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SECULAR TRENDS IN THE SIRTH RATIO OF WHITES, BY STATES FOR THE UNITED STATES, 1870-1950

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SECULAR TRENDS IN THE BIRTH RATIO OF WHITES, BY STATES FOR THE UNITED STATES, 1870-1950

A. Introduction -- The Setting of the Analysis

1. Sources and Nature of the Basic Data

The basic data underlying this analysis were compiled by the University of Pennsylvania Study of Population Redistribution and Economic Growth under the direction of Professors Simon Kuznets and Dorothy S. Thomas. Consisting of census figures on the distribution of population by age and sex, the data are reported by states and cover the time span from 1870 to 1950. The age distribution data distinguish five-year intervals, and are recorded separately for native whites and foreign-born whites.

In the analysis, there are 46 spatial units. These include each of the 48 states, except Oklahoma for which there are no data prior to 1890 and except for the treatment of North and South Dakota as one unit called Dakota.

2. The Variables in the Analysis

Because of the nature of the basic data, neither the crude nor the refined birth rate is directly obtainable. Since the age distribution distinguishes five year intervals, we cannot determine the number of children born in a given year. Hence it is impossible to ascertain the crude or refined birth rate for that year. The measure that will be used as an indirect approximation to the crude birth rate is the ratio of

children aged 0-4 to total population -- to be referred to as the crude birth ratio. As an indirect measure of the refined birth rate, we shall employ the ratio of children aged 0-4 to women aged 15-44 -- to be called the refined birth ratio. Another variable, relevant in the analysis, is the proportion of women aged 15-44 in the total population, that is, the percentage of women of child-bearing age. Consideration will also be given to two other demographic variables -- the proportion of women aged 20-29 among all women aged 15-44, and the proportion of foreign-born white women among all women aged 15-44. Since this paper is concerned with whites only, any reference to a population class such as all women, total population, or children aged 0-4 pertains only to whites.

With the basic census data available at decennial intervals, the crude and refined birth ratios yield information for the second half of each intercensal decade. For reasons that will presently become apparent it is useful to have an estimate of the refined birth ratio for the first half of a decade. As an approximate measure of the ratio of children aged 0-4 to women aged 15-44 living at the end of the first quinquennium of each decade, we employ the ratio of children aged 5-9 to women aged 20-49 living at the end of the second quinquennium of the decade.

3. The Calculation of the Trends

For each variable noted above, a state by state trend analysis has been carried out. The method of semi-averages has been used to calculate the trends. Dividing the 1870-1950 time interval into two periods, 1870-1910 (Period I) and 1910-1950 (Period II), we calculated the geometric

average of the ratios for each period. The two averages, centered in their respective periods, determine the trend line.

Although the method of semi-averages reveals the general direction of the trend, it fails to indicate whether the trends have been consistently downward (or upward) throughout the time period. In order to test the consistency of the trends, we have calculated a three item moving average (geometric), The moving average analysis has been confined to the two refined birth ratio variables — the ratio of children aged 0-4 to women aged 15-44 and the ratio of children aged 5-9 to women aged 20-49.

4. The Shortcomings of the Birth Ratio as a Measure of the Birth Rate

Before presenting a summary of the findings, we should point out some of the limitations and qualifications. A trend analysis of birth ratios yields results different from those of a trend analysis of true birth rates for at least three distinct reasons.

a. The Problem of the Differential Death Rate Decline

One of the differences results from the fact that during the past ninety years the absolute decline of the death rate of children aged 0-4 has been greater than the decline of the death rate of women aged 15-44. The error created because of the differential death rate decline can be illustrated by means of an example. Consider the ratio of children aged 0-4 to women aged 15-44 in Maine in 1880. The number of children aged 0-4 in 1880 is not equal to the number born in Maine between 1875 and 1880, partly because some of them died during the period. Likewise, the figure for women aged 15-44 in 1880 understates the number of women aged

15-44 who lived in Maine between 1875 and 1880, partly because some of them died during the period. The degree of understatement in each age group varies directly with the death rate of that age group. Since the death rate for children aged 0-4 has fallen absolutely more than for women aged 15-44, the relative amount of understatement of births has decreased more than the relative amount of understatement of women aged 15-44. Consequently, a downward trend in the refined birth ratio understates any long-term decline of the actual refined birth rate.

Since we are interested in finding the percentage decline of the refined birth rate, but have only been able to compute the percentage decline of the refined birth ratio, it is necessary to estimate by how much the decline of the latter understates the decline of the former. The following model was devised in order to estimate the error of understatement attributable to the differential death rate decline:

Let X_1 = the geometric average of census year figures of children aged 0-4 for 1870-1910.

X_1^1 = the geometric average of the number of children born in the periods of 1865-1870, 1875-1880,...1905-1910.

X_2 and X_2^1 correspond to X_1 and X_1^1, respectively, but for the period from 1910-1950.

Y_1 = the geometric average of census year figures for women aged 15-44 from 1870-1910.

Y_1^1 = the geometric average of census year figures for women aged 15-44 adjusted to include those women who would have been in the 15-44 age class had they not died in the preceding five years (for the period from 1870-1910).

Y_2 and Y_2^1 correspond to Y_1 and Y_1^1, respectively, but for the period from 1910-1950.

Let us make the following assumptions:

(1) $X_1 = .85X_1^1$ (3) $Y_1 = .95Y_1^1$

(2) $X_2 = .90X_2^1$ (4) $Y_2 = .98Y_2^1$

In other words, we are assuming that the average death rate per quinquennium of children aged 0-4 was 15% in Period I and 10% in Period II; it is assumed that the average death rate per quinquennium of women aged 15-44 was 5% in Period I and 2% in Period II.(1)

The percentage decline of the refined birth ratio unadjusted for death rates is(2)

$$P = \frac{.539 - .423}{.539} = 21.5\%$$

The percentage decline of the refined birth ratio, adjusted for deaths, is

$$p^1 = \frac{\frac{X_1^1}{Y_1^1} - \frac{X_2^1}{Y_2^1}}{\frac{X_1^1}{Y_1^1}}$$

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(1) These estimates are based on specific death rate figures found in P. K. Whelpton and W. S. Thompson, Population Trends in the United States (New York: McGraw Hill Book Company, Inc., 1933), pp. 236, 246.

(2) .539 and .423 are the geometric averages of the refined birth ratios for the United States whites in Periods I and II, respectively.

Substituting (1), (2), (3), and (4)

$$P = \frac{\frac{539}{\frac{.85}{1000}} - \frac{423}{\frac{.90}{1000}}}{\frac{539}{\frac{.85}{1000}}} = 23.5\%$$

$$P^1 - P = 23.5\% - 21.5\% = 2.0\%$$

Thus, in this illustration, the percentage decline of the refined birth ratio is about 2 percentage points greater when the figures are adjusted to eliminate the error caused by the differential death rate decline.

b. The Problem of Interstate Migration

Another source of error is interstate migration. The nature of this error can be illustrated by means of an example. Assume that the number of children aged 0-4 living in Maine was 100 according to the 1880 census. Also assume that the number of births in Maine between 1875 and 1880 was 125, but that 25 of those children emigrated to other states during the period. Clearly, unless the mothers of the 25 children emigrated with their offspring, the refined birth ratio based on 1880 figures would misrepresent Maine's refined birth rate. Furthermore, if, over time, the relation between the migration of children aged 0-4 and the migration of their mothers changes, the trend of the refined birth ratio cannot accurately portray the trend of the refined birth rate. However, since children aged 0-4 usually migrate with their mothers, the error due to

interstate migration is probably not significant. But separation of 5-9 year old children from their mothers is more common, and therefore, interstate migration may distort somewhat the 5-9 to 20-49 refined birth ratio of any given spatial unit.

c. The Problem of Underenumeration

The third source of error is the census underenumeration of children aged 0-4. In every census, there is an undercount of the 0-4 age class.(3) Part of the undercount of the 0-4 group may result from the erroneous reporting as 5 of many of the children who were 4 on their last birthday. The shift of these children to the 5-9 group is balanced partially or fully by the erroneous shift to the 10-14 group of children who were 9 on their last birthday, and consequently, census enumeration of the 5-9 group is not likely to be seriously affected by this type of mis-reporting of age.

Over time, there has been a decline in the percentage underenumeration of children aged 0-4. Thus, everything else being equal, the refined birth ratio would tend to rise over time simply because of a rise in the numerator which has been brought about by more complete reporting of the 0-4 age class. Therefore, any observed decline of the refined birth ratio understates the decline of the actual refined birth rate.

In an unpublished manuscript, Dr. Everett Lee of the University of Pennsylvania has adjusted for underenumeration the census figures for native whites aged 0-4. To estimate the 0-4 age group in year x, Dr. Lee applied reverse survival ratios (taken from life tables) to the 10-14 age group in year x + 10. Note that this correction for underenumeration is

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(3) There may also be an undercount of women aged 15-44 which, in the computation of the refined birth ratio, partially offsets the effect of the 0-4 undercount.

relative to the enumerated 10-14 age group of a following decade. Table I - 1 presents estimates of the undercount for United States whites aged 0-4 since 1870.

In order to estimate the size of the error caused by underenumeration, we found the country-wide trend lines calculated on the basis of both the adjusted and the unadjusted data. The geometric average of the unadjusted refined birth ratio was .539 in Period I and .423 in Period II. The absolute decline was .116 and the percentage decline was 21.5%. Repeating the calculations with the adjusted 0-4 figures, we found that the geometric averages were .581 and .444 for Periods I and II, respectively. The absolute decline was .137, and the percentage decline was 23.6%. As was expected, the percentage decline of the refined birth ratio is greater when the figures are adjusted for underenumeration: the former exceeds the latter by 2.1 percentage points.

In the trend analysis by state, the unadjusted 0-4 data are used. It would be invalid to apply the same country-wide adjustment ratio to the 0-4 class of each state because the degree of underenumeration varies from state to state and from region to region. In working with unadjusted data, we must bear in mind that interstate differences in the refined birth ratio are not equivalent to the actual refined birth rate differentials. However, cross-section differentials are so clear cut that they could not have been distorted by the error of underenumeration. In fact, if the error could somehow have been removed, the cross-section differences would most likely be even sharper because it is in the high birth ratio states that the undercount tends to be greatest.

Table I-1

Underenumeration of White Children

Aged 0-4

	Unadjusted	Adjusted	Proportion Enumerated
1870	4,719,792	5,337,587	.884
1880	5,800,151	6,246,073	.929
1890	6,579,648	7,348,787	.895
1900	7,919,952	8,176,996	.968
1910	9,322,914	9,664,440	.965
1920	10,373,920	10,949,619	.947
1930	10,142,169	10,543,767	.962
1940	9,229,505	9,799,582	.944
1950	14,254,065	15,060,738	.944 (4)

(4) Percentage enumerated in 1950 census assumed equal to percentage enumerated in 1940 census.

d. The Bearing of the Qualifications

The use of birth ratios in the analysis gives rise to a number of errors. However, these errors do not distort the conclusions of the paper; on the contrary, if adjustments are made to account for the errors, the conclusions are strengthened. For example, the analysis reveals that the secular trend of the refined birth ratio is moving downward, but because of the differential death rate decline and the error of underenumeration, the downward trend of the refined birth ratio is not as sharp as the downward trend of the refined birth rate.

Later in the paper, the findings for the ratio of children aged 5-9 to women aged 20-49, a measure less distorted by undercount, will be summarized. It will be seen that these findings are similar to those for the 0-4 to 15-44 measure — a further indication that the error of underenumeration will not affect the conclusions. We may therefore turn to the analysis feeling that the qualifications which have been introduced do not imperil the major findings.

B. Levels and Trends of the State-wide Birth Ratios

1. Levels and Trends of the Crude Birth Ratio

The levels and trends of the crude birth ratio are summarized in Tables I - 2a, I - 2b, and I - 2c. Each state is classified in one of nine regions according to the standard census breakdown. Columns I and II of Table 1 - 2a, which show the geometric averages for Periods I and II, throw light on the question of geographic differentials in the crude birth ratio. Columns III and IV show the absolute and relative changes in the geometric averages between Periods I and II.

