

REPLACEMENT RATES IN THE PRODUCTIVE AGES

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WHEN facts are desired which are pertinent to such questions as the present rate of expansion of the labor supply, the expansion in demand for housing, the probable expansion of the market for other commodities with relatively inelastic demand, or the actual volume of the youth problem—students often turn to the total increase of the population. This is a crude measure at best since it is possible for the rate of total population increase to slacken and the rate of increase of middle age groups to remain constant or to rise. Increase by births is not effective for eighteen or twenty years in the form of maturing adults and, while some deaths over 65 represent losses of active members of the labor market, others represent losses of people who have previously retired.

The change, in any particular year, in the number of persons in the productive age groups is due to the survivals from births in past years to the first year of productive age, less the deaths within the productive ages during the current year, less the number who pass annually beyond the last year of productive age. This is the replacement rate due solely to excess of maturities over deaths and senescence and for a particular geographic area ignores any changes attributable to migration.

We, therefore, suggest as a more refined measure of increase in workers at a particular time the use of the rate of replacement of productive persons. This is illustrated in this article chiefly by analysis of the farm population. The replacement rate used is the annual increase in the number of males 18 to 65 years of age.² The use of

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² These ages were used as approximate average ages of entry and retirement from farming.

the ages 18 and 65 is somewhat arbitrary but not entirely so since evidence indicates that these are roughly the average entrance and retirement ages for farmers. The determination of the most significant age grouping for use in the non-farm groups and in cities would require considerable research.

The effective increase of the rural farm group may be calculated in several ways. At the time of a census enumeration the number of persons 65 years of age may be subtracted from the number of persons 18 and the result further reduced by the deaths between 18 and 65 during the year. The result will be the annual increment in the working group which may be converted to a rate simply as percentage increase of the age group 18 to 65 or as ratio of maturities to deaths and senescence. For comparison with other rates such as the rate of natural increase the per cent increase of males 18 to 65 years of age is preferable. In other words just as reproductive rates represent the extent to which daughters replace mothers so male replacement rates may be considered as the rate at which sons replace fathers.

Specifically, the factors expressed in the replacement rate are (a) survivals from births eighteen years before, (b) deaths between 18 and 65 during the current year, and (c) the proportion of the population between the ages of 18 and 65 upon which the rate of death and senescence operates. If, in addition, the rate is applied to males only, then the sex ratio affects the rate since births are usually fairly closely balanced between the sexes and maturities will have a balanced ratio whereas deaths and senescence would apply to the segment of the population with the unbalanced ratio.

For past periods, the rate of increase in the age group can be calculated as of the date of enumeration of each census by the above method. It is not possible to use the actual enumerated increase from one census to another in the group 18 to 65 as this is disturbed by migration. The comparison of the male replacement rate in the rural farm population in 1920 and 1930 is shown in Table 1.

From Table 1, it is evident that although the rate of natural increase was beginning to slacken, the lower rate had not been operative long enough to affect the productive age levels. In fact increase in the productive ages was still climbing. This is owing, probably, to the more rapid decline in the number of deaths of the middle age groups than there had been in the number of births from 1902 to 1912.

Table 1. Replacement rate of males in the rural farm population, 1920 and 1930.

Item	1920	1930
18 Years of Age	336,827	363,793
65 Years Plus Deaths 18 to 65 ¹	160,165	162,390
Difference	176,662	201,403
Age Group 18-65	8,424,907	8,360,946
Annual Replacement Rate	2.10	2.41

¹Age specific death rates from Dublin, Louis I.: *Length of Life*, page 91, applied to 1920 and to 1930 ten-year age groupings.

It is apparent that at the beginning of the depression farm youth were entering the productive age groups at the rate of about 200,000 per year faster than these age groups decreased by death and old age, i. e., without cityward migration the rural farm group 18 to 65 would have increased by about 1,000,000 between 1930 and 1935. This is in essence the measure of the pressure of population on agriculture during the depression. It is a measure of the volume of the youth problem in the rural farm population. With estimates of the type of those of Thompson and Whelpton³ at hand, however, future projections can be made. Projection for eighteen years in the future carries a high degree of accuracy since the effective replacements for that period are already born.

The change in this replacement rate in the rural farm population is projected to 1955 in Table 2 by the use of Thompson and Whelpton's age group survival tables corrected to correspond to the enumerated farm population in 1935. Having distributed the farm population as enumerated in 1935 by sex, as in 1930, and by age, as in Thompson and Whelpton's estimates, this population is

³Published in a mimeographed bulletin of the National Resources Board, "Estimates of Future Population, by States"—a series of tables prepared by Warren S. Thompson and P. K. Whelpton, December, 1934.

