, 1953, p. 41). Lydall (1959, p. 33) reached the same conclusion regarding the British income leveling 1938-1957.

[3] The civilian labor force unemployment rate was 5.5 percent in 1929 and averaged 5 percent in the period 1925-1929 (Coen, 1973, Table 2, p. 52). The rate in 1948 was lower, 3.8 percent, but the average from 1946 to 1950 was very similar to that of the late twenties: 4.6 percent (Lebergott, 1964, Table A-3, p. 512).

[4] Denote the unskilled wages share as θ_U, the "conventional" wages share as θ_T (Williamson, 1974a, Table 4.1, p. 24), and B90,95 as the shares of bottom income classes in total income (Kuznets, 1953). The following correlations for the nonfarm sector, 1916-1938, are relevant:

$$B90(t) = \underset{(24.803)}{55.048} + \underset{(5.227)}{0.507}\theta_U(t), \quad R^2 = 0.845$$

$$B90(t) = \underset{(7.687)}{61.003} + \underset{(0.702)}{0.071}\theta_T(t), \quad R^2 = 0.090$$

$$B95(t) = \underset{(27.898)}{68.807} + \underset{(2.736)}{0.295}\theta_U(t), \quad R^2 = 0.600$$

$$B95(t) = \underset{(14.069)}{68.781} + \underset{(1.379)}{0.086}\theta_T(t), \quad R^2 = 0.276$$

The figures in parentheses are t-statistics. While $\theta_U(t)$ is quite a good predictor of B(t), $\theta_T(t)$ has no significant correlation with any of the available size-distribution statistics. In short, the distribution of wage income itself is at least as important as the distribution between wages and nonwages. Human capital is already too important by World War I to ignore in any distributional analysis.

[5] With far less data at hand, Simon Kuznets made a pretty fair guess in 1955:

> I would place the early phase in which income inequality might have been widening...from about 1840 to 1890...I would put the phase of narrowing income inequality...beginning with the first World War.... (1955, p 19)

Peter Lindert and I hope to complete a paper soon that will contain a comprehensive survey of American trends in inequality from the seventeenth century onwards.

[6] The rhetoric is borrowed from Faulkner (1931). The literature on this period is extraordinarily rich, exciting, and voluminous. For a sampling, see Jenks and Lauck (1913), Commons (1908), Bremner (1956), and Faulkner (1951).

[7] Kindleberger (1967) uses an elastic labor supply model to explain the West European "miracle." The motivation was to explain the high profit shares and relatively stable real wages, high savings shares, high capital formation rates, and thus "miraculous" growth. The correspondence with America from 1896 to 1914 is less than perfect, however. There was nothing miraculous about American growth prior to World War I, even when compared with growth during the 1920s, a period of presumed unskilled-labor shortage.

[8] Recall that we are discussing only full employment episodes. The short-run impact of inflation, stabilization, cycles, and growth is straightforward and well understood.

[9] To be more precise,

$$\log M_t = \log\left(\frac{wL}{qK}\right)_t - (1 - \sigma_o)\log\left(\frac{w}{q}\right)_t$$

where (wL/qK) is the ratio of the total--not just unskilled--wage bill to property--excluding human capital--income, and σ_o is the 1902 elasticity of substitution. Thus, "M_t may be regarded as a proxy for that part of [labor's share] which is attributed to induced and autonomous inventions and changes in the industrial composition" (Morishima and Saito, 1968, p. 436). The index in Figure 2 is very similar to that found in David and van de Klundert (1965, p. 383).

[10] The traditional literature stresses rapid rates of labor saving in manufacturing. From this, the argument goes, profits swelled, monopoly proliferated along with mergers and organizational change, while labor union membership waned. See the summaries and critiques in Keller (1973) and Williamson (1974c).

[11] That is, among econometricians. Keller (1973) has argued the point at length. Somewhat immodestly, so too has Williamson (1974c).

[12] The model has been presented at greater length in Williamson (1974a; 1974c). It relies very heavily on Jones (1965).

[13] Denoting the percentage change in factor i's price as $\overset{*}{V}_i$, the percentage change in the input coefficient is

$$-\overset{*}{a}_{ij} = \theta_{kj}\sigma^j_{ik}(\overset{*}{V}_i - \overset{*}{V}_k).$$

[14] It should also be emphasized that the model makes predictions regarding the commodity price structure. The historical variation in this price structure had an uneven impact on the cost of living by income class. In another paper (Williamson, 1974d), we show that the nominal income distribution patterns exhibited in Figure 1 are reinforced by cost-of-living changes. Presumably, our interest is in explaining real income distribution. Our model is not yet equipped to do so, since there is no statement about the distribution of K, thus no prediction about per capita income of the skilled or of "capitalist" classes, and thus no relevant budget weights for the high-income groups. The model should, however, make predictions on changes in the price structure and these should conform to historical reality.