The tables demonstrate clearly that interstate differences in crude

Table I-2a

The Crude Birth Ratio

Geometric Averages of the Ratio of Whites Aged 0-4 to Total Whites, 1870-1950

		1870-1910 Period I	1910-1950 Period II	II-I	$\frac{II-I}{I}$
I	**New England**				
	Maine	.097	.096	-.001	-.010
	New Hampshire	.089	.089	0	0
	Vermont	.099	.095	-.004	-.040
	Massachusetts	.099	.087	-.012	-.121
	Rhode Island	.101	.089	-.012	-.119
	Connecticut	.101	.089	-.012	-.119
II	**Middle Atlantic**				
	New York	.106	.085	-.021	-.198
	Pennsylvania	.123	.098	-.025	-.203
	New Jersey	.114	.088	-.026	-.228
III	**South Atlantic**				
	Delaware	.111	.090	-.021	-.189
	Maryland	.119	.094	-.025	-.210
	Virginia	.136	.111	-.025	-.184
	West Virginia	.149	.124	-.025	-.168
	North Carolina	.148	.125	-.023	-.155
	South Carolina	.146	.122	-.024	-.164
	Georgia	.149	.118	-.031	-.208
	Florida	.145	.103	-.042	-.290
IV	**East South Central**				
	Kentucky	.140	.118	-.022	-.157
	Tennessee	.146	.117	-.029	-.199
	Alabama	.152	.124	-.028	-.184
	Mississippi	.153	.120	-.033	-.216
V	**West South Central**				
	Arkansas	.160	.122	-.038	-.238
	Louisiana	.145	.115	-.030	-.207
	Texas	.154	.112	-.042	-.273

Table I-2a concluded

		1870-1910 Period I	1910-1950 Period II	II-I	$\frac{II-I}{I}$
VI	East North Central				
	Ohio	.115	.093	-.022	-.191
	Indiana	.121	.095	-.026	-.215
	Illinois	.126	.089	-.037	-.294
	Michigan	.118	.101	-.017	-.144
	Wisconsin	.129	.099	-.030	-.233
VII	West North Central				
	Minnesota	.143	.099	-.044	-.308
	Iowa	.128	.097	-.031	-.242
	Missouri	.131	.092	-.039	-.298
	Dakota	.143	.116	-.027	-.189
	Nebraska	.140	.101	-.039	-.279
	Kansas	.134	.098	-.036	-.267
VIII	Mountain				
	Montana	.098	.102	+.004	+.041
	Idaho	.127	.115	-.012	-.094
	Colorado	.111	.099	-.012	-.108
	Wyoming	.104	.105	+.001	+.010
	New Mexico	.142	.130	-.012	-.085
	Arizona	.106	.115	+.009	+.085
	Utah	.162	.127	-.035	-.216
	Nevada	.089	.086	-.003	-.034
IX	Pacific Coast				
	Washington	.120	.087	-.033	-.275
	Oregon	.118	.085	-.033	-.280
	California	.101	.079	-.022	-.218

Table I-2b

Geometric Averages of the Crude Birth Ratio, 1870-1910, (Period I)

Crude Birth Ratio	All States	New Eng.	Mid. Atl.	S. Atl.	East S. Cen.	West S. Cen.	East N. Cen.	West N. Cen.	Mountain	Pacific Coast
.150-.162	5				2	2			1	
.140-.149	12			5	2	1		3	1	
.130-.139	3			1				2		
.120-.129	7		1				3	1	1	1
.110-.119	7		1	2			2		1	1
.100-.109	6	2	1						2	1
.090-.099	4	3							1	
.080-.089	2	1							1	
Median	.126	.099	.114	.140	.149	.154	.121	.137	.108	.118

Table I-2c

Geometric Averages of the Crude Birth Ratio, 1910-1950, (Period II)

.130-.139	1								1	
.120-.129	7			3	2	1			1	
.110-.119	9			2	2	2		1	2	
.100-.109	5			1			1	1	2	
.090-.099	13	2	1	2			3	4	1	
.080-.089	10	4	2				1		1	2
.070-.079	1									1
Median	.099	.089	.088	.115	.119	.115	.095	.098	.110	.085

birth ratio levels are associated with differences in the geographic location of the states. States in the West South Central, East South Central, and South Atlantic regions had comparatively high crude birth ratios in both Periods I and II. In thirteen of the fifteen states in these regions, the ratios were greater than the median state ratio. The exceptions, Maryland and Delaware, are border states. The New England, Middle Atlantic, and Pacific Coast states had comparatively low crude birth ratios. In neither period did a state in one of these three regions have a ratio average above the median. States in the West North Central and East North Central regions clustered near the middle of the range, but those in the West North Central region tended to have the slightly higher ratios. Perhaps the Mountain region is the most interesting of all. Its states were widely scattered throughout the crude birth ratio distribution. At one extreme, Utah and New Mexico had exceptionally high ratios. At the other extreme, Nevada ranked very low. Other Mountain states were dispersed between these extremes.

Interstate differences in crude birth ratio levels are substantially narrower in the later period. This is because the states with comparatively high ratios in Period I tended to experience greater absolute and relative declines than the other states. However, the relative regional positions are not changed in the second period.

Turning to a more careful examination of the trends, we find that the geometric averages of the crude birth ratio was lower in Period II than in I in every state except four. The median state's average declined from .126 to .099. In general, the New England and Mountain states experienced slight or no declines at all. Arizona, Montana, and

Wyoming actually experienced a slightly rising trend. Southern, Central and Pacific Coast states experienced relatively large percentage declines.

2. Levels and Trends in the Proportion of Women of Child-bearing Age in the Population

The crude birth ratio is equal to the product of the refined birth ratio and the percentage of women of child-bearing age in the population. In equation form, $\frac{\text{children aged 0-4}}{\text{total population}} = \frac{\text{children aged 0-4}}{\text{women aged 15-44}} \times \frac{\text{women aged 15-44}}{\text{total population}}$. Thus, in order to explain the trends and geographic differentials of the crude birth ratio, it is necessary to examine the trends and levels of the refined birth ratio and the percentage of women of child-bearing age. We begin with the second of these variables.

Tables I - 3a, I - 3b, and I - 3c summarize the findings for the proportion of women of child-bearing age in the population. The first characteristic to be noted is the East-West differences in Period I. The range in Period I ran from 16% to 26%, but in each of the New England, Middle Atlantic, Southern, and East North Central states, the number of women aged 15-44 constituted more than 21% of the total inhabitants. On the other hand, the ratio of women aged 15-44 to total population was less than 21% in eight of the eleven Mountain and Pacific Coast states. The extremely small proportion of women of child-bearing age in many of the Western states can be attributed to the fact that the population of these states depended largely on migration from the East. The mining camps and cattle and sheep ranches of the early West were far more successful in attracting men than women; Hollywood has been pictorially reiterating this message for more than twenty-five years. The low percentage of women of child-bearing age in the West significantly reduced crude birth ratio

Table I-3a

The Proportion of Women of Child-Bearing Age in the White Population

Geometric Averages of the Ratio of White Women Aged 15-44 to Total Whites, 1870-1950

	State	1870-1910 Period I	1910-1950 Period II	II-I	$\frac{II-I}{I}$
I	**New England**				
	Maine	.229	.217	-.012	-.052
	New Hampshire	.237	.222	-.015	-.063
	Vermont	.223	.214	-.009	-.040
	Massachusetts	.262	.243	-.019	-.073
	Rhode Island	.259	.243	-.016	-.062
	Connecticut	.246	.241	-.005	-.020
II	**Middle Atlantic**				
	New York	.249	.248	-.001	-.004
	Pennsylvania	.235	.233	-.002	-.009
	New Jersey	.245	.244	-.001	-.004
III	**South Atlantic**				
	Delaware	.233	.233	0	0
	Maryland	.240	.239	-.001	-.004
	Virginia	.227	.231	+.004	+.018
	West Virginia	.218	.223	+.005	+.023
	North Carolina	.224	.232	+.008	+.036
	South Carolina	.227	.234	+.007	+.031
	Georgia	.228	.234	+.006	+.026
	Florida	.222	.231	+.009	+.041
IV	**East South Central**				
	Kentucky	.224	.223	-.001	-.004
	Tennessee	.225	.233	+.008	+.036
	Alabama	.225	.230	+.005	+.022
	Mississippi	.222	.229	+.007	+.032
V	**West South Central**				
	Arkansas	.216	.223	+.007	+.032
	Louisiana	.228	.237	+.009	+.039
	Texas	.214	.235	+.021	+.098

Table I-3a concluded

	State	1870–1910 Period I	1910–1950 Period II	II-I	$\frac{II-I}{I}$
VI	**East North Central**				
	Ohio	.236	.233	-.003	-.013
	Indiana	.230	.228	-.002	-.009
	Illinois	.233	.240	+.007	+.030
	Michigan	.227	.229	+.002	+.009
	Wisconsin	.217	.225	+.008	+.037
VII	**West North Central**				
	Minnesota	.213	.227	+.014	+.066
	Iowa	.221	.224	+.003	+.014
	Missouri	.227	.233	+.006	+.026
	Dakota	.194	.218	+.024	+.124
	Nebraska	.220	.226	+.013	+.061
	Kansas	.216	.225	+.009	+.042
VIII	**Mountain**				
	Montana	.160	.216	+.056	+.350
	Idaho	.169	.215	+.046	+.272
	Colorado	.210	.230	+.020	+.095
	Wyoming	.170	.216	+.046	+.271
	New Mexico	.219	.223	+.004	+.018
	Arizona	.185	.227	+.042	+.227
	Utah	.204	.224	+.020	+.098
	Nevada	.176	.213	+.037	+.210
IX	**Pacific Coast**				
	Washington	.187	.226	+.039	+.209
	Oregon	.205	.227	+.022	+.107
	California	.220	.236	+.016	+.073

Table I-3b

Geometric Averages of the Ratio of White Women Aged 15-44 to Total Whites, 1870-1910. (Period I)

Women 15-44 / Total Pop.	All States	New Eng.	Mid. Atl.	S. Atl.	East S. Cen.	West S. Cen.	East N. Cen.	West N. Cen.	Moun-tain	Pacific Coast
.250-.262	2	2								
.240-.249	4	1	2	1						
.230-.239	6	1	1	1			3			
.220-.229	16	2		5	4	1	1	2		1
.210-.219	9			1		2	1	3	2	
.200-.209	2								1	1
.190-.199	1							1		
.180-.189	2								1	1
.170-.179	2								2	
.160-.169	2								2	
Median	.224	.242	.245	.228	.224	.216	.230	.214	.180	.205

Table I-3c

Geometric Averages of the Ratio of White Women Aged 15-44 to Total Whites, 1910-1950 (Period II)

.240-.249	6	3	2				1			
.230-.239	16		1	7	2	2	1	1	1	1
.220-.229	17	1		1	2	1	3	4	3	2
.210-.219	7	2						1	4	
Median	.229	.232	.244	.234	.230	.235	.229	.226	.220	.227

levels in a number of states. For example, Idaho ranked 2nd in refined birth ratio and 23rd in crude birth ratio; Montana ranked 22nd in refined birth ratio and 43rd in crude birth ratio.

In the East, the North tended to have a greater percentage of women of child-bearing age than the South in both Periods I and II. This is more likely due to age distribution differences rather than sex ratio differentials. The North had a larger proportion of persons aged 15-44 in its population because (1) a larger percentage of children survived to enter the 15-44 class; (2) it had a smaller proportion of children in the population because of its lower crude birth rate; (3) people aged 15-44 were comparatively mobile, and some of them emigrated from the South to the North; (4) the North had a much larger proportion of foreign-born persons in its population than the South. As a result of these factors, the North has had the higher percentage of women of child-bearing age in its population. However, this does not account for North-South differences in crude birth ratio levels; the South has had the higher crude birth ratios because of its much greater refined birth ratios.