YEAR	AVERAGE POPULATION 18-65 YEARS OF AGE (Thousands) ¹	AVERAGE ANNUAL INCREASE (Thousands)	ANNUAL REPLACEMENT RATE	ESTIMATED INCREASE IN TOTAL POPULATION
1935-1939	9,762	225.6	2.31	1.53
1940-1944	10,813	195.0	1.80	1.45
1945-1949	11,710	163.6	1.40	1.35
1950-1954	12,557	176.0	1.40	1.16

¹The farm population as enumerated in 1935 was distributed by sex according to the sex ratio of the 1930 population and by age according to the age group distribution estimated by Thompson and Whelpton.

Table 2. Replacement rate of males in the rural farm population, 1935-1955.

projected to 1955 by the age group survival method and the per cent increase in the group 18 to 65 calculated. This gives a quinquennial replacement rate of which the average is approximately the annual replacement rate at the middle of the quinquennium.

Although maturities had been increasing from 1920 to 1930 the trend reversed after 1935 and it is apparent from Table 2 that the

Table 3. Replacement rate of males in the rural farm population, 1930 (selected states).¹

State	Annual Replacement Rate
United States—Total	2.41
North Carolina	3.64
Kentucky	2.42
North Dakota	2.88
Utah	3.08
Indiana	1.22
Ohio	1.12
Vermont	.81

¹Ages 18 to 65 from *Fifteenth Census of the United States: 1930*. Deaths between 18 and 65 obtained by rates from Dublin, Louis I.: *op. cit.*, page 350.

future course of the increase in the productive ages is sharply downward until about 1947 when it levels off.

Expressed in actual numbers, this means that in twenty years, assuming no resumption of migration to cities, the present generation of rural farm population will mature 3,800,000 youth in excess

of the losses in the 18 to 65 group in spite of the rapid fall in the rate of natural increase.

The varying geographic incidence of this youth pressure as measured by the replacement rate is indicated by comparison of the 1930 replacement rates for selected states (Table 3) and by states

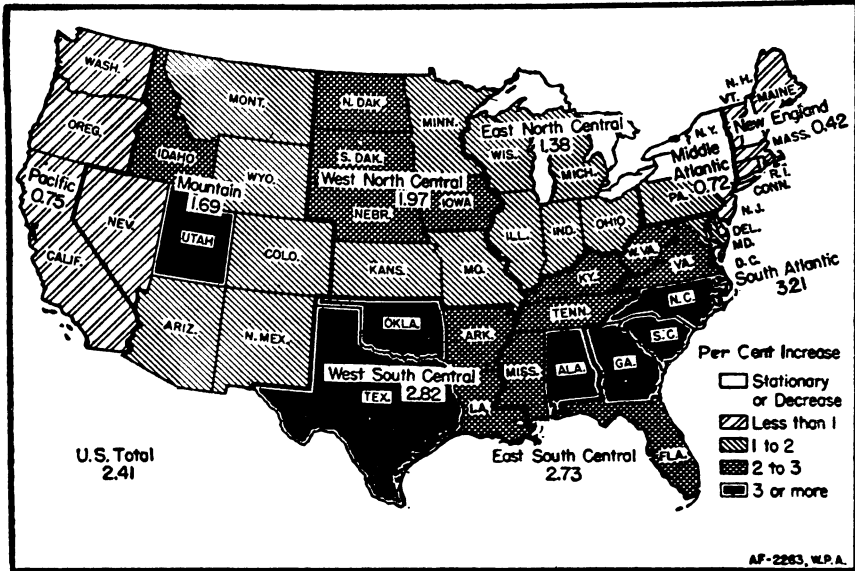


Fig. 1. Replacement rates of males 18 to 65 years of age in the rural farm population, by regions and by states, 1930.

and regions for the entire country (Figure 1). It will be noted that the two states of North Carolina and Kentucky in the Appalachian Area have rates as high as those of the western states, Utah and North Dakota. The states of Vermont, Ohio, and Indiana where the falling birth rate is of relatively earlier incidence already have low replacement rates.

The difference in the replacement rate and the rate of natural increase may be illustrated by data for the total United States given in Table 4. It will be observed that while the rate of natural increase dropped 26 per cent from 1920 to 1930 the male replacement rate did not change markedly. The 1920-1930 decline in natural increase will show in the replacement rates from 1938 to 1948 pro-

Table 4. Rate of natural increase and replacement rate of males, per 100 for the United States total population, 1920 and 1930.