[15] The most recent industry study would seem to deny the relevance of factor saving, at least for agriculture. Exploiting the translog cost function, Binswanger (1974) finds the following: (1) no evidence of factor-saving bias up to 1928, certainly not labor saving; (2) very weak labor saving, 1928-1948; (3) very strong labor saving and

[15] (continued)
machine using, 1948-1968. Binswanger views this as support of the induced-innovation hypothesis with a "six to ten year" lag. This *ad hoc* lag does well for the post-World War II period, but fails badly for post-World War I.

For a summary of the labor-saving literature as it applies to the 1920s, see Williamson (1974a; 1974c).

[16] I'm sure many readers will object to a model that treats $\overset{*}{K}$ as exogenous. Indeed, some may feel strongly that large historical values of $\overset{*}{L}$ inevitably implied large values of $\overset{*}{K}$ via income distribution, although there is a significant amount of literature now accumulating that challenges the "classical" capital-formation-profit-share model (see Cline, 1972). One must start somewhere, however, and simple comparative statistics are a first step. As an essential concession to the view that $\overset{*}{K}$ and $\overset{*}{L}$ are interrelated, all empirical analysis that follows shall treat "supply forces" as a *joint* influence, not to be separated.

[17] I am grateful to Frank Lewis and Michael Percy, who pointed out some empirical flaws in my earlier (1974a; 1974c) papers. The λ_{Kj} are correct, but the λ_{Lj} have been revised. The following relationships must hold:

$$\frac{\lambda_{Lj}}{\lambda_{Lk}} = \left(\frac{\theta_{Lj}}{\theta_{Lk}}\right)\left(\frac{\sigma_j}{\sigma_k}\right).$$

Given this expression and that $\sum_j \lambda_{Lj} = 1$, then the θ_{Lj} and ϕ_j data imply λ_{Lj}.

[18] The Nordhaus and Tobin (1972, Table A.3, p. 30) figures for 1929 suggest that human capital accounted for only 11.4 percent of total capital (excluding land). I tend to favor Schultz's older estimate, but if the reader prefers Nordhaus and Tobin, he should *inflate* the estimates of demand's impact on distribution that follow.

[19] A similar argument can be made, I think, for an earlier epic surge in inequality that also coincides with an unusual immigration surge—the antebellum years after 1846. See Williamson (1974b).

[20] This result has been greatly amplified in Williamson (1974a) where the shorter-run influences from 1913 to 1929 were at issue.

[21]Perhaps not a surprising result since a rise in the supply of a factor bids down its rate of pay, thus inducing a diminished impact on shares, no matter what the aggregate elasticity of substitution may be.

[22]The impact of neutral technical progress involves, in terms of Appendix Table A.1, an evaluation of the influence of $\overset{*}{T}_A$, $\overset{*}{T}_M$, $\overset{*}{T}_C$, and some implied values for Π_i. For example, total factor productivity growth in manufacturing is

$$\overset{*}{T}_M = \theta_{KM}\overset{*}{b}_{KM} + \theta_{LM}\overset{*}{b}_{LM} .$$

If we impose neutrality, then by assumption $\overset{*}{b}_{KM} = \overset{*}{b}_{LM}$. It follows that $\overset{*}{T}_M = \overset{*}{b}_{KM} = \overset{*}{b}_{LM}$. Similarly for the other two sectors, so that explicit values of Π_i are implied by the neutrality assumption:

$$\Pi_K = \lambda_{KM}\overset{*}{b}_{KM} + \lambda_{KC}\overset{*}{b}_{KC} = \lambda_{KM}\overset{*}{T}_M + \lambda_{KC}\overset{*}{T}_C$$

$$\Pi_N = \overset{*}{b}_{NA} = \overset{*}{T}_A$$

$$\Pi_L = \lambda_{LA}\overset{*}{b}_{LA} + \lambda_{LM}\overset{*}{b}_{LM} + \lambda_{LC}\overset{*}{b}_{LC} = \lambda_{LA}\overset{*}{T}_A + \lambda_{LM}\overset{*}{T}_M + \lambda_{LC}\overset{*}{T}_C.$$

See Williamson (1974a; 1974c) for further discussion of this point.

[23]The following two paragraphs are taken from Williamson (1974c, pp. 20-22).

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