A comparison of Periods I and II reveals that interstate differences in the proportion of women of child-bearing age in the population have been strikingly reduced. This is demonstrated by the narrowness of the range in Period II: it ran from a high of 24.8% to a low of 21.3%. There has not been any general nation-wide trend. Each of the New England and Middle Atlantic states experienced a downward trend and most of the North Central and Southern states a slightly rising trend. The Mountain and Pacific Coast states, becoming less dependent on the pioneer type migrant

and growing more attractive to women, experienced a more sharply rising trend. In Montana, Wyoming, and Arizona, this upward trend has been sharp enough to offset a decline in the refined birth ratio and induce an upward trend in the crude birth ratio. The rise in the crude birth ratio is observed in these three states alone.

3. Levels and Trends of the Refined Birth Ratios

a. Levels and Trends, the Ratio of Children Aged 0-4 to Women Aged 15-44

We now pass to the second and more important determinant of the crude birth ratio — the refined birth ratio. Here again there is an apparent association between the level of a state's refined birth ratio and its geographic location. The cross-section patterns of the ratio of children aged 0-4 to women aged 15-44 are summarized in Tables I - 4a, I - 4b, and I - 4c. In Period I, New England had the lowest levels. Following New England in ascending order were the Middle Atlantic, East North Central, and Pacific Coast states. Sixteen out of the seventeen states in these four regions (all except Washington) had ratios that were below the ratio of the median state. In the upper half of the distribution, listed in ascending order, were the West North Central, South Atlantic, and South Central states. The Mountain states were widely dispersed. While Utah and Idaho ranked first and second in the nation, Nevada and Colorado had comparatively low ratios, and the remaining states were somewhere in the middle of the distribution.

Let us turn to the distribution for Period II. The relative standings of the various regions are basically unchanged although some noticeable shifts in the rankings occurred. The New England, Middle Atlantic,

Table I-4a

The Refined Birth Ratio

Geometric Averages of the Ratio of Whites Aged 0-4 to White Women Aged 15-44, 1870-1950

	State	1870-1910 Period I	1910-1950 Period II	II-I	$\frac{II-I}{I}$
I	**New England**				
	Maine	.423	.442	+.019	+.045
	New Hampshire	.373	.401	+.028	+.075
	Vermont	.445	.450	+.005	+.011
	Massachusetts	.379	.360	-.019	-.050
	Rhode Island	.389	.367	-.022	-.056
	Connecticut	.410	.372	-.038	-.093
II	**Middle Atlantic**				
	New York	.420	.341	-.079	-.188
	Pennsylvania	.523	.418	-.105	-.201
	New Jersey	.465	.361	-.104	-.224
III	**South Atlantic**				
	Delaware	.477	.390	-.087	-.182
	Maryland	.494	.394	-.100	-.202
	Virginia	.597	.481	-.116	-.194
	West Virginia	.687	.553	-.134	-.195
	North Carolina	.661	.539	-.122	-.185
	South Carolina	.639	.522	-.117	-.183
	Georgia	.654	.504	-.150	-.229
	Florida	.650	.447	-.203	-.312
IV	**East South Central**				
	Kentucky	.633	.531	-.102	-.161
	Tennessee	.642	.497	-.145	-.226
	Alabama	.675	.539	-.136	-.201
	Mississippi	.688	.525	-.163	-.237

Table I-4a concluded

	State	1870-1910 Period I	1910-1950 Period II	II-I	$\frac{II-I}{I}$
V	West South Central				
	Arkansas	.739	.546	-.193	-.261
	Louisiana	.637	.484	-.153	-.240
	Texas	.721	.478	-.243	-.337
VI	East North Central				
	Ohio	.490	.399	-.091	-.186
	Indiana	.524	.416	-.108	-.206
	Illinois	.540	.374	-.166	-.307
	Michigan	.520	.439	-.081	-.156
	Wisconsin	.595	.440	-.155	-.261
VII	West North Central				
	Minnesota	.640	.439	-.201	-.314
	Iowa	.582	.434	-.148	-.254
	Missouri	.577	.393	-.184	-.319
	Dakota	.739	.532	-.207	-.280
	Nebraska	.653	.445	-.208	-.319
	Kansas	.622	.437	-.185	-.297
VIII	Mountain				
	Montana	.614	.474	-.140	-.228
	Idaho	.750	.534	-.216	-.288
	Colorado	.528	.432	-.096	-.182
	Wyoming	.616	.491	-.125	-.203
	New Mexico	.646	.583	-.063	-.098
	Arizona	.570	.503	-.067	-.118
	Utah	.793	.568	-.225	-.284
	Nevada	.503	.403	-.100	-.199
IX	Pacific Coast				
	Washington	.639	.386	-.253	-.396
	Oregon	.575	.374	-.201	-.350
	California	.460	.343	-.117	-.254

Table I-4b

Geometric Averages of the Ratio of Whites Aged 0-4 to White Women Aged 15-44, 1870-1910 (Period I)

0-4 / 15-44	All States	New Eng.	Mid. Atl.	S. Atl.	East S. Cen.	West S. Cen.	East N. Cen.	West N. Cen.	Moun-tain	Pacific Coast
.770-.810	1								1	
.730-.769	3					1		1	1	
.690-.729	1					1				
.650-.689	7			4	2			1		
.610-.649	10			1	2	1		2	3	1
.570-.609	6			1			1	2	1	1
.530-.569	1						1			
.490-.529	7		1	1			3		2	
.450-.489	3		1	1						1
.410-.449	4	3	1							
.370-.409	3	3								
Median	.596	.400	.465	.644	.658	.721	.524	.631	.615	.575

Table I-4c

Geometric Averages of the Ratio of Whites Aged 0-4 to White Women Aged 15-44, 1910-1950 (Period II)

.580-.620	1								1	
.540-.579	3			1		1			1	
.500-.539	9			3	3			1	2	
.460-.499	6			1	1	2			2	
.420-.459	10	2		1			2	4	1	
.380-.419	9	1	1	2			2	1	1	1
.340-.379	8	3	2				1			2
Median	.441	.386	.361	.492	.528	.484	.416	.438	.497	.374

East North Central, and Pacific Coast states maintained their relatively low positions, but there were changes of position among these regions; the Middle Atlantic and Pacific Coast states now occupied the lowest standings. Among the regions with comparatively high refined birth ratios, the same general pattern of regional differentials prevailed in both periods. Another characteristic of the cross-section pattern of Period II is the significant narrowing of interstate differences in the refined birth ratio.

It has already been pointed out that the secular trend of the refined birth ratio has been downward. For the country as a whole, the average in Period II was 23.6% below the average in Period I (based on the adjusted 0-4 data). The ratio in the median state declined from .596 in Period I to .441 in Period II. All the states except Maine, New Hampshire, and Vermont shared in the nation-wide downward trend. The other New England states and some of the Mountain states experienced small percentage declines, whereas the ratio in a number of Pacific Coast, West North Central, and Southern states underwent comparatively sharp declines.

Except for several Mountain states, the refined birth ratio was the major component in the change of the crude birth ratio. In general, states experiencing larger (smaller) percentage declines in the refined birth ratio also experienced larger (smaller) percentage declines in the crude birth ratio. Also the cross-section patterns of the crude and refined birth ratios are quite similar in both periods.

b. Levels and Trends, the Ratio of Children Aged 5-9 to Women Aged 20-49

The ratio of children aged 5-9 to women aged 20-49 is an indirect

measure of the refined birth rate for the first half of an intercensal decade. It was pointed out above that the findings for the ratio of children aged 0-4 to women aged 15-44 may not accurately reflect the cross-section patterns and trends of the refined birth rate because of the undercount of the 0-4 age class. Therefore an analysis of the ratio of children aged 5-9 to women aged 20-49, a measure which is less affected by the undercount error, may shed more light on the behavior over time and space of the refined birth rate.

We begin by comparing three different indirect measures of the refined birth rate of United States whites:

	Ratio of Children Aged 0-4 (Unadjusted) to Women Aged 15-44	Ratio of Children Aged 0-4 (Adjusted) to Women Aged 15-44	Ratio of Children Aged 5-9 to Women Aged 20-49
Period I	.539	.581	.577
Period II	.423	.444	.435

The levels of the ratio of children aged 5-9 to women aged 20-49 exceed the levels of the ratio of children aged 0-4 (unadjusted) to women aged 15-44 since the latter two averages, .539 and .423, understate the true averages because of the undercount of children 0-4 years old. On the other hand, the refined birth ratio levels based on adjusted 0-4 data are close to the 5-9 to 20-49 ratio levels. This indicates that the ratio of children aged 5-9 to women aged 20-49 is less affected by an undercount error. For this reason, it is useful to compare the findings by state for the 5-9 to 20-49 ratio with those for the unadjusted 0-4 to 15-44 ratio. If no important differences emerge, it follows that the error of underenumeration does not affect the conclusions.

Tables I - 5a, I - 5b, and I - 5c show clearly that the relative

Table I-5a

The Refined Birth Ratio

Geometric Averages of the Ratio of Whites Aged 5-9

to White Women Aged 20-49, 1870-1950

	State	1870-1910 Period I	1910-1950 Period II	II-I	$\frac{II-I}{I}$
I	New England				
	Maine	.461	.453	-.008	-.017
	New Hampshire	.393	.405	+.012	+.031
	Vermont	.479	.460	-.019	-.040
	Massachusetts	.380	.360	-.020	-.053
	Rhode Island	.396	.369	-.027	-.068
	Connecticut	.416	.377	-.039	-.094
II	Middle Atlantic				
	New York	.437	.340	-.097	-.222
	Pennsylvania	.549	.431	-.118	-.215
	New Jersey	.458	.371	-.114	-.249
III	South Atlantic				
	Delaware	.523	.394	-.129	-.247
	Maryland	.541	.405	-.136	-.251
	Virginia	.647	.518	-.129	-.199
	West Virginia	.741	.592	-.149	-.201
	North Carolina	.701	.588	-.113	-.161
	South Carolina	.688	.574	-.114	-.165
	Georgia	.703	.547	-.156	-.222
	Florida	.701	.461	-.240	-.342
IV	East South Central				
	Kentucky	.706	.573	-.133	-.188
	Tennessee	.709	.545	-.164	-.231
	Alabama	.732	.587	-.145	-.198
	Mississippi	.747	.577	-.170	-.228

Table I-5a concluded

	State	1870-1910 Period I	1910-1950 Period II	II-I	$\frac{II-I}{I}$
V	**West South Central**				
	Arkansas	.796	.612	-.184	-.231
	Louisiana	.693	.525	-.168	-.242
	Texas	.791	.523	-.268	-.338
VI	**East North Central**				
	Ohio	.538	.406	-.132	-.245
	Indiana	.591	.426	-.165	-.279
	Illinois	.578	.378	-.200	-.346
	Michigan	.557	.436	-.123	-.220
	Wisconsin	.665	.457	-.208	-.312
VII	**West North Central**				
	Minnesota	.688	.456	-.232	-.337
	Iowa	.641	.447	-.194	-.256
	Missouri	.646	.417	-.229	-.354
	Dakota	.684	.562	-.122	-.178
	Nebraska	.680	.467	-.213	-.313
	Kansas	.670	.459	-.211	-.315
VIII	**Mountain**				
	Montana	.557	.469	-.088	-.158
	Idaho	.738	.556	-.182	-.247
	Colorado	.516	.438	-.078	-.151
	Wyoming	.557	.490	-.067	-.120
	New Mexico	.690	.619	-.071	-.102
	Arizona	.590	.508	-.082	-.139
	Utah	.836	.593	-.243	-.291
	Nevada	.494	.382	-.112	-.227
IX	**Pacific Coast**				
	Washington	.672	.392	-.280	-.417
	Oregon	.654	.387	-.267	-.408
	California	.501	.329	-.172	-.343

Table I-5b

Geometric Averages of the Ratio of Whites Aged 5-9 to White Women Aged 20-49, 1870-1910 (Period I)

5-9 / 20-49	All Reg.	New Eng.	Mid. Atl.	S. Atl.	East S. Cen.	West S. Cen.	East N. Cen.	West N. Cen.	Moun-tain	Pacific Coast
.800-.850	1								1	
.750-.799	2					2				
.700-.749	9			4	4				1	
.650-.699	10			1		1	1	4	1	2
.600-.649	3			1				2		
.550-.599	6						3		3	
.500-.549	6		1	2			1		1	1
.450-.499	4	2	1						1	
.400-.449	2	1	1							
.350-.399	3	3								
Median	.646	.406	.458	.694	.721	.791	.578	.675	.573	.654

Table I-5c

Geometric Averages of the Ratio of Whites Aged 5-9 to White Women Aged 20-49, 1910-1950 (Period II)

.600-.650	2					1			1	
.550-.599	9			3	3			1	2	
.500-.549	6			2	1	2			1	
.450-.499	9	2		1			1	3	2	
.400-.449	9	1	1	1			3	2	1	
.350-.399	9	3	1	1			1		1	2
.300-.349	2		1							1
Median	.458	.391	.371	.533	.575	.525	.426	.458	.499	.387

standings of the regions are not affected by a substitution in the analysis of the ratio of children aged 5-9 to women aged 20-49 for the ratio of children aged 0-4 to women aged 15-44. The cross-section patterns of the two refined birth ratio variables are virtually identical so that there is no need to restate the findings.