	1920 ¹	1930 ¹
Rate of Natural Increase	0.99	0.73
Rate of Male Replacement	1.21	1.17

¹Rates of natural increase per hundred from Thompson, Warren S.: *Population Problems*, p. 242. 1920 = 1918-1922 average, 1930 = 1928-1932 average. Male replacement rate calculated as in Table 1.

POPULATION	QUINQUENNIAL MID-YEAR			
	1937	1942	1947	1952
Urban	.72	.59	.09	-.30
Rural Non-Farm	1.56	1.46	1.07	.73
Rural Farm	2.31	1.80	1.40	1.40

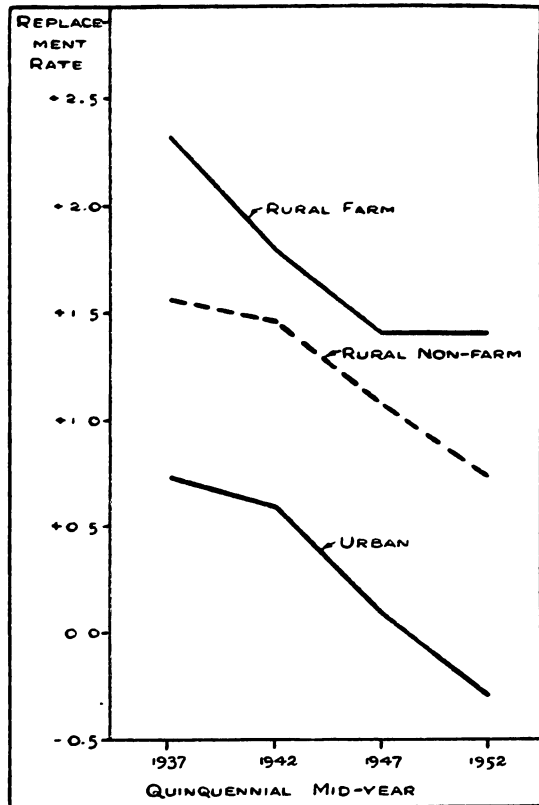
Table 5. Annual replacement rate of males 18 to 65. (Estimated from Thompson and Whelpton's age survival tables [no interstate migration] at midpoint of five-year period.)

5 and Figure 2 for the United States total by farm, non-farm, and urban groups. Table 6 indicates the projected replacement rate for the United States total farm population and the farm population of eight drought states. Knowledge of the future trends of population in those states is particularly important since many of the rehabilitation measures advocated for the drought states will call for a reduction in, rather than an increase of, population. A question of paramount administrative importance, therefore, is the number of people that will probably be in excess of present needs as a result of the rate of maturity of the children now under 18 years of age. In actual numbers if there is

vided there is not an offsetting decline in the death rate, 18 to 65, within that period.

The extent of decline in the replacement rate of males in the population is illustrated in Table

Fig. 2. Annual replacement rate of males 18 to 65 in rural farm, rural non-farm, and urban populations of the United States. Estimated from Thompson and Whelpton's age survival tables (no interstate migration) at midpoint of 5-year period.



no migration, these drought states will mature over a quarter of a million youth in excess of the losses from the productive age group. However, the rapid decline in the replacement rate indicates that by 1955 the population pressure will be greatly alleviated in most of the states.

Such replacement ratios are often more useful as a measure of population increase than net total increases or rates of actual increase, and also they can be calculated for groups for which specific birth and death rates are not available. Any population for which the age distribution and a knowledge of the survival rates are available is subject to such calculation.

Table 6. Annual replacement rate of males in the rural farm population, 1935-1955 in eight drought states and in the United States.¹

State	QUINQUENNIAL MID-YEAR			
	1937	1942	1947	1952
United States—Total	2.31	1.80	1.40	1.40
North Dakota	2.23	1.62	1.25	1.22
Montana	1.49	.95	.55	.46
South Dakota	2.17	1.65	1.10	.83
Wyoming	1.33	.84	.61	.52
Nebraska	2.00	1.53	1.07	.77
Colorado	1.82	1.41	.98	.92
Kansas	1.48	1.26	.97	.85
New Mexico	2.28	1.68	1.75	1.85

¹Age group 18 to 65 projected by Thompson and Whelpton's estimates *op. cit.*, corrected by the 1935 Census.