Although the principal conclusions are the same, a comparison of Tables I - 4a and I - 5a reveals some interesting contrasts. Because of the undercount error, the ratio of children aged 0-4 to women aged 15-44 is generally less than the counterpart ratio of children aged 5-9 to women aged 20-49 for the same state and period. The difference between the ratios is greater in the South Atlantic and South Central states than in most other states. This indicates that the 0-4 undercount is particularly great in the South. On the other hand, since the difference between the ratios is relatively small in the New England and Middle Atlantic states, we surmise that the undercount error in the Northeast must have been rather slight. Thus the use of the ratio of children aged 0-4 to women aged 15-44 results in an understatement of interstate differences in refined birth rates because it is in the high birth ratio states that the undercount is greatest. It is also interesting to note that in most states the percentage decline of the ratio of children aged 5-9 to women aged 20-49 was greater than that of the ratio of children aged 0-4 to women aged 15-44. This is what we would expect. For reasons discussed earlier in the paper, the ratio of children aged 0-4 to women aged 15-44 understates the secular decline of the refined birth rate.

c. Consistency and Patterns of the Trends

Has the trend of the refined birth ratio been consistently downward, or does it fall at first and then level off or rise? This question cannot be answered on the basis of the findings presented thus far; the method of semi-averages reveals the general direction of a trend but not a detailed picture of its pattern. In need of a more flexible method of trend analysis, we employed a simple three item moving geometric average and applied this analysis to both refined birth ratios. This is preferable to a presentation of the ratios for each census because the ratios may be affected by cycles in the birth rate and fluctuations in the degree of underenumeration from census to census.

In the discussion, the average for 1870, 1880, and 1890 will be referred to as 1880; the average for 1880, 1890, and 1900 will be referred to as 1890, etc. We begin by comparing the levels of the first and last averages, that is, 1880 and 1940. (See Table I - 6.) In all but two New England states, 1880 was greater than 1940. Invariably, in any given state, the absolute difference between 1880 and 1940 was greater than the absolute difference between the averages for the whole of Period I and II. This is simply because the average for 1870-1890 tended to be greater than the average for 1870-1910 and the average for 1930-1950 tended to be less than the average for 1910-1950, a finding which suggests that the refined birth ratio may have been falling continuously.

In thirty eight states the trend of the ratio of children aged 0-4 to women aged 15-44 can be described as having declined consistently. In ten states, six Southern states and three Mountain states plus Dakota, the moving average fell continuously. In seventeen other states, most of

Table I-6

Moving Averages, The Ratio of White Children Aged 0-4 to White Women Aged 15-44

		1st Average (1870-1890)	Last Average (1930-1950)	Change	Summary
I	New England				
	Maine	.422	.443	+.021	
	Vermont	.452	.451	-.001	
	New Hampshire	.363	.394	+.031	
	Massachusetts	.378	.339	-.039	d, b
	Connecticut	.410	.333	-.077	d
	Rhode Island	.386	.342	-.044	d, b
II	Middle Atlantic				
	New York	.437	.311	-.126	d, b
	Pennsylvania	.546	.370	-.176	d
	New Jersey	.487	.317	-.170	d
III	South Atlantic				
	Delaware	.509	.360	-.149	d
	Maryland	.529	.371	-.158	b
	Virginia	.607	.435	-.172	a
	West Virginia	.717	.504	-.213	a
	North Carolina	.652	.473	-.179	c
	South Carolina	.639	.464	-.175	c
	Georgia	.659	.447	-.212	c
	Florida	.672	.390	-.282	a
IV	East South Central				
	Kentucky	.662	.505	-.157	a
	Tennessee	.673	.456	-.217	a
	Alabama	.669	.477	-.192	c
	Mississippi	.696	.470	-.226	c
V	West South Central				
	Arkansas	.771	.488	-.283	a
	Louisiana	.641	.439	-.202	c
	Texas	.765	.431	-.334	b

Table I-6 concluded

		1st Average (1870-1890)	Last Average (1930-1950)	Change	Summary
VI	East North Central				
	Ohio	.536	.379	-.157	b
	Indiana	.578	.402	-.176	b
	Illinois	.603	.341	-.262	b
	Michigan	.559	.415	-.144	b
	Wisconsin	.651	.416	-.235	b
VII	West North Central				
	Minnesota	.718	.409	-.309	b
	Iowa	.648	.419	-.229	b
	Missouri	.648	.368	-.280	b
	Dakota	.795	.483	-.312	a
	Nebraska	.737	.413	-.324	b
	Kansas	.704	.406	-.298	b
VIII	Mountain				
	Montana	.683	.446	-.237	a
	Idaho	.828	.497	-.331	a
	Colorado	.590	.424	-.166	b
	Wyoming	.635	.461	-.174	b, c
	New Mexico	.642	.562	-.080	
	Arizona	.565	.476	-.089	c
	Utah	.884	.527	-.357	a
	Nevada	.563	.398	-.165	b
IX	Pacific Coast				
	California	.543	.332	-.211	b
	Oregon	.696	.358	-.338	b
	Washington	.787	.367	-.420	b

a - trend continuously downward

b - trend continuously downward except for rise from 1930-1940

c - trend continuously downward except for rise from 1880-1890

d - trend continuously downward except for rise from 1900-1910

which were in the North Central and Pacific Coast regions, the moving average declined continuously except for a rise from 1930 to 1940. The 1940 figure was greater than the 1930 figure because of the sharp rise in the birth rate in the 1940's. In six Southern states plus Arizona, the moving average dropped continuously except for a rise from 1880 to 1890. This rise occurred because Southern refined birth ratios were relatively low in the 1860's, partly as a result of the Civil War and partly as a consequence of a large undercount of children 0-4 years old in the census of 1870. Finally a fourth group, comprising New Jersey, Pennsylvania, Connecticut, and Delaware, experienced a consistently downward trend except for a rise from 1900 to 1910. This rise was due to an upswing in the birth rate in 1915-1920 which may be attributable to swings in immigration. An upswing in immigration from 1900 to 1913, followed by a lag of about ten years, may have accounted for an upswing in the birth rate of foreign-born women in 1915-1920.(5) In summary, each successive moving average was lower than the one preceding it in ten states; in twenty eight other states, six out of seven successive moving averages were lower than the one preceding it. The trend in each of these thirty eight states may be regarded as consistently downward.

In Massachusetts, New York, and Rhode Island, the 1910 average exceeded that for 1900, and the 1940 average was greater than that in 1930. Rather unusual trends were registered in Maine, New Hampshire, and Vermont. The first characteristic peculiar to these three states is

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(5) See Simon Kuznets and Ernest Rubin, Immigration and the Foreign Born (New York: National Bureau of Economic Research, Inc., 1954), p.46.

a rising secular trend as disclosed by the method of semi-averages. A comparison of the moving average values in 1880 and 1940 shows that the 1940 average exceeded the 1880 average in Maine and New Hampshire, and that the two were approximately equal in Vermont. Moving averages were rising in the following periods: 1880 to 1910 in New Hampshire, 1890 to 1920 in Maine, 1900 to 1920 in Vermont, and 1930 to 1940 in all three states.

What accounts for this most unusual finding — a rising trend in the refined birth ratio in the Northern New England states? Joseph J. Spengler, in a study of fertility rates in New England, observed that there was no evidence to show a decrease in the fertility of native women from 1870 to 1920.(6) He attributes the absence of a decline in native-white fertility to a rise in the percentage of native whites who had one or both parents born abroad, and cites the following figures:(7)

Per Cent of Native Whites Whose Parents (one or both) Were Immigrants

State	1870	1890	1920
Maine	7	7	19
Vermont	13	13	20
New Hampshire	5	11	29

In essence Spengler's contention is that native children of immigrants transmit some of the immigrant attitudes in favor of large families to their own family patterns. Thus as the percentages of native whites whose parents were immigrants increased, the effect is to make the fertility

(6) Joseph J. Spengler, The Fecundity of Native and Foreign-Born Women in New England (Washington: The Brookings Institute, 1930), p. 41
(7) Ibid.

rate of native women greater than it otherwise would have been.

In terminating the discussion of the moving average analysis, we should take note of the fact that some of the principal conclusions is altered if the ratio of children aged 5-9 to women 20-49 is substituted in the analysis for the ratio of children aged 0-4 to women aged 15-44.

4. Levels and Trends in the Proportion of Women Aged 20-29 Among Women Aged 15-44

In the foregoing paragraphs, the levels and trends of three demographic variables have been discussed — the crude birth ratio, the refined birth ratio, and the percentage of women of child-bearing age. To account for the levels and trends of the crude birth ratio, it was only necessary to describe those of its immediate determinants, i.e., the refined birth ratio and the percentage of women of child-bearing age. What, then, accounts for the behavior of the latter two variables?

The percentage of women of child-bearing age depends on the age-sex distribution of the population. This in turn is a function of other demographic variables — age specific death rates, crude birth ratios of earlier periods, population movements.

From the point of view of the economist, the refined birth ratio is probably the most interesting of the variables thus far discussed. It depends on human decisions which to a large extent may be influenced by economic factors. One of the hypotheses that we shall test is that economic development, accompanied by an increase in the percentage of people living in urban areas, has contributed to the long run decline of the refined birth ratio. Before turning to this hypothesis, we shall consider two possible demographic explanations of the decline of the

refined birth ratio.

First, the hypothesis that a secular decline in the ratio of women aged 20-29 to women aged 15-44 has contributed significantly to the decline of the refined birth ratio is examined. Among 15-44 year old women, those aged 20-29 have a higher fertility rate than the others. If, over time, the ratio of women aged 20-29 to women aged 15-44 has declined, then even if the age-specific fertility rates were constant, the refined birth ratio would fall. Has the ratio of women aged 20-29 to women aged 15-44 been declining? If so, has this decline contributed significantly to the decline of the refined birth ratio?

Table I - 7 presents geometric averages, by state, of the ratio of women aged 20-29 to women aged 15-44. In each of the 46 states, the average in Period I was above that in Period II. Although the trend has been downward in all states, the decline has not been sharp. The average in the median state fell from .389 to .363, and in only five states did the absolute decline between Period I and II exceed .035. In general, the Mountain, South Atlantic, and South Central regions comprised the high ratio states while the New England and the Pacific Coast regions were low ratio areas.

Having shown that the proportion of women 20-29 among all women 15-44 declined, we must now examine the quantitative effect of this decline on the trend of the refined birth ratio. The following model is designed for this purpose:

Let I = the refined birth ratio (ratio of children 0-4 to women 15-44).

L = the fertility ratio of women aged 20-29 (the ratio of children aged 0-4 born of women aged 20-29 to women aged 20-29).

Table I-7

Geometric Averages of the Ratio of White Women Aged 20-29 to White Women Aged 15-44, 1870-1950

	State	1870-1910 Period I	1910-1950 Period II	II-I
I	**New England**			
	Maine	.369	.349	-.020
	New Hampshire	.371	.349	-.022
	Vermont	.364	.346	-.018
	Massachusetts	.393	.359	-.034
	Rhode Island	.387	.361	-.016
	Connecticut	.382	.359	-.023
II	**Middle Atlantic**			
	New York	.388	.362	-.026
	Pennsylvania	.387	.363	-.014
	New Jersey	.382	.358	-.024
III	**South Atlantic**			
	Delaware	.377	.363	-.014
	Maryland	.382	.363	-.019
	Virginia	.387	.371	-.016
	West Virginia	.394	.374	-.020
	North Carolina	.389	.379	-.010
	South Carolina	.393	.380	-.013
	Georgia	.393	.376	-.017
	Florida	.394	.366	-.028
IV	**East South Central**			
	Kentucky	.391	.366	-.025
	Tennessee	.393	.374	-.019
	Alabama	.394	.378	-.016
	Mississippi	.399	.372	-.027

Table I-7 concluded

	State	1870-1910 Period I	1910-1950 Period II	II-1
V	West South Central			
	Arkansas	.394	.365	-.029
	Louisiana	.392	.376	-.016
	Texas	.395	.375	-.020
VI	East North Central			
	Ohio	.383	.363	-.020
	Indiana	.383	.360	-.023
	Illinois	.391	.364	-.027
	Michigan	.381	.366	-.015
	Wisconsin	.375	.359	-.016
VII	West North Central			
	Minnesota	.385	.367	-.018
	Iowa	.384	.360	-.024
	Missouri	.389	.358	-.031
	Dakota	.412	.370	-.042
	Nebraska	.400	.365	-.035
	Kansas	.389	.361	-.028
VIII	Mountain			
	Montana	.421	.363	-.058
	Idaho	.394	.363	-.031
	Colorado	.404	.362	-.042
	Wyoming	.441	.379	-.062
	New Mexico	.389	.377	-.012
	Arizona	.412	.374	-.038
	Utah	.381	.374	-.007
	Nevada	.387	.361	-.026
IX	Pacific Coast			
	Washington	.385	.359	-.026
	Oregon	.384	.356	-.028
	California	.374	.354	-.020

M = the fertility ratio of women aged 15-19, 30-44 (the ratio of children 0-4 who were born of women 15-19, 30-44 to women aged 15-19, 30-44).

Y = ratio of women aged 20-29 to women aged 15-44.

Then L-Y = ratio of women aged 15-19, 30-44 to women aged 15-44.

(1) $X = LY + M(1 - Y)$

(2) $X = LY + M - MY$

(3) $X = Y(L - M) + M$

Since we wish to ascertain the effect on X of a decrease in Y, everything else held fixed, we have

(4) $X + \Delta X = (Y + \Delta Y)(L - M) + M$

(5) $X + \Delta X = Y(L - M) + M + \Delta Y(L - M)$

Subtracting X from both sides,

(6) $\Delta X = \Delta Y(L - M)$

Based on the fertility statistics of native white women ever 15 enumerated in the 1910, 1940, and 1950 censuses, L and M have been computed and are given in the following table:(8)

Year	1910	1940	1950
L	.566	.462	.698
M	.337	.220	.317
L-M	.229	.242	.381

Using the geometric average of the three values of L - M as an estimate of L - M, we have

(6') $\Delta X = .276\ \Delta Y$

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(8) Sources: U.S. Bureau of the Census, Sixteenth Census of the United States: 1940, Population. Differential Fertility, 1940 and 1910. Women by Number of Children Ever Born (Washington: U.S. Government Printing Office, 1943), Table III on p. 5; U.S. Bureau of the Census, U.S. Census of Population: 1950 Vol. IV, Special Reports, Part 5, Chapter C, Fertility (Washington: U.S. Government Printing Office, 1955), Table 40 on p. 101.

Let us assume that the absolute decline of Y between Periods I and II was .062. This is an extreme assumption since ΔY was as great as .062 in only one state — Wyoming. Substituting .062 in 6', we find that ΔX = - .017. Thus the decline in the proportion of 20-29 year old women among all women aged 15-44 accounts for an absolute decline of the refined birth ratio of only .017 which is a small share of the actual declines of the adjusted and unadjusted United States refined birth ratios of .137 and .116, respectively; yet this model errs on the side of exaggerating the importance of the decline in Y. Clearly, the hypothesis that the decline in the proportion of women aged 20-29 among all women aged 15-44 has contributed significantly to the decline of the refined birth ratio must be rejected.

5. Levels and Trends in the Proportion of Foreign-born White Women Aged 15-44 Among All White Women Aged 15-44

The trend of the ratio of foreign-born white women aged 15-44 to all white women aged 15-44 has been downward in every state (except for an absolute increase of + .001 in North Carolina). As Table I - 8 indicates, the ratios in Period II were substantially below those in Period I in some of the Mountain, North Central, New England, and Middle Atlantic states. In general, the states with the greatest ratios in Period I experienced the largest absolute declines.

An hypothesis that may merit consideration is that the decline in the proportion of foreign-born white women aged 15-44 among all white women aged 15-44 has contributed significantly to the secular decline of the refined birth ratio in some states. Of course, the assumption underlying this hypothesis is that foreign-born women have a higher fertility

Table I-8

Geometric Averages of the Ratio of Foreign-Born White Women Aged 15-44 to Total White Women Aged 15-44, 1870-1950

	State	1870-1910 Period I	1910-1950 Period II	II-I
I	**New England**			
	Maine	.140	.119	-.021
	New Hampshire	.223	.151	-.072
	Vermont	.148	.080	-.068
	Massachusetts	.363	.207	-.156
	Rhode Island	.378	.199	-.179
	Connecticut	.309	.194	-.115
II	**Middle Atlantic**			
	New York	.322	.229	-.093
	Pennsylvania	.182	.101	-.081
	New Jersey	.283	.176	-.107
III	**South Atlantic**			
	Delaware	.108	.066	-.042
	Maryland	.117	.056	-.061
	Virginia	.015	.013	-.002
	West Virginia	.030	.023	-.007
	North Carolina	.003	.004	+.001
	South Carolina	.012	.005	-.007
	Georgia	.012	.007	-.005
	Florida	.069	.044	-.025
IV	**East South Central**			
	Kentucky	.031	.007	-.024
	Tennessee	.012	.005	-.007
	Alabama	.016	.007	-.009
	Mississippi	.012	.006	-.006

Table I-8 concluded

	State	1870-1910 Period I	1910-1950 Period II	II-I
V	West South Central			
	Arkansas	.014	.005	-.009
	Louisiana	.086	.020	-.066
	Texas	.100	.061	-.039
VI	East North Central			
	Ohio	.127	.073	-.054
	Indiana	.060	.030	-.030
	Illinois	.243	.119	-.124
	Michigan	.260	.136	-.124
	Wisconsin	.299	.073	-.226
VII	West North Central			
	Minnesota	.376	.077	-.299
	Iowa	.154	.034	-.120
	Dakota	.378	.071	-.307
	Missouri	.093	.029	-.064
	Nebraska	.219	.045	-.174
	Kansas	.106	.025	-.081
VIII	Mountain			
	Montana	.283	.095	-.188
	Idaho	.195	.043	-.152
	Colorado	.192	.062	-.130
	Wyoming	.260	.079	-.181
	New Mexico	.073	.053	-.020
	Utah	.310	.050	-.260
	Nevada	.271	.096	-.175
	Arizona	.424	.191	-.233
IX	Pacific Coast			
	Washington	.210	.108	-.102
	Oregon	.129	.070	-.059
	California	.272	.132	-.140

rate than native whites. Data on differential fertility ratios of foreign-born and native white women aged 15-44 cast some doubt on the soundness of this assumption. Based on data of the 1910, 1940, and 1950 censuses, the following table has been drawn up which shows the fertility ratio differentials:(9)

Year	1910	1940	1950
Ratio of children 0-4 born of native whites 15-44 to native whites 15-44	.424	.310	.455
Ratio of children 0-4 born of foreign-born white women 15-44 to foreign-born whites 15-44	.421	.262	.414

Obviously, the data are too scanty to permit generalizations to be drawn concerning differences in the refined birth ratio of foreign-born whites and native whites since 1870. Yet, at least for 1935-1940 and 1945-1950, the data are inconsistent with the assumption that foreign-born white women are more fertile than native whites.

The striking decline of the refined birth ratio of foreign-born whites since 1910 may be partly attributable to a radical change in age distribution within the class of foreign-born women aged 15-44. Among the foreign-born women aged 15-44, the proportion aged 20-29 diminished from .380 in 1910 to .270 in 1950. The corresponding proportions for native-white women fell less sharply, changing from .384 in 1910 to .360 in 1950. Whelpton and Thompson point out that the marked decline in "the proportion of foreign-born aged 20-29 arises chiefly from the falling

(9) Sources: Ibid.

off of immigration since 1914," and secondly from aging of the foreign-born.[10] Thus, the decline in immigration, through its effect on the age distribution of the foreign-born, exercises a depressing effect on the refined birth ratio of the foreign-born.

It is interesting to note that according to the 1950 census report the age-specific fertility rates classified by urban, rural nonfarm, and rural farm areas are generally higher for foreign-born than for native whites. Nevertheless, for the country as a whole, native white women have the higher 0-4 to 15-44 ratio. These findings are not contradictory. They can be attributed to two factors: (1) a much larger proportion of foreign-born white women than native white women were living in urban areas in 1950; (2) native whites had a larger ratio of women aged 20-29 to women aged 15-44 than foreign-born whites in 1950.

[11]

1950

	Native White Women Aged 15-44	Foreign-born White Women Aged 15-44
Proportion Urbanized	.668	.853
Ratio of Women Aged 20-29 to 15-44	.360	.270

Since the evidence indicates that the foreign-born white refined birth ratio has been below the native white ratio in the past two decades, it cannot be argued that the small proportion of foreign-born among all white women aged 15-44 has been a factor tending to keep the white refined birth ratio down in recent years. Let us now assume that the foreign-born whites had the higher refined birth ratio during Period I. Is there

(10) P.K. Whelpton and W.S. Thompson, op. cit., p. 417.

any evidence that interstate differences in the proportion of foreign-born white women aged 15-44 among total white women aged 15-44 accounted for interstate differences in the refined birth ratio? A comparison of Tables I - 4a and I - 8 reveals that many of the low refined birth ratio states, especially the New England and Middle Atlantic states, had comparatively high ratios of foreign-born to total white women aged 15-44; many of the high refined birth ratio states, especially the Southern states, had very few foreign-born women in their population. Thus it is clear that even in Period I, the proportion of foreign-born women among total white women aged 15-44 was not the chief factor affecting interstate differences in the refined birth ratio levels.

It is also noteworthy that some of the Mountain and New England states experienced small declines in the refined birth ratio; yet these states experienced comparatively sharp declines in the proportion of 15-44 year old women who were foreign-born. On the other hand, many Southern states, sustaining comparatively sharp declines in the refined birth ratio, experienced only negligible declines in the proportion of foreign-born women. This evidence suggests that the secular decline in the proportion of foreign-born women among all white women aged 15-44 did not contribute significantly to the secular decline of the refined birth ratio.

A test of the importance of the decline in the proportion of foreign-born women would be more valid if it were confined to those states with comparatively large numbers of foreign-born women. In fifteen states during Period I, 25% or more of the white women aged 15-44 were immigrants. These states were ranked according to the percentage decline between

Periods I and II of the proportion of white women aged 15-44 who were immigrants, and they were also ranked according to the percentage decline of their refined birth ratios. The coefficient of rank correlation, Kendall's τ is +.05, a clearly insignificant value. Thus even among the states where in Period I more than 25% of the white women aged 15-44 were foreign-born, the lack of significant correlation between the percentage decline in the proportion of 15-44 year old white women who are foreign-born and the percentage decline in the refined birth ratio suggests that the decline in the proportion of the foreign-born contributed little to the decline in the refined birth ratio.

6. Urbanization

a. The Record of Rural-Urban Differences in the Refined Birth Ratio

It is well-known that the refined birth rate is higher in rural than in urban areas. P.K. Whelpton points out that this has been true in the United States as far back as 1800.(12) Abram J. Jaffee found that rural fertility exceeded urban fertility throughout much of Europe during the nineteenth century, and that this differential existed in many Latin American, Asian, and European countries during the first half of the twentieth century.(13) In a census monograph Warren S. Thompson showed that differentials in ratios of children to women in different communities in 1920 were very great, and that the refined birth ratio tended to vary inversely with the size of the community.(14) Tables I - 9A and I - 9b, which summarize Thompson's findings, show this inverse relation

(12) P.K. Whelpton, "Industrial Development and Population Growth," Social Forces, Vol. VI (1928), p. 464.

(13) Abram J. Jaffee, "Urbanization and Fertility," The American Journal of Sociology, Vol. XLVIII (1942), p. 57.

(14) Warren S. Thompson, Ratio of Children to Women 1920, (Washington: U.S. Government Printing Office, 1931).

(15)

Table I-9a

Children 0-4 per 1000 Native White Women 20-44 for Communities of Different Sizes, and for the United States and Its Divisions, 1920

Locality	Area as a Whole	Cities of 100,000 and over	Cities of 25,000 to 100,000	Cities of 10,000 to 25,000	Cities of 2,500 to 10,000	Rural Districts
United States	538	341	390	434	477	720
New England	393	322	350	386	412	528
Middle Atlantic	429	342	381	431	466	588
East North Central	493	360	413	451	476	639
West North Central	554	328	385	424	453	680
South Atlantic	713	406	459	494	551	846
East South Central	734	375	406	463	516	846
West South Central	682	369	376	466	512	817
Mountain	631	356	390	423	535	775
Pacific	388	268	315	365	407	563

Table I-9b

Children 0-4 per 1000 Foreign-Born White Women 20-44 in Communities of Different Sizes, 1920

Locality	Area as a Whole	Cities of 100,000 and over	Cities of 25,000 to 100,000	Cities of 10,000 to 25,000	Cities of 2,500 to 10,000	Rural Districts
United States	779	679	766	861	873	998
New England	747	700	710	811	806	870
Middle Atlantic	789	672	862	1,033	1,034	1,121
East North Central	811	751	833	843	844	984
West North Central	849	632	670	705	778	1,037
South Atlantic	831	768	682	708	846	1,832
East South Central	710	625	527	626	718	927
West South Central	758	579	603	580	676	929
Mountain	848	574	648	646	764	986
Pacific	582	449	534	567	666	792

(15) Source: Warren S. Thompson, Population Problems, (New York: McGraw Hill, 1930), pp. 101, 102.

and indicate that it exists for native as well as foreign-born whites. These figures reveal a marked difference in ratio among communities of varying sizes, among different sections of the country, and between native and foreign-born women. Although the figures presented are for one year alone — 1920, it is reasonable to assume that similar differentials existed in other years.

Since the rural birth ratio is greater than the urban birth ratio, it seems plausible to suppose that states which have a larger proportion of their population living in urban areas would tend to have a lower refined birth ratio. In order to test this hypothesis, it is necessary to examine the cross-section structure of the proportion of whites living in urban areas. An urban area is defined as a city or other incorporated place having 2,500 inhabitants or more. Certain densely populated unincorporated areas are also classified as urban. The time span covered is 1870-1950, and the method of semi-averages is employed in the analysis.

Table I - 10 presents, by state, the geometric averages of the proportion of whites living in urban areas in Periods I and II. The cross-section pattern in each period is similar and clear-cut. Ranked in descending order are the Middle Atlantic, New England, East North Central, Pacific Coast, Mountain, West North Central, South Atlantic, West South Central, and East South Central regions.

Is there an association between the states with low ranks in the ratio of children aged 0-4 to women aged 15-44 and the states with high ranks in the proportion of people living in urban areas? The coefficient of rank correlation, Kendall's tau, indicates that there is. In Period I $\tau = +.612$, and in Period II $\tau = +.679$. Both coefficients are significant

Table I-10

Geometric Averages of the Percentage of Total Whites Living in Urban Areas, 1870-1950

	State	1870-1910 Period I	1910-1950 Period II	II-I	$\frac{II-I}{I}$
I	**New England**				
	Maine	27.50	41.00	+13.50	+ .49
	New Hampshire	38.57	59.19	+20.62	+ .53
	Vermont	14.52	32.41	+17.89	+1.23
	Massachusetts	79.75	90.12	+10.37	+ .13
	Rhode Island	85.05	92.26	+ 7.21	+ .08
	Connecticut	48.76	69.53	+20.77	+ .43
II	**Middle Atlantic**				
	New York	65.24	82.30	+17.06	+ .26
	Pennsylvania	47.19	64.76	+17.57	+ .37
	New Jersey	60.49	80.75	+20.26	+ .33
III	**South Atlantic**				
	Delaware	41.79	54.71	+12.92	+ .31
	Maryland	47.70	60.16	+12.46	+ .26
	Virginia	15.48	32.04	+16.56	+1.07
	West Virginia	11.04	26.33	+15.29	+1.38
	North Carolina	5.39	22.51	+17.12	+3.18
	South Carolina	12.20	25.63	+13.43	+1.10
	Georgia	12.97	30.93	+17.96	+1.38
	Florida	16.08	46.38	+30.30	+1.88
IV	**East South Central**				
	Kentucky	17.45	27.19	+ 9.74	+ .56
	Tennessee	9.72	27.30	+17.58	+1.81
	Alabama	9.23	26.74	+17.24	+1.87
	Mississippi	6.63	20.36	+13.73	+2.07

Table I-10 concluded

	State	1870-1910 Period I	1910-1950 Period II	II-I	$\frac{II-I}{I}$
V	**West South Central**				
	Arkansas	5.28	20.17	+14.89	+2.82
	Louisiana	35.83	43.24	+ 7.41	+ .21
	Texas	13.16	39.26	+26.10	+1.98
VI	**East North Central**				
	Ohio	38.72	63.76	+25.04	+ .65
	Indiana	25.06	51.06	+26.00	+1.04
	Illinois	40.49	69.83	+29.34	+ .72
	Michigan	31.21	61.22	+30.01	+ .96
	Wisconsin	30.34	50.69	+20.35	+ .67
VII	**West North Central**				
	Minnesota	27.02	47.41	+20.39	+ .75
	Iowa	19.92	39.68	+19.76	+ .99
	Missouri	30.64	48.23	+17.59	+ .57
	Nebraska	20.75	34.54	+13.79	+ .66
	Kansas	16.22	37.22	+21.06	+1.30
VIII	**Mountain**				
	Montana	25.89	36.93	+11.04	+ .43
	Colorado	32.83	52.31	+19.48	+ .59
	New Mexico	8.54	26.78	+18.24	+2.14
	Arizona	22.77	41.35	+18.58	+ .82
	Utah	30.86	53.42	+22.56	+ .73
	Nevada	23.39	32.06	+ 8.67	+ .37
IX	**Pacific Coast**				
	Oregon	29.15	49.75	+20.60	+ .71
	California	49.29	70.94	+21.65	+ .44

at the 99% confidence level.

One qualification is attached to the above analysis. Since only women of child-bearing age can produce children, it is more relevant to consider the proportion of this population component which is urbanized. However, it is impossible to measure this variable prior to 1910 because the requisite data are lacking, and therefore it is necessary to use the proportion of total whites living in urban areas in its place.

Table I - 11 presents figures on the percentage of total whites living in urban areas and the percentage of white women aged 15-44 living in urban areas for 1910 and 1930. For the same state and date, white women aged 15-44 are (with one exception) slightly more urbanized than whites as a whole with a difference in most instances of between 2 and 6 percentage points. The difference is probably attributable partly to age selectivity in the rural to urban migration as persons aged 15-44 are a comparatively mobile group.

An inspection of Table I - 11 reveals that the cross-section patterns of the two variables are quite similar. Most likely, this is also true for the period prior to 1910, as it is to be expected that there is a strong positive correlation between states ranked according to the proportion of total whites who are living in urban areas and states ranked according to the proportion of white women aged 15-44 who are living in urban areas. It follows that the conclusions reached concerning the close relation between the cross-section patterns of the refined birth ratio and the proportion of whites living in urban areas would not be affected if the proportion of white women aged 15-44 who are urbanized were somehow brought into the analysis as a substitute for the proportion of all whites who are urbanized.

Table I-11

The Percentage of Persons Living in Urban Areas, 1910 and 1930

		For White Women Aged 15-44			For Total Whites		
		1910	1930	1930-1910	1910	1930	1930-1910
I	**New England**						
	Maine	56	45	-11	51	40	-11
	New Hampshire	64	63	- 1	59	59	0
	Vermont	52	38	-14	47	33	-14
	Massachusetts	94	92	- 2	92	90	- 2
	Rhode Island	97	93	- 4	97	92	- 5
	Connecticut	91	93	+ 2	90	70	-20
II	**Middle Atlantic**						
	New York	82	86	+ 4	79	83	+ 4
	Pennsylvania	64	71	+ 7	59	67	+ 8
	New Jersey	78	84	+ 6	75	83	+ 8
III	**South Atlantic**						
	Delaware	54	56	+ 2	50	53	+ 3
	Maryland	57	64	+ 7	53	60	+ 7
	Virginia	27	37	+10	22	32	+10
	West Virginia	22	33	+11	18	29	+11
	North Carolina	16	25	+ 9	14	25	+11
	South Carolina	21	28	+ 7	18	25	+ 7
	Georgia	26	37	+11	22	31	+ 9
	Florida	34	57	+23	29	53	+24
IV	**East South Central**						
	Kentucky	26	33	+ 7	22	29	+ 7
	Tennessee	20	36	+16	17	31	+14
	Alabama	20	32	+12	17	28	+11
	Mississippi	17	24	+ 7	14	21	+ 7
V	**West South Central**						
	Arkansas	15	25	+10	13	21	+ 8
	Louisiana	41	48	+ 7	36	43	+ 7
	Texas	28	46	+18	24	41	+17

Table I-11 concluded

		For White Women Aged 15-44			For Total Whites		
		1910	1930	1930-1910	1910	1930	1930-1910
VI	**East North Central**						
	Ohio	60	72	+12	55	67	+12
	Indiana	46	59	+13	41	54	+13
	Illinois	65	77	+12	61	73	+12
	Michigan	53	73	+20	47	67	+20
	Wisconsin	48	59	+11	43	53	+10
VII	**West North Central**						
	Minnesota	47	55	+ 8	41	49	+ 8
	Iowa	34	43	+ 9	30	39	+ 9
	Missouri	47	56	+ 9	41	50	+ 9
	Nebraska	30	38	+ 8	26	35	+ 9
	Kansas	32	42	+10	28	37	+ 9
VIII	**Mountain**						
	Montana	43	38	- 5	36	34	- 2
	Idaho	25	33	+ 8	22	30	+ 8
	Colorado	57	54	- 3	50	50	0
	New Mexico	18	29	+11	15	27	+12
	Arizona	41	38	- 3	35	39	+ 4
	Utah	52	57	+ 5	47	53	+ 6
	Nevada	22	45	+23	17	40	+23
IX	**Pacific Coast**						
	Washington	59	62	+ 3	53	57	+ 4
	Oregon	51	57	+ 6	45	51	+ 6
	California	68	77	+ 9	62	74	+12

b. Urbanization and the Declining Birth Ratio, Period I (1870-1910) to Period II (1910-1950)

In the discussion thus far, two points have been noted. First, the refined birth ratio tends to vary inversely with the size of the community. Secondly, states which have a comparatively large proportion of their population living in urban areas tend to have a comparatively small refined birth ratio. In view of these findings an obvious explanation of the secular decline in the refined birth ratio is suggested. The hypothesis frequently propounded is that a secular rise in the proportion of people living in urban areas is responsible for the secular decline in the refined birth rate.(16)

An examination of Table I - 10 confirms the premise of this hypothesis. In every state, the secular proportion of whites living in urban areas has risen. A close examination of the third and fourth columns reveals that there are substantial interstate differences in the rate of increase in urban proportions. If urbanization, in the sense of redistribution of population in favor of urban areas, is the dominant factor behind the decline in the refined birth ratio, we would expect that states which experienced comparatively large increases in the proportion of persons living in urban areas would also experience comparatively large declines in the ratio of children aged 0-4 to women aged 15-44. But this has not been the case. Forty-two states were ranked in order of absolute rise in the proportion of whites living in urban areas, and in order of absolute decline in the refined birth ratio (as between Periods I and II). The

(16) United Nations Department of Social Affairs, The Determinants and Consequences of Population Trends (New York: United Nations, 1953), p. 78.

coefficient of rank correlation, Kendall's τ, is +.17. The same states were also ranked in order of percentage rise in the proportion of whites living in urban areas, and in order of percentage decline in the refined birth ratio. Kendall's τ in this case is +.16. In both instances, the coefficients of rank correlation, although positive, are very small and not significant at the 95% confidence level. Thus, the secular rise in urbanisation does not appear to be a factor contributing significantly to the secular decline in the refined birth ratio. Apparently, declines of the refined birth ratios within urban and rural areas were the principal causes of the declines of the state-wide refined birth ratios.

A combination of two factors must account for the lack of significance observed above. First, declines in the refined birth ratio within urban and rural areas were the principal causes of the declines of the state-wide refined birth ratio in most states. Secondly, during the period considered, 1870-1950, the states which experienced the smaller percentage increases in the proportion of people living in urban areas were the states which tended to experience the larger percentage declines in the refined birth ratio within their urban and rural districts.

It should be noted that the hypothesis which links urbanisation to the secular decline of the refined birth ratio must not be flatly rejected in spite of the absence of significant correlation. Our analysis neglects the effects of an intensification of urbanisation on the urban refined birth ratio. It may well be that increases in the size and density of urban areas significantly contributed to the decline of the urban refined birth ratio. This is a question which merits subsequent exploration.

There is perhaps a more important reason for not flatly rejecting the

urbanization hypothesis, despite the insignificant correlation coefficients. In the correlation analysis between the trends of the refined birth ratio and the proportion of people living in urban areas, a heterogeneous group of states with widely varying levels in birth ratio and urban living were treated as if they belonged to a single universe. Since the relationship between trends in urbanization and the refined birth ratio probably depends on the levels in the birth ratio and in urban living, it is not surprising that no very meaningful conclusion was reached on the basis of the correlation analysis.

Under what conditions, if any, may an increase in the proportion of people living in urban areas be a significant contributing factor to the decline of a state's refined birth ratio? After a state has attained low rural and urban refined birth ratios (in both an absolute and comparative sense), there is little room for it to experience further declines in these ratios. At that stage any major decline in the state-wide refined birth ratio is likely to be brought about through a shifting of population from rural to urban districts. On the other hand, states which have comparatively high refined birth ratios within rural and urban areas are likely to experience a state-wide decline in the form of a decline in the ratio within rural and urban districts; a shift in population to urban areas would have only a slight effect.

Thirteen states with high refined birth ratios in Period I were ranked in order of the percentage decline of their refined birth ratio and in order of the percentage rise in the proportion of persons living in urban areas. The coefficient of rank correlation, T, is -.12. Thus it appears that among states with high refined birth ratios in

Period I, there is no relationship between the rate of urbanization and the rate of decline of the refined birth ratio.

Ten states with low refined birth ratios in Period I were ranked in the manner noted above. For this group of states, r is +.33, which is not significant at the 95% confidence level. Yet the positive correlation suggests that, in comparison with the high refined birth ratio states, states with low refined birth ratios in Period I were states in which the rate of urbanization had a relatively more important effect on the trend of the refined birth ratio.

One further comment relates to the variable chosen to measure urbanization — the change in the proportion of whites living in urban areas. It would have been preferable to consider instead the urbanization of white women aged 15-44 because it is the redistribution of the persons who are capable of producing children that is the relevant factor. However, insufficient data prior to 1910 precluded the use of this variable. Thus, the preceding analysis, which employed the cruder variable, is based on the assumption that the cross-section patterns of inter-temporal change of the urbanization of total whites and of white women aged 15-44 are similar. This assumption will subsequently be tested for the period between 1910 and 1930.

c. Urbanization and the Changing Birth Ratio, 1910 to 1930 and 1930 to 1950

Thus far it has been contended that the rise in urbanization has not been the major factor accounting for the secular decline of the refined birth ratio in most states. However, this conclusion is based on data showing changes in urbanization and in birth ratios from Period I to

Period II. Perhaps over shorter and yet secular intervals the effect of urbanization may be found to have had greater significance. To investigate this possibility, we examined the effect of urbanization between 1910 and 1930, and between 1930 and 1950.

The period from 1910 to 1930 was one of generally declining birth ratios and increasing urbanization. Forty-four states were ranked in orders of absolute and percentage refined birth ratio declines, and in orders of absolute and percentage rises in the proportion of whites living in urban areas. The coefficient of rank correlation was found for the absolute changes and for the relative changes. For the former, T equals +.26 and is significant at the 95% confidence level. For the latter, T equals +.32 and is significant at the 99% confidence level. The coefficients of correlation suggests, but do not prove, that urbanization may have contributed to the birth ratio declines between 1910 and 1930.

The above analysis is in terms of the urbanization of total whites. Are the findings altered when the urbanization of white women aged 15-44 is substituted in the analysis?

Table I - 11 presents, by state, the absolute change between 1910 and 1930 in the percentage urbanized for total whites and for white women aged 15-44. The cross-section patterns of the absolute changes are closely correlated, with T equal to +.86. In other words, states which experienced the greater absolute increases in the urbanization of whites also tended to experience the greater absolute increase in the urbanization of white women aged 15-44. This supports the assumption that the cross-section patterns of inter-temporal change of these two variables are closely correlated.

When the states are ranked according to the absolute decline in the refined birth ratio and in order of the absolute increase in the urbanisation of women aged 15-44, we find a coefficient of rank correlation of +.30. This compares with +.26 which was found when the absolute increase in the urbanisation of all whites was used in the analysis. Both are significant at the 95% confidence level, but not at the 99% confidence level.

These findings suggest two points: (1) the substitution of the more refined urbanisation variable (the urbanisation of women aged 15-44) for the cruder variable (the urbanisation of all whites) does not affect the conclusions; (2) urbanisation may have contributed to the birth ratio declines between 1910 and 1930.

It is possible to calculate for each state the share of the refined birth ratio decline explained by urbanisation of white women aged 15-44 between 1910 and 1930. Census data which distinguish age, sex, and race by rural and urban divisions are available on the state level as far back as 1910. From these data, rural and urban ratios of children aged 0-4 to women aged 15-44 were found for 1910 and 1930 in each state. Taking the rural and urban white refined birth ratios in conjunction with data on the proportion of women aged 15-44 living in urban areas in 1910 and 1930, we calculated the quantitative effect of urbanisation on the state-wide refined birth ratio between these two dates. The arithmetic means of the rural and urban birth ratios in 1910 and 1930 are taken as weights. Applying these weights to the figures for the proportion of women aged 15-44 living in urban areas in 1910 and 1930, we calculated the change in the state-wide refined birth ratio ascribable to an increase in the

proportion of women aged 15-44 living in urban areas. This change was divided by the actual change in the state's refined birth ratio; the quotient is the proportion of the change in the state's refined ratio which can be "attributed" to urbanization.

Table I - 12 summarizes the figures on the share of the decline in the refined birth ratio accounted for by urbanization (of women aged 15-44) between 1910 and 1930. An inspection of the table shows that in most states urbanization did not exercise an important effect on refined birth ratio movements between these years. In 8 states there was actually a decrease in urbanization (while the birth ratio declined in 6 of these);(17) in 6 states, urbanization explained less than 10% of the refined birth ratio decline; in 16 states, it explained between 10% and 19%; in 7 states, it explained between 20% and 29%; in 6 states, it explained between 30% and 39%; and in Michigan and Nevada, it explained 60% and 100% respectively. The contribution of urbanization was least in the Northeastern and several Southern and Western states, all of which experienced slight or no increase in urbanization. On the other hand, the effect of urbanization was most strongly felt in the East North Central and several

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(17) Three of the states which experienced a decrease in urbanization between 1910 and 1930 are New Hampshire, Massachusetts, and Rhode Island. Attention should be called to the difficulty of measuring urbanization in these three states, as they contain many unincorporated cities with more than 2,500 inhabitants. In 1910, the census practice in these three states was to count all cities with more than 2,500 inhabitants as urban, even if the cities were unincorporated. In 1930, however, the practice was changed, and among the unincorporated cities, only those "containing a village or thickly settled area embracing more than 2,500 inhabitants were classified as urban." Thus, in New Hampshire, Massachusetts, and Rhode Island, an urban area was more narrowly defined in 1930 than in 1910, and this may be partly or wholly responsible for what appears to be a decrease in the proportion of persons living in urban areas according to the census data.
See T. Lynn Smith, Population Analysis (New York: McGraw Hill Book Company, Inc., 1948), pp.31, 32. (The quotation is taken from page 32.)

Table [illegible]

The Share of the State-wide Decline in Low Birth Weight Rate Attributable to Urbanization (of White Women Aged [illegible]) Between 19[illegible] and 19[illegible]

	State	Percentage Share
I	New England	
	Maine	a
	New Hampshire	b
	Vermont	a
	Massachusetts	b
	Rhoade Island	b
	Connecticut	1%
II	Middle Atlantic	
	New York	4%
	Pennsylvania	13%
	New Jersey	3%
III	South Atlantic	
	Delaware	3%
	Maryland	17%
	Virginia	21%
	West Virginia	34%
	North Carolina	14%
	South Carolina	10%
	Georgia	16%
	Florida	28%
IV	East South Central	
	Kentucky	34%
	Tennessee	32%
	Alabama	20%
	Mississippi	12%
V	West South Central	
	Arkansas	16%
	Louisiana	14%
	Texas	23%

Table [illegible]

	State	Percentage Rate
VI	East North Central	
	Ohio	21%
	Indiana	26%
	Illinois	18%
	Michigan	40%
	Wisconsin	23%
VII	West North Central	
	Minnesota	18%
	Iowa	23%
	Missouri	19%
	Nebraska	14%
	Kansas	16%
VIII	Mountain	
	Montana	b
	Idaho	16%
	Colorado	b
	Wyoming	2%
	New Mexico	38%
	Arizona	b
	Utah	10%
	Nevada	100%
IX	Pacific Coast	
	Washington	5%
	Oregon	13%
	California	28%

a - State-wide birth ratio increased.

b - State-wide birth ratio declined despite a decrease in urbanization.

Southern states along with New Mexico, California, and Nevada. The increase in urbanization was comparatively large in most of these states. Summarizing the findings for the period from 1910 to 1930, we may conclude that urbanization was not a major cause of the refined birth ratio declines. Except for 8 states, it accounted for less than 30% of the decline.

During the period from 1930 to 1950, urbanization did not greatly affect the direction of refined birth ratio movements. This is obvious because 1950 urbanization levels surpassed those of 1930 while 1950 birth ratio levels were also in excess of those prevailing in 1930. Urban and/or rural refined birth ratios must have risen sufficiently to have pushed state-wide ratios in 1950 above those of 1930 despite the fact that larger proportions of persons were living in urban areas in 1950.

Did states experiencing relatively small increases in urbanization (of total whites) also tend to experience comparatively large increases in the refined birth ratio? Ranking the states in order of absolute increase in the proportion of whites living in urban areas (the states with larger increases given higher ranks), and in order of absolute increase in the refined birth ratio (the states with smaller increases given higher ranks), we found Kendall's T. T equals +.12, and this fails to meet the test of significance at the 95% confidence level. Thus we may definitely conclude that between 1930 and 1950, as well as between 1910 and 1930, urbanization did not have an important effect on refined birth ratio movements.

Before the close of the discussion on urbanization, two final comments should be added. Our quantitative analysis attempted in a mechanical way to segregate the effects on the state-wide refined birth ratio of an

inter-sectoral shift (urbanisation) from intra-sectoral changes (changes in rural and urban birth ratios). An implicit assumption underlying such an analysis is that intra-sectoral changes are independent of inter-sectoral shifts. Is this a sound assumption for our problem? Surely the movement of persons from rural to urban areas served to relieve population pressure on the land (in rural agricultural areas) and therefore retarded the rate of decline in rural fertility. Furthermore, if the rural migrants to cities are generally more fertile than the native urbanites, urbanisation may have retarded the rate of decline in urban fertility. Our analysis, in failing to recognise that urbanisation may have slowed down the rate of decline in urban and rural fertility, overstates the contribution of urbanisation towards the decline in the state-wide birth ratios.

Our second comment deals with the period from 1800 to 1870. The decline in the refined birth ratio since 1870 is part of a longer decline which began after 1800 or 1810. P.K. Whelpton's figures on the ratio of white children under 5 to white women aged 20-44 indicate the existence of the earlier downward trend:(18)

Ratio of Whites Aged 0-4 to White Women Aged 20-44

Year	United States	New England	Middle Atlantic	East North Central	South Atlantic	East South Central
1800	1.342	1.164	1.334	1.918	1.402	1.875
1870	.814	.564	.702	.892	.833	.922
$\frac{1870}{1800}$	.61	.48	.53	.47	.59	.49

(18) P.K. Whelpton, Forecasts of the Population of the United States 1945-1975 (Washington: U.S. Government Printing Office, 1947), p. 16.

The above figures should be viewed in conjunction with the fact that in 1870 no South Atlantic or East South Central state had more than 15% of its whites living in urban areas except for Delaware and Maryland, and no East North Central state had more than 25% of its white population living in urban areas.(19) With such small proportions of whites living in urban areas as late as 1870, it is obvious that the sharp declines in the refined birth ratios which occurred in these regions between 1800 and 1870 cannot be accounted for by urbanization. Clearly, in attempting to explain the decline in the refined birth ratio in these regions, one must search for factors which explain the decline in rural fertility. Urbanization is an even less important factor from 1800 to 1870 than it is from 1870 to 1950.

Since the redistribution of population from rural to urban areas has not been the principal cause of the decline in the refined birth rate, additional research should be directed towards explaining the declines in the refined birth rate within rural and urban areas. A possible explanation for the decline in the urban refined birth rate has already been suggested — the growth in size and density of cities. However, no evidence has been offered to support this contention. We may also speculate about the causes of the decline in the rural birth rate. Since 1870, the gradual disappearance of the frontier and the growing scarcity of agricultural land may have been forces which tended to induce rural parents to check their family size. Because farm parents have found it increasingly necessary to equip some of their children for urban living, a large family

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(19) Figures based on unpublished data of the University of Pennsylvania Study of Population Redistribution and Economic Growth.

may have become more of a burden than an assistance to them. If the relative cost of raising children has increased while the relative usefulness of children on the farm has diminished, there may have been further motivation for farm parents to restrict family size.

NOTE: Part C, which follows, is a summary of Parts A and B, and in addition, is a summary of other research not included in Parts A and B. Thus, not all of Part C follows from Parts A and B.

C. Summary and Conclusions

This study has examined secular trends and cross-section patterns in the birth ratio of whites during the period from 1870 to 1950 in the United States. It has revealed marked regional and state differences in fertility. It has also disclosed the existence in most states of the much-discussed phenomenon of the declining birth rate.(20)

The recording of births developed slowly, and not until 1933 has birth data become available for the entire country. Fortunately other measures of fertility are available for census years as far back as 1800. As an indirect measure of the crude birth rate, the ratio of whites aged 0-4 to total whites was used; it was referred to as the crude birth ratio. Two indirect measures of the refined birth ratio were employed — the ratio of whites aged 0-4 to white women aged 15-44 and the ratio of whites aged 5-9 to white women aged 20-49; they were called refined birth ratios.

Caution must be exercised in the interpretation of the birth ratio measures. The number of children aged 0-4 recorded in a census year misrepresents the number of children born during the preceding 5 years because of the death of some of them during the period, because of under-reporting, and because of interstate migration. Since young children usually migrate with their mothers, interstate migration probably does not distort the birth ratio. A more accurate measure than the crude or refined birth ratio would show a larger decline in fertility since 1870 because the mortality rate of infants and children has declined more sharply than that of any other population component. Likewise a more

(20) The method of semi-averages was used to measure trends.

precise measure would show a larger decline in fertility because the degree of census underenumeration of children under 5 has decreased over time. Thus it is evident that if adjustments for underenumeration and the differential mortality rate decline were somehow made, the conclusion that the secular trend of the birth rate is downward would be strengthened.

Feeling that the qualifications which were introduced did not imperil the major findings, we turned to the analysis of the birth ratios. The crude birth ratio, a sort of catch-all variable, was considered first. Its trend has been downward in all states with the exception of three in the Mountain region. In general, the South has the highest ratios and the Northeast and Pacific Coast the lowest ratios. Interstate differences narrowed over time.

Of the two determinants of the crude birth ratio, the proportion of women of child-bearing age in the population is less important. Its trends and interstate differences are not sharp enough to affect significantly the trends and cross-section structure of the crude birth ratio. In fact, except for the New England, Middle Atlantic, and 5 other states, the ratio of white women aged 15-44 to total whites increased somewhat while the crude birth ratio generally declined. However, the proportion of women of child-bearing age was an important factor in the Mountain region. Here the low proportion reduced the crude birth ratio levels of a number of states in Period I and a rise in the proportion on Period I (1870-1910) to Period II (1910-1950) was sharp enough to offset a decline in the refined birth ratio and induce an upward trend in the curde birth ratio in 3 states.

The second and major component in the change of the crude birth ratio

is the refined birth ratio. Its declining trend, experienced by all but the 3 Northern New England states, is chiefly responsible for the downward trend of the crude birth ratio. Its cross-section pattern is similar to that of the crude birth ratio. The Northeastern and Pacific Coast states have the low ratios, followed by the East and West North Central states and the high ranking Southern states. Interstate differences in the refined birth ratio have narrowed over time.

The cross-section birth ratio differentials suggest some interesting problems. During the period from 1870 to 1950, the economically backward South has had the highest crude and refined birth ratios. The Middle Atlantic, Pacific Coast, and East North Central regions have been areas where economic development has proceeded at a relatively fast pace, but these are regions in which the birth ratios have been quite low. Thus the increase in population necessary to sustain the growth of these regions has been partly dependent on population migration. Since the South has been the nation's most efficient population producer (measured in births per 1000 women) as well as the nation's principal population exporter, it has contributed to the economic development of other regions. On the other hand, the South's own economic development may have been retarded as a result of these factors. It was compelled first to support a relatively young and unproductive population; when many of its people eventually reached productive age, they then migrated to other parts of the country.

Several possible explanations for the decline of the refined birth ratio were examined. First it was found that the proportion of white women aged 20-29 among white women aged 15-44 has been declining over

time. Since the fertility rate of 20-29 year old women exceeds that of the other women in the 15-44 group, the hypothesis was suggested that the change in the age composition within the 15-44 group accounted for a significant share of the decline in the refined birth ratio. However, this hypothesis was rejected for it was found that the decline in the 20-29 to 15-44 ratio was not sharp enough to contribute much to the decline of the refined birth ratio.

Another hypothesis which was considered is that the decline in the ratio of foreign-born white women aged 15-44 to all white women aged 15-44 contributed significantly to the decline in the refined birth ratio. Although the premise was confirmed (the ratio of 15-44 year old foreign-born to 15-44 year old white women did decline), the hypothesis was rejected because it was found that this change did not account for much of the decline in the refined birth ratio.

The next hypothesis to be tested was that urbanisation accounted for a significant share of the decline in the refined birth ratio. An urban area is defined as an incorporated place of 2,500 or more persons (plus some densely settled but unincorperated New England towns); urbanisation is defined as the redistribution of population from rural to urban areas. In as much as the decline in the refined birth ratio has been accompanied by urbanisation and rural fertility ratios exceed urban fertility ratios, the hypothesis linking urbanisation and the decline in fertility seemed plausible. It was tested for the following intervals: Period I to Period II, 1910 to 1930, and 1930 to 1950. In each instance, the statistical evidence indicated that the hypothesis should be rejected.

Evidently, changes in the refined birth ratio <u>within</u> urban and rural

areas were the major components in the change of the state-wide refined birth ratios. The ratio of whites aged 0-4 to white women aged 15-44 was found for the urban and rural segments of the states in 1910, 1930, 1940, and 1950. Movements in these ratios resembled the changes in the state-wide ratios. The trend was generally downward from 1910 to 1940 and then rose sharply during the 1940's.

In 1910, the Middle Atlantic and Southern states had the relatively high urban refined birth ratios. They were followed by the New England, East North Central, and Mountain states which were in the middle of the distribution, and by the West North Central and Pacific Coast states which were ranked very low. By 1940 and 1950, the Southern and Middle Atlantic states experienced a sharp decline in relative standing while the Mountain and North Central states rose in rank.

The cross-section pattern of the rural refined birth ratio in 1940 resembled closely the pattern prevailing in 1910. Following the high ranking Mountain and Southern states were the North Central states, while the Pacific Coast, New England, and Middle Atlantic states ranked low. By 1950, interstate differences in rural fertility were substantially reduced.

In the analysis of the effect of urbanization on the refined birth ratio, it was pointed out that the urban and rural classification used was insensitive to increases in the intensification of urban living. In view of the fact that urban communities of large size have lower birth ratios than urban communities of small size, it was suggested that a redistribution of urban dwellers from communities of small size to communities of large size contributed significantly to the decline of the urban refined

birth ratio. However, it was found that this process, referred to as urban intensification, contributed little to the decline in urban fertility since 1910.

It was also noted that rural-nonfarm refined birth ratios were generally lower than rural-farm refined birth ratios. Although a redistribution of the rural population from the farm to the non-farm sector occurred, the statistical analysis suggested that this did not account for much of the decline in the rural refined birth ratio.

Thus this study affirms that although differences in specific environmental setting are related to differences in the refined birth ratio at any given point in time, of the change in the refined birth ratio over time only a small part can be attributed to changes in the distribution of persons from one setting to another. Changes in the refined birth ratio are ascribable principally to changes in the reproductive patterns of persons living in fixed environmental sub-divisions — rural and urban, rural-farm and rural-nonfarm, large city and small.

Does this conclusion contradict the widely accepted thesis that the long run decline in the birth rate is related closely to urbanization, and more broadly speaking, to industrialization and economic development? If urbanization is interpreted as meaning a type of population shifting in space, then the analysis presented does demonstrate that little of the secular decline of the birth rate is attributable to urbanization. But we may also speak of <u>urbanism</u> as the spread of "urban" ideas and attitudes regarding family size to rural and urban people. This is distinguished from urbanization in that it is the spread of the "urban mentality" rather than population shifts in space which is responsible for the decline in

the refined birth ratio. The "urban mentality" is associated with an emphasis on personal material success and the presence of strong drives to attain higher socio-economic status which seem to deny that reproduction is a criterion of individual success and in fact suggest that it is an obstacle to it. These attitudes probably originated among certain urban elements in the upper social classes and then spread to other urban elements as well as to segments of the rural population. The observation that rural birth ratios are lowest in the most urbanized and industrialized states where rural and urban persons are probably most closely integrated indicates that it is in these states that urbanism has its greatest effect on the rural refined birth ratio. The fact that rural-urban birth ratio differentials are narrowing over time also suggests that urbanism is spreading to rural areas.

The decline in fertility within urban and rural areas is of course attributable to many factors. There have been fundamental changes within rural and urban districts which probably had a profound effect on fertility. The growing scarcity of agricultural land may have induced rural parents to check family size because they found it increasingly necessary to bear the cost of equipping some of their children for urban living. Furthermore, the more intensive application of machinery to farming made children less useful to the farm family. In the cities, living conditions probably became more crowded and therefore less suitable for the raising of large families. (In recent years, however, the wide-spread use of the automobile enabled people to live farther from their work and may have made conditions less crowded in the cities.) Undoubtedly, many parents adopted the attitude that it is better to rear one or two children properly than to rear more

then two children inadequately, and this too may have contributed to the decline in the size of the urban family.